TRADE REVIEW

SOUTH AFRICA'S *ALOE FEROX* PLANT, PARTS AND DERIVATIVES INDUSTRY

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TRAFFIC East/Southern Africa – South Africa

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INTRODUCTION

The family Aloaceae consists of approximately 436 species in about seven genera in southern Africa. In general, the geographical distribution of the family covers most of sub-Saharan Africa, with species numbers increasing considerably southwards (Hilton-Taylor and Smith, 1994). The genus *Aloe* Linneus, with around 360 species, occurs predominantly in Africa with centres of species richness in South Africa, East Africa and Madagascar (Oldfield, 1992). The taxonomy of the genus *Aloe* is still subject to debate (Hilton-Taylor, pers. comm., 1994), however, the species *Aloe ferox* Miller is recognised by Arnold and de Wet (1993). The scientific nomenclature used in this report for southern African *Aloe* species follows that of Arnold and de Wet (1993).

An estimated 28% of the 177 *Aloe* taxa found in South Africa, Lesotho, Swaziland, Botswana and Namibia are classified as threatened (Hilton-Taylor and Smith, 1994). About 45% of these occur in South Africa's Cape Province (now sub-divided into Eastern Cape, Northern Cape, Western Cape and part of North West Province) and 30% in the Transvaal (now sub-divided into Northern Province, Mpumalanga, Gauteng and the remaining part of North West Province). Although many taxa have a naturally restricted distribution, succulent plant collectors, injudicious farming practices, afforestation, mining and urbanisation have all contributed to the decline of many species.

The genus *Aloe* was one of the original taxa listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), this listing becoming effective when the treaty was ratified in 1975. Five South African *Aloe* species were included in Appendix I at that time. A further 17 *Aloe* species, all Madagascan endemics, were transferred to Appendix I in 1994, this listing becoming effective in February 1995. The generic listing of *Aloe* in CITES Appendix II requires trade in all species to be conducted in accordance with the requirements of the Convention. This includes requirements that all international trade be accompanied by valid CITES export permits, and that such trade be reported by both exporting and importing CITES Parties. With respect to *Aloe* species, trade in seeds, spores, pollen, seedlings and tissue cultures obtained *in vitro* is exempt from CITES trade controls.

Lewington (1992, in Oldfield, 1992) developed a priority list of the worlds most widely-used medicinal plants which included *Aloe africana, A. ferox, A. spicata,* and *A. vera.* Other species which have been subject to scientific investigation for medicinal and cosmetic purposes are *A. classenii, A. graminicola, A. macrosiphon, A. ruspoliana, A. ukambensis* and *A. vahombe* (Lewington, 1992, in Oldfield, 1992) and *A. elgonica* (Conner *et al.*, 1990). A number of other species are used locally in a very limited way for medicinal and cosmetic purposes in South Africa. These include *A. aristata, A. chabaudii, A. cooperi* and *A. linearifolia* (Cunningham, 1990, in Oldfield, 1992). In addition, Fox and Norwood-Young (1983) list species which have been used as medicinal, food or water-bearing plants in South Africa, they are *A. boylei, A. candelabrum, A. castanea, A. ecklonis, A. littoralis, A. marlothii, A. parvibracteata, A. maculata* and *A. zebrina.* Watt and Breyer-Brandwijk (1962) listed 34 *Aloe* species used for a variety of medicinal and food uses. The main *Aloe* species exploited for export in Kenya are *A. secundiflora* and, to a limited extent, *A. turkanensis* (Oldfield, 1992).

Oldfield (1992) lists 11 *Aloe* species as being current or past commercial sources of aloe drugs, namely *A. africana, A. bainesii, A. candelabrum, A. distans, A. ferox, A. maculata, A. marlothii, A. perryi* (Socotrine and Zanzibar aloes), *A. spectabilis, A. succotrina* and *A. vera* (Curacao or Barbados aloes). Oldfield (1992) discusses the trade in *A. vera* more comprehensively.

According to Oldfield (1992), *Aloe* species are used as ornamental plants and medicinally in foods and cosmetics. *A. vera,* the main species used commercially, is not known in the wild but is believed to be

originally native to the Arabian Peninsula. It is widely naturalised in southern USA, the Caribbean, Central America and else-where. According to Botha (*in litt.*, 1992(a)), plantations of *Aloe vera* have recently been established in Natal and the far Northern Transvaal provinces of South Africa. Leaves and parts, and derivatives of naturalised and artificially propagated *Aloe vera* have been exempted from CITES controls since 1985 (Oldfield, 1992). Furthermore, in recognition of the fact that trade does not represent a significant threat to the species, the 9th COP (CITES Conference of the Parties), voted to remove *A vera* from Appendix II thus exempting it from the provisions of the Convention.

According to Botha (*in litt.*, 1992(a)) South Africa's main commercial species is *A. ferox*. The species distribution extends from the Swellendam district in the Western Cape Province, (Map 1) through the Eastern Cape Province (including the former 'homelands' of Transkei and Ciskei), southern Lesotho into southern Kwazulu/Natal. In the southern Cape *A. ferox* is found in Renosterveld* vegetation on soils derived from shale's of the Bokkeveld Group. *A. ferox* is a tall (two to five metres), tree-like *Aloe* species usually with a single stem but may occasionally be branched. Palgrave (1983) reports that over the wide range of the species, both climatic conditions and habitats vary considerably. The main stem is topped by a rosette of large succulent leaves. The leaves are dull edged with stout brownish-red teeth; the leaf surfaces may be smooth but usually have a few, and often many, scattered spines (the specific epithet meaning 'fierce' refers to this feature) (Palgrave, 1983). A single candelabrum-like inflorescence with dense erect spikes of scarlet flowers is produced from May to October. *A. ferox* propagates easily and reaches flowering stage within four to six years (Botha *in litt.*, 1992(a)), when, depending on habitat, the plant will be approximately one metre tall. Muller (pers. comm., 1994) estimated that some plants could be as old as 1,000 years; but this contradicts the estimated life span of 150 years mentioned by Holland and Fuggle (1982, in McDonald, 1991). *A. ferox* was probably the first aloe to be illustrated for it features at least twice in cave paintings of the Khoi San people (Palgrave, 1983), an indication of the importance of the plant to them.

The main pressure on the species is said to be the commercial exploitation of 'bitters' sap which is concentrated, crystallised and sold around the world. Supporting this view, aloe tappers in the Albertinia/ Herbertsdale (Map 2) district stated that no other *Aloe* species is used for sap extraction in their zone of activity and that the entire impact of the industry falls on *A. ferox* (Newton, 1993). In light of these activities and despite the fact that *A. ferox* is not currently an endangered species TRAFFIC East/Southern Africa - South Africa (TESA-ZA), noting high trade volumes, decided to investigate South Africa's domestic and export trade in *A. ferox* plants and derivatives.

The researchers set out to investigate and report on the sustainability of the industry. In order to achieve this, the project was divided into five objectives:

A. to identify *Aloe* species used by industry, to assess trade volumes and to identify the source(s) of harvested plant material;

B. to identify the products of the aloe industry and to quantify the amount of final or semi-processed products imported into, exported from and traded within South Africa;

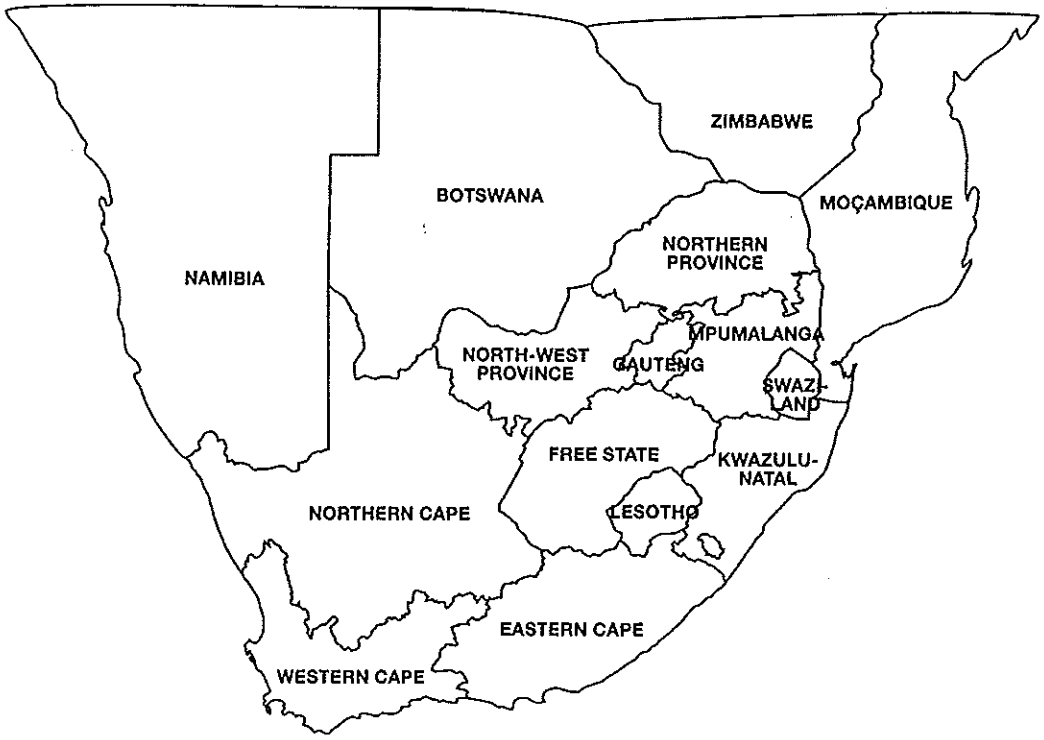
* Renosterveld vegetation comprises a variety of non-succulent small-leafed and broad leafed shrubs, which are distinctly not fynbos (part of the Cape Floral Kingdom). They are generally restricted to the fine grained, very fertile soils derived from the Malmesbury, Bokkeveld shale's. The vegetation is dominated by a grey shrub, renosterbos *(Elytropappus rhinocerotis)*. Renosterbos has probably become dominant as the result of past disturbance, particularly frequent burning and over-grazing. It was thought that renosterveld was at some time in the past a rooigras/red grass *(Themeda triandra)* grassland. There are three Renosterbos types but the type where *A ferox* occurs is known as South and South West coast Renosterveld.

C. to determine whether aloes, which are harvested to produce aloe bitters and gels, are grown in plantations established from artificially propagated stock, or are harvested from wild plants;

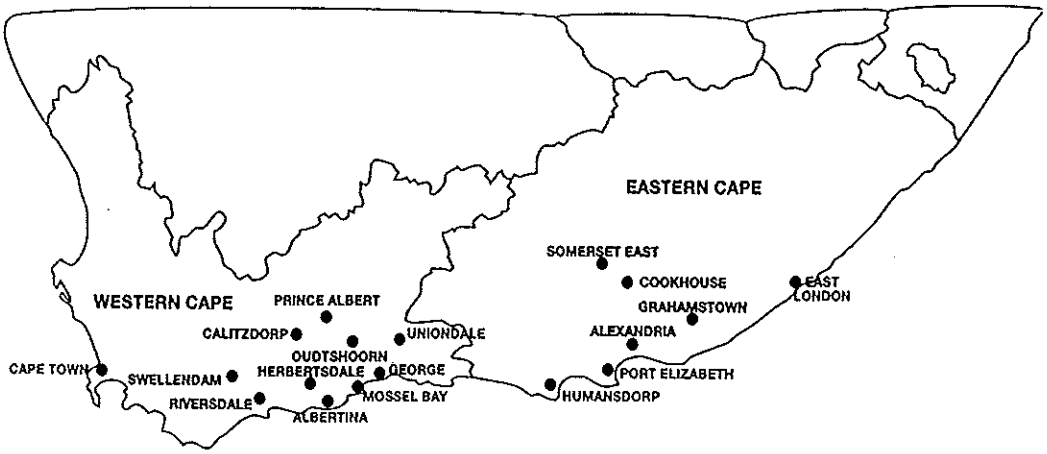
D. to determine whether trade controls in place to protect South Africa's wild aloes are adequate to fulfil their objectives (e.g. species conservation; compliance with CITES);

E. to develop recommendations, based on the results of this research, to improve current trade controls and to identify priorities for further research or conservation action.

Map1: South Africa and its Provinces



Map 2: Distribution of *Aloe Ferox* and the aloe industry



METHODS AND PROCEDURES

The *A. ferox* plant propagation and derivatives industry in South Africa is large and represents a means of income for many people, from farm workers to nurserymen and import/export agents. In order to understand the scale and nature of the industry, data were collected from sources such as nature conservation and CITES authorities, the Department of Customs, the Department of Agricultural Extension Services, the pharmaceutical industry, full-time aloe tappers and the scientific community. Anecdotal information was gathered during interviews and compared with trade data to give an indication of the degree of accuracy or variability of perceptions within the industry. Provincial nature conservation legislation was examined and compared with other information collected during this study to evaluate the efficacy of current trade controls.

The following specific methods and procedures were followed:

A. Collection and Collation of CITES Trade Data

All *Aloe ferox* import and export data were consolidated in three databases:

1. CITES import and export data, for the period 1981 to 1991, prepared by WCMC (World Conservation Monitoring Centre, Cambridge, United Kingdom) from South Africa's annual reports were examined. Subsequently, omissions and inaccuracies, stemming from South Africa's reports, were corrected by checking entries permit-by-permit. Other than using the information as a basis for producing a corrected database no further use was made of WCMC export data. Data for 1981 could not be adequately checked and is considered inaccurate.

2. CITES import and export data, for the period 1992 to 1994 was prepared from permit information provided by South African nature conservation authorities.

3. WCMC data, for the period 1982 to 1991, on trade in *A. ferox* reported by importing countries were examined. Although incomplete, these data were regarded as the most accurate available for comparison with South Africa's exports.

The data in the first two databases are accurate to the extent that CITES permits had the declared trade volume of *A. ferox* entered on them rather than the actual amount that left the country.

B. Comparison of CITES Annual Reports

South Africa's CITES annual reports for 1989, 1990, 1991 and 1992 were compared with CITES permits to assess their accuracy. A summary of the problems discovered was produced. Although not a primary motivating factor for this exercise, the comparison was helpful in uncovering reasons for inaccuracies in WCMC data, derived from these annual reports, and which had to be corrected in section A above.

C. International and Domestic Trade in *Aloe ferox* for Horticultural Purposes

Data from the TESA-ZA horticultural plant trade database, developed from international and national plant catalogues, were analysed to assess the international horticultural trade in *A. ferox* and to determine whether plants were artificially propagated or wild-collected.

D. Examination of Legislation

National and provincial legislation relevant to the *A. ferox* trade was examined to assess the efficacy of 'paper' controls on the protection, harvest, transport and international trade in wild, indigenous plants.

E. Interviews

Interviews with government conservation and agriculture officials were arranged to evaluate the implementation of South Africa's trade regulations. Interviews with various succulent plant dealers, scientists, members of the horticultural community and aloe tapping industry were organised to gain perspectives on harvesting practices, artificial propagation, trade controls, the economics of aloe derivative production and illegal trade.

F. Wholesale and Retail Market Survey

A national telephone survey of wholesale companies and a market survey of pharmacies was undertaken to provide an overview of the major sources of *A. ferox* crystalline bitters supplied to the domestic pharmaceutical industry. The dynamics of the trade through various levels of the wholesale industry were traced and, where possible, data on price and turnover were obtained. Anecdotal information about the uses of *A. ferox* was gathered in the pharmacies by speaking to pharmacy assistants and pharmacists. Due to time constraints, it was necessary to limit the market survey of pharmacies to the East Rand and far East Rand of Gauteng Province. No survey of supermarkets or traditional medicine markets was conducted, but anecdotal information regarding these sources was collected.

PRODUCTS AND MARKETS

The three centuries old industry is based on the harvesting of *A. ferox* for the extraction of aloe bitters, used in beverages and medicines, and gels used in skin and hair care products. Botha (*in litt.*, 1992(a)) reports Theal as stating that "in 1761 the first aloes were exported from South Africa. A quantity of 98 kg in weight was produced". The directors of the Dutch East India Company issued instructions to purchase it at the stores at a price not exceeding "five shillings and half penny" per kilogram. During the years 1799 to 1802, a total of nearly 342,000lbs (155,128 kg) of crystalline aloe to a value of approximately 5,114 pounds sterling was produced (Botha *in litt.*, 1992(a).

Since then, the aloe tapping industry has grown, but has largely remained an export industry with little secondary or tertiary processing occurring in South Africa. The domestic demand for aloe bitters also remains limited. Domestic sales of commercially processed aloe products, other than bitter, in South Africa has been slow because of competition with *A. vera* which have been on the market longer. Similarly, in Europe, *A. vera* sales seem to dominate those of *A. ferox* as demonstrated by Oldfield (1992) in a survey of European aloe derivative importers. One company reported importing between 10 and 20 tons of *A. vera* per annum from the United States. However, as imported gels are generally composed of one part *A. vera* to seven parts lactose or dextran, this quantity would only contain between one to three tons of pure *A. vera* extract. Another reported annual imports of about 20 kg of aloes grown in the United States of America, from France; another reported importing about 25 kg of *A. vera* from Germany, and another importing 50 kg of *A. vera* from the United States of America. Only one company supplying pharmaceutical products, reported importing 25 to 30 kg per annum of 'Cape Aloes' from South Africa.

The various products which can be derived from *A. ferox* and the uses are described in the following sections.

A. Aloe Bitters

The pale-yellow sap collected from harvested leaves is commonly known as 'aleweesap' (Rothman and Warner, 1983, in McDonald, 1991), 'bitter aloes' or 'Cape aloes' (Bond, 1983; Reynolds, 1950). Bitters sap is restricted to ducts just under the pidermal/palisade cell layers of the leaves. In the plant the liquid forms part of a defence system which acts in two ways. Firstly, it has an extremely bitter taste to dissuade herbivorous insects and animals. Its second purpose is to rapidly cover, coagulate and seal any open wounds the plant may receive (Muller, pers. comm., 1994). The protective value of sap to the plant is well known and Brown (1994) reports that some aloe brokers consider the industry unpleasant, as "the fumes (of the liquid extract) make your teeth fall out" and also "irritate(s) the skin".

There are two forms of aloe bitters namely, crystalline and powdered. The difference between the two is in the processing method used.

1. **Crystalline Bitters** are obtained by boiling raw aloe sap in the field in drums to a stage, where upon cooling, it sets. The dried crystalline bitters are dark brown or greenish-brown glassy masses; thin fragments are transparent, exhibiting a yellowish or reddish brown tinge; the crystal fractures clean and glassy. It has a distinctive, somewhat acid odour.

2. **Powdered Bitters** are produced through a process of spray-drying or mechanical grinding. Powdered bitters are a yellowish-brown to dark reddish-brown powder.

3. Chemicals Derived from Crystalline Bitters

a. Aloin

Aloin is the chemical which gives aloe sap its bitter taste and which is included in medicinal and other preparations. It has been reported that aloin and barbaloin are identical and refer to the same substance or group of relatively crude substances (Groom and Reynolds, 1987). Rhamnosides of aloin; aloinoside A and B, were absent from *A. ferox* growing in the Port Elizabeth-Grahamstown area but not from Mossel Bay aloes (Von Horhammer *et al.*, 1963). McCarthy and van Oudtshoorn (1966), found that the yield of aloin reached a maximum level during the summer months. They also found that *A. marlothii* could be used for the extraction of aloin.

b. Aloe-emodin.

Although listed as a product obtained from *Aloe elgonica* bitters, no details on uses or characteristics were provided (Conner *et al.*, 1990).

4. Uses of 'Cape Aloe Bitters'

According to Botha (*in litt.*, 1992(a)) the small local consumption is due mainly for traditional medicine, rough veterinary practice and non-commercial use by landowners and others. Muller (pers. comm., 1994), reports that the bitter contents of the aloe wards off grazing animals, but animals do eat the leaves after the bitters sap has been drained. Pettitt (pers. comm., 1993) stated that cut leaves are dipped into water for chickens to drink to eliminate parasites.

According to Brown (1994), the most frequent use of the product reported by surveyed pharmacies was for its laxative qualities. Crystalline bitters in lump or powder form is mixed with senna pods, senna leaves and Epsom salts and is taken mixed with water. The perceived benefit of using this mixture is that it "cleanses the blood". It is also believed to be an acceptable treatment for "gal". The exact definition of "gal" was not established, but relates to a bilious disorder of the liver due to overeating and drinking. Another common use of the product is to ingest it in order to make the blood bitter. This is thought to prevent bites from mosquitoes, fleas, ticks and other pests. Dogs are also fed on the product for similar reasons. Bitters aloe sap is applied to children's fingertips, to prevent them from biting their nails and to mother's breasts to dissuade children from breast feeding. One pharmacy assistant said it is used on the skin to improve the complexion and to prevent sunburn. On the Cape Flats, near Cape Town, it was said that the product is used for treating sore throats and sores in the mouth. Friar's Balsam, a patent (non-scheduled) remedy, which contains crystalline bitters is used to prevent infection in cuts and grazes and is also used as an inhalant for blocked sinuses. Brown (1994) after consultation with five homeopaths reported that unlike *A. succotrina*, *A. ferox* does not appear to be used much by the homeopathic industry. Crystalline bitters can be used as a laxative, a purgative, for arthritis, for ridding cattle of ticks, and pigeons of parasites. Crystalline bitters are also used in some Mexican beverages as a bitter component. When used as a purgative it is administered orally at a dosage of 100 to 200 mg and takes 8 to 12 hours to produce an effect. Crystalline bitters have largely been replaced by safer purgatives (Anonymous, 1979; Anonymous, 1980).

B. Aloe Gel Powder

Aloe gels are highly refined and require relatively sophisticated extraction technology. Tappers or landowners harvest leaves, extract the bitters sap and sell the leaves to a gel processing factory

where the gel is extracted from the central core of the leaves. The leaf is pulped and squeezed dry under high pressure. The juice is settled and chemically treated to flocculate the jelly fraction. The product can be used as a gel, or dried to a powder. Approximately two tons of leaves yields 1 kg gel powder which according to Pettitt (pers. comm., 1993), is a higher volume than that derived from *A vera*. Gel manufactured from the plant should not contain bitters sap as some people are allergic to it; some countries insist that the pure gels are analysed before it is imported or mixed into cosmetics.

According to Pettitt (pers. comm., 1992) and Botha (*in litt.*, 1992(a)), during 1992 the one aloe refining factory in South Africa was operating at one-third capacity using between 15 and 33 tons leaves per annum. When leaf is available, it is possible for South African manufacturers to produce 2 kg of gel per day (Pettitt, pers. comm, (1993) and, according to Botha (*in litt.*, 1992(a)), up to 50 kg per annum with about 30 kg used locally 20 kg exported per annum.

According to Muller (pers. comm., 1994), sales of *A. ferox* gels are reported to be increasing slowly now that technical problems in the South African industry have been solved (especially the drying methods). Aloe gels are used in hair and skin care products such as in moisturising creams, sunburn and burn treatments which are produced in South Africa and abroad. Production volumes in 1992 were low compared with bitters production, however, the product is valuable and this factor helps to offset lower production volumes.

C. Dried Aloe Leaves, Flowers and Trunks

According to retail outlets in Albertinia, aloe tappers and landowners, dried plant parts are gathered from dead plants in the wild. Adams (pers. comm., 1994) stated that landowners either supply dried flowers to co-operatives or the South African Dried Fruit Board. Some private harvesters bypass all these groups and there appears to be a move to eliminate middlemen so that individuals can benefit from higher prices

The primary market is for flower arranging, however, it is possible to make a tea-like infusion from chopped dried leaves mixed with normal tea. Palgrave (1983) reports that the leaves are often dried and burnt to repel insects. Dead aloe plant sections are hollow and can easily be broken up into different sized section to be used as decorative ash trays, pot plants, flower pots, and other items. Examples of these products can be found in curio shops in the production areas.

D. Live Plants and Seeds

A. ferox plants are commonly used as horticultural subjects due to their aesthetic shape and hardiness. Palgrave (1983) reports that the plant's fleshy leaves can be used as fodder during times of severe drought and famine. Also they are said to produce an excellent jam. The stockades of *A. ferox* which are planted around cattle pens, form a characteristic and attractive feature in rural areas.

CURRENT STRUCTURE OF THE ALOE TAPPING INDUSTRY

A. South African National Trade in *Aloe ferox*

1. Aloe Extract Tapping

In the Albertinia, Calitzdorp, Herbertsdale, Mossel Bay, Prince Albert, Riversdale and Van Wyksdorp districts of the southern Cape and the Cookhouse, Grahamstown, Port Elizabeth, and Swartkops districts of Eastern Cape Province, (Map 2) *A. ferox* is harvested to produce various derivatives.

According to Botha (*in litt.*, 1992(a)) *A. ferox* growing in the former Transkei and southern Kwazulu/Natal or north of the southern-most mountain ranges of the south-east Cape are not harvested to any significant extent at present.

The bitters (aloin) content is variable in *A. ferox* plants from different locations. Albertinia, Herbertsdale, Mossel Bay and Riversdale aloes provide sap with a high bitters content of between 20% and 28% (mass per volume) (Muller, pers. comm., 1994). In the Karroo and Port Elizabeth regions, the aloin content may drop to between seven and 14 percent, and occasionally higher, while Kenyan aloes have approximately nine percent bitters content. According to Muller (pers. comm., 1994), the reason for the high bitters content is that the production area used to be the floor of a lake, the soil of which contains many micro nutrients. Aloe bitters from the Albertinia district (e.g. Mossel Bay 'Prime Aloe') are in demand from countries such as Germany and Spain because of the high aloin content (Muller, pers. comm., 1994). These countries may even insist that bitters content be analysed before they purchase to make sure the concentration of the desired ingredient is high enough.

According to Muller (pers. comm., 1994), aloes with short leaves and many spines tend to have higher bitters content. These leaves are known as 'skurwe' (rough) aloes because of the many thorns and have a reputation for 'loop goed' ('run well') when cut. Apparently, leaves that are difficult to cut normally do not give good juice extraction and a rule of thumb is that the longer the leaf the lower the aloin content of the leaf. Muller (pers. comm., 1994) also reported, along with several tappers, that plants harvested for the first time produce little bitters but that damaged plants are stimulated to form bitters which is retained for about two years up to the next harvest. Aloe tappers also explained how soil type appears to affect the physical yield of bitters sap, with shale and lime soils being poor, and soil containing a great deal of rounded river stone the best.

Both Muller (pers. comm., 1994) and Botha (*in litt.*, 1992(a)) report that the leaves of *A. ferox* are mostly harvested (95%) from wild populations but some use is made of cultivated 'orchards' in Herbertsdale and Albertinia. According to Muller (pers. comm., 1994), crystalline bitters prices were high in the 1970s and some landowners established aloe plantations. Other landowners simply preserved wild populations of aloes.

A limited number of plantations has been planted by individuals having interests in the aloe industry. It is difficult to quantify the volume of leaves harvested from plantations. However, from interviews conducted with landowners and tappers and, in comparison to the large volumes harvested from wild populations, the quantities are likely to be insignificant and probably no more than five percent of annual production. In all areas where this species occurs, aloes growing in the fenced off areas (i.e. road reserves) alongside most roads in South Africa, are also tapped.

The products are extracted from wild aloes on an 18 to 36 month cycle by independent full-time tappers, farm workers and also by casual labour as a way of supplementing their normal income. The methods used by tappers were noted during field trips and interviews with tapping groups from Herbertsdale and can be summarised briefly as follows:

a. A standard team of five tappers assesses whether the stand of aloe plants is dense enough to make tapping viable.

b. At a central point among a group of approximately 50 plants a shallow drainage basin is scraped into the ground and lined with plastic from heavy duty fertiliser bags to form a water-proof layer. The same basins tend to be used from one season to the next thereby limiting environmental degradation.

c. The tappers arm themselves with sickles, strong gloves and a piece of plastic sheeting or rubber inner tube which is draped over the arm on which to pile the leaves. The plastic sheet/inner tube serves to gather any sap which drips from the leaves while being gathered.

d. Leaves on the plant are scored with a sickle deep enough to make them easy to break off. Because the aloe leaves are generally covered in short sharp spines the tappers wear thick gloves to protect their hands.

e. Two to three centimetres is normally left attached to the plant to avoid damaging the plant's vascular tissues, however, the tappers consider four centimetres an ideal length.

f. Severed leaves are stacked onto the harvester's arm on the inner tube/plastic sheet until 20 to 30 leaves have been collected. Approximately one-third to one-half of each plant's leaves are removed. The leaves are transported rapidly to the plastic lined drainage basin and stacked, with the cut end facing inwards so that the bitters sap can drain into the depression, in a circle around the edge of the plastic sheets.

g. The pile of leaves looks like an inverted cone and can eventually almost close in at the top when it would contain approximately 2,000 leaves. The height of the cone depends on the number of plants in the vicinity but generally consists of about 1,000 leaves obtained from approximately 35 plants.

h. The pile of leaves is left draining for about six hours and produces between two and six litres of bitters sap depending on the weather conditions and the health of the plants. A pile of approximately 1,000 leaves from drought-stressed plants drained for two hours produces about two litres of bitters sap.

i. After allowing sufficient time for drainage, the accumulated bitters sap is emptied out of the plastic bags lining the depression into plastic bottles. At the end of the week's tapping, all bitters sap is placed in a large pot and boiled using locally gathered firewood. The collection of firewood is one of the negative aspects of this trade as, in semi-arid conditions where *A. ferox* also grows, supplies are rapidly exhausted.

j. At a stage which only an experienced tapper can recognise the boiling bitters sap is removed from the fire and poured into 20 litre tins or other suitable containers where it solidifies into a crystalline lump on cooling. Great care has to be taken that the bitters sap is not overcooked or burnt as this can reduce the value of the crystalline product. Generally speaking, crystalline bitters is stored in 25 kg amounts in steel ice-cream containers.

k. The solid crystal (lump) is sold to shopkeepers or other middlemen dealers.

2. Dried Aloe Parts

According to tappers, landowners and shopkeepers, dried *A. ferox* parts are only obtained from plants which have died of natural causes. The fact that plants are not purposefully killed reflects the value of live plants for commercial bitters production. The aloe tapping business produces many tons of leaves which when dried may also be collected for the ornamental trade.

3. Live Plant Trade

According to local tappers and landowners, there is apparently no removal of plants from the wild for the horticultural trade and no signs of any major trade were detected. However, South Africa does have a well-developed nursery industry, and prices quoted by seven South African nurseries for *A. ferox* plants and seed are given in Table10.

4. Employment and Social Impacts

People and institutions who benefit from the aloe tapping industry fall into nine groups, namely:

a. full-time tappers;
b. casual workers who use the resource as a source of supplementary income;
c. landowners who allow the aloes on their property to be harvested for a fee;
d. farm workers who harvest the crop on their employer's land for a fee;
e. shopkeepers and other agents;
f. factories and pharmaceutical companies producing aloe products;
g. retailers of aloe products;
h. shareholders of the above listed factories and companies;
i. immediate families of all the above listed groups of people and institutions.

Full-time tappers apparently gather the majority of the export crop. Some tappers earn reputations for consistent work and conservation of the aloe resource and landowners may specifically request those groups to work their farm. Landowners protect their plants because of self-interest in the industry engendered by commission earnings, or through income generated by their farm shops which buy the crystalline bitters from tappers and/or sell materials required for harvesting aloes. According to Muller (pers. comm., 1994), some landowners use crystalline bitters to pay for their groceries as shopkeepers are happy to receive payment in kind.

The casual worker segment is small, but supplements labour needs of full-time tappers during the main picking season which is anytime during a year of normal rains. Nature conservation staff report that so-called 'trekboere' (nomadic farmers) tap aloes on the roadside while erecting farm fencing (Adams, pers. comm., 1994).

An unquantified sector of the market involves part-time tappers normally employed on farms and who, during lulls in farm activities, tap aloes on their employer's land. Some landowners allow workers to keep all the proceeds from the harvest, but most expect a minimum cut of 33% to 40%, even during times of drought (Muller, pers. comm., 1994). Some workers travel from farm to farm on a speculative basis and it is these workers that are difficult to monitor. According to Steyn (pers. comm., 1994), some workers earn their entire income from aloe tapping; in these cases, women do the picking, while men join them when there is no other work on the farms.

Workers who are reliable suppliers of crystalline bitters to one shopkeeper or agent build up a credit rating that allows them to purchase goods on credit when the aloe season is bad. The shops that farm workers normally deliver to are 'general dealers' operated either by the landowner or by an independent operator. If independent, the general dealer may pay the landowner their share of the profit (Steyn, pers. comm., 1994). In the aloe tapping areas shops within towns will also buy the crystalline bitters. The shops and agents are familiar with market prices and generally sell it on again to import/export agencies who deal regularly with the product. Apparently these agencies buy up as much of the crystalline bitters as they can and may even pay shopkeepers in advance which encourages bartering of crystalline bitters for food by the locals and pushes up production (Pettitt, pers. comm., 1993).

Examples of communities dependent on aloe products are the tapping communities' of Herbertsdale (approximately 600 people) and Buysplaas (approximately 400 people) who supply the labour for the full-time aloe tapping work force in these districts. The Buysplaas tappers generally tap on surrounding farms in the Herbertsdale to Albertinia district while Herbertsdale tappers gather sap within a 500 km radius, which potentially means they could cover most *A. ferox* populations in the Eastern Cape Province and southern Cape. Tappers from these communities have aired many

complaints about unfair distribution of money and the patronising system in place in the district. As a result the tappers formed a community Aloe Tapper's Association which was the first ever to be formed in South Africa to deal with their particular issues. The work circumstances of full-time and part-time aloe tappers were examined and the details are as follows:

The apparent depletion of the aloe resource in the Gouritz valley in combination with high unemployment levels, induced a local aloe agent (allegedly trading without valid nature conservation permits) to seek out plants in the little Karroo, up to 500 km from Herbertsdale where these tappers were based. The agent, after negotiation with the landowners, arranged transport for the tappers from their homes to the farms. Under the terms of the arrangement, the landowner's share was one-third of the crop. The tappers remained freelance workers and were liable for their own food, equipment, transport fees and lodging while in the field. To this end, credit was extended to the tappers by the agent's shop for food, equipment, building materials, fuel and for purchases by family members remaining at home while the tappers were away. At the end of the normal expedition period of six weeks (less if the aloe resource was insubstantial), the tappers with their crystalline product returned to home. The debt owed by the tappers and their families was purchased by the agent and offset against crystalline bitters gathered which was valued at the going rate. Each safari of forty tappers realised a retail transaction of approximately R30,000 per party (US$ 9,174.31) Because of factors such as landowner's commission, agent's profit margin, and a R1 (US$ 0.31) per kg transport charge, the tappers were not able to settle all R30,000 (US$ 9,174.31) of debt. Consequently they became dependant on the agent to extend them more credit and their debt cycle became entrenched. Sometimes the tappers owed so much money that there was not enough left to pay casual labour who earned as little as R400 (US$ 122.32) to R500 (US$ 152.91) for 6 weeks work.

This practice resulted in a secure supply of crystalline bitters to the agent and created employment opportunities for the community, where potentially approximately R10,000 (US$ 3,508.77) per annum could be realised during 1992 for each tapper. However, the communities' inability to pay back debt and the damage caused to family life by long periods of parental absence during harvest led to considerable antagonism towards the agent.

Up until about ten years ago, the aloe industry was a largely semi-formal business involving landowners, tappers, general dealers, wholesale and pharmaceutical companies and other agents. However, at least one factory now exists whose sole activity is the commercial production of crystalline bitters powder and aloe gels. The relatively sophisticated techniques used in the factory (namely, spray drying of extract and chemical extraction of gel from leaves) demands skilled and semi-skilled workers; consequently employment opportunities are limited. The factory operates as a co-operative with approximately thirteen landowners and their staff supplying raw materials.

Employment opportunities for the collection and processing of dried aloe parts and in the production of plants for the horticultural industry exist, but it was not possible during this study to determine the circumstances of employment offered in these sectors.

5. Estimated Production Levels

a. Estimate of Aloe ferox Extract Produced

Whilst calculating a production estimate for South Africa it was not possible to visit the entire aloe tapping area which covers thousands of square kilometres. However, during visits to Herbertsdale, Buysplaas and Albertinia it was possible to derive estimates from field observations and interviews with landowners and tappers. For areas not visited, it was possible to interpolate production esti-

mates from several sources, namely, trade data obtained from nature conservation departments, production yields worked out during field research and from statistics on illegal and undocumented trade gathered during the retail market survey in Gauteng. The methods used to obtain the final production estimate for South Africa are described in this section.

Experienced tappers in the Herbertsdale district estimated their annual production to be between 100 and 600 tons. In addition, some tappers estimated that each tapper in a six week cycle produces 14.5 cans of crystalline bitters, each weighing 27 kg, which adds up to production of approximately 392 kg. Therefore, forty tappers produce an estimated 15.7 tons (15,660 kg) over six weeks, and over one year (7 cycles) an estimated 110 tons of extract. These estimates were compared to results obtained from field research which is presented below. In Herbertsdale aloe tappers were venturing into the field in eight teams consisting of approximately five tappers each and all calculations done have been based on this number. According to Otto (pers. comm., 1993), during times of drought and unemployment the number of tappers can increase to 80 which represents 16 teams.

Experienced tappers estimate that each person can build between seven and twelve piles of leaves each day, with the individual average being nine and the group average being 45 piles. A team of five can work on three piles simultaneously and individual productivity becomes obscured by the collective input. From field observations, it takes two pickers approximately 45 minutes to build a pile of approximately 600 to 1,000 leaves, therefore, one person should be able to construct a pile in about 90 minutes during a normal working day of 10 to 12 hours. This estimate converts to the production of approximately six to eight piles per person per day.

Based on these facts, and the assumptions and conclusions contained in Appendix 2, the estimated annual production of bitters extract by Herbertsdale tappers is 151 tons. This figure is based on a reduction ratio of three to one (volume to mass) from 453,600 litres of bitters sap collected in the field to 151,200 kg (151 tons) crystalline bitters after boiling and crystallisation. With 252 working days in the year it follows that eight teams of tappers produce 600 kg crystalline bitters per day, and hence each tapper produces 15 kg crystalline bitters per day.

For surrounding areas, it was more difficult to obtain estimates that could be corroborated, however, the community leader of Buysplaas (near Herbertsdale) estimated that 45 people in his community were tappers, that in a good week between three and four tons, or four tins per person per week (1 tin holds 27 kg extract), of extract was produced and that the tappers produced approximately 100 tons per annum. Taking each estimate separately, firstly, three to four tons (average 3.5 tons) per week converts to 147 tons per seven, six-week cycles, and secondly, four tins per person per week (16 kg per day) adds up to 204 tons per seven, six-week cycles. It appears that the 100 tonne estimate for Buysplaas is conservative and that the true level could be anywhere between 100 and 204 tons per annum with the higher levels being for an exceptional year and the average being approximately 150 tons.

No one interviewed could give educated estimates for the total amount of extract produced in Albertinia. Herbertsdale tappers thought that Albertinia tappers produced approximately 50 tons per annum. The lack of accurate statistics could be due to reports that tappers there work in small independent teams that are not well organised and normally sell on an *ad hoc* basis to general dealers in the town or to the aloe factory The Albertinia based factory uses modern spray drying techniques to dry bitters sap with the ratio of sap used to powder produced being just under 2:1 (42 litres bitters sap yields 24.5 kg crystalline bitters powder). During 1992/1993, given the under-developed state of the powdered crystalline bitter's market, powder was being produced at rate of four kg per day. Based on 252 working days per year, also assuming daily production, an uninterrupted supply of bitters sap,

and one-third production capacity, the factories total production would be approximately one tonne per annum.

Some Albertinia tappers are employed by a co-operative supplying the aloe factory with extract and leaves. Muller (pers. comm., 1994), based in Albertinia, estimated that an enthusiastic tapper can produce at least 100 kg of crystalline bitters each six day week (16 kg per day) under ideal picking conditions. Often families work together to increase the amount of crystalline bitters produced but aloe tapping is hard and can only be done under ideal climatic conditions thus limiting production. A further limiting factor is that apparently the younger generation is not keen to get involved with this industry.

In conclusion, a daily production rate of 15 to 16 kg extract seems to be the norm. A conservative production level for Herbertsdale is 151 tons per annum, Buysplaas about 150 tons per annum and for Albertinia approximately 50 tons per annum. In addition the factory produces approximately one tonne bitters powder per annum. Total production for that region is approximately 352 tons per annum.

Finally, in Table 14 (Pg. 36) it can be seen that during the period 1980 to 1985 the districts of Albertinia, Herbertsdale and van Wyksdorp accounted for 84% of sales to exporters, thus, production for the rest of South Africa at current production rates is assumed to be 16% of 352 tons which is 56 tons. Therefore, South Africa's total production is approximately 400 tons per annum. However, there is evidence to suggest the existence of an informal, possibly illegal, export market which consumes an additional 300 tons extract per annum, in the Eastern Cape Province (see "Illegal Trade" section).

Assuming 400 tons is produced per annum and allowing for average exports of 252 tons per annum, an estimated 150 tons extract remains in South Africa for storage, internal consumption or other undocumented use.

b. Estimate of Plant Population Harvested

An estimated 25 leaves are taken from each plant depending on the plant's health, the size of the plant's leaves and whether it has been harvested before. Counts made during two field trips and confirmed from anecdotal information showed that approximately 40 plants (range according to tappers is 25 to 50 plants) were harvested to make one pile of leaves. The larger the leaves the fewer were required to complete a pile. Approximately 1,000 leaves were used per pile but this figure varied considerably and no survey of the exact number's utilised was conducted. In contrast to this Botha (*in litt.*, 1992(a)) reports that conservation minded landowners only allow four to eight leaves per plant to be removed every three to four years. This may be the situation pertaining to members of a factory co-operative where a relatively small amount of sap and leaf is required to meet demand.

Based on these facts, a production level of 151 tons for crystalline bitters in Herbertsdale and the assumptions and conclusions contained in Appendix 3, the estimated number of plants utilised in South Africa each year to produce 400 tons extract is approximately 10 million. This figure was obtained as follows; if 3,628,800 plants generate 151,000 kg extract, then 400,000 kg extract is produced from harvesting 240,317,875 leaves or 9,612,715 (approximately 10 million) plants per annum.

These figures are considered conservative in light of the fact that in this community up to 16 teams can be in the field harvesting approximately twice the number of plants. In addition there are many other groups of part-time tappers whose activities have not been taken into account.

If the suspected illegal trade of 300 tons per annum is accurate then this trade would account for the harvest of a further 180,238,410 leaves or 7,209,536 plants per annum and bring the total number of plants harvested to 16,822,251 (approximately 17 million).

The number of plants dying due to the effects of harvesting is not known and a scientific study into this aspect of the trade needs to be conducted.

6. Impact on the Environment

a. Impact on Aloe Habitat

Concern has been expressed about the impact of harvest on the local environment and especially on the recruitment of *A. ferox* seedlings in the harvesting areas. There appears to be little information available regarding the recruitment of *A. ferox* in road reserves but, according to Holland and Fuggle (1982, in McDonald, 1991), if the habitat is undisturbed, recruitment from seedlings would be normal and a full range of ages could be expected. Consequently, McDonald (1991) suggested that the disturbance associated with the harvest of *A. ferox* in the road reserves, and presumably all other harvest areas, may be detrimental to the recruitment of aloe seedlings. Furthermore, it was reported that few aloe plants in road reserves are left undamaged with harvesting taking place from plants scarcely one metre tall. Tappers acknowledged during field research that they harvest any plant taller than 0.4 metre. McDonald (1991) concedes that given the species long life span this may not be a problem, but maintains that if harvest is coupled with debilitation of plants, then popula-tions of *A. ferox* may be compromised. Cape Nature Conservation (CNC) staff in the area were not aware of any studies having been done into the survival of harvested aloes (Adams, pers. comm., 1994) and tappers were not aware of large-scale debilitation or die-off as a result of their activities.

McDonald (1991) also suggested that *A. ferox* populations together with other plant species in road reserves are important as corridors between remnant patches of Renosterveld. He maintains that aloes in these corridors may permit gene flow between populations which could in turn sustain genetic stability of the species in any given region. Many of the barriers to gene flow are now artificial resulting from the activities of man and included the considerable trampling and disturbance of the remaining natural bush during aloe harvesting.

Flowers of *A. ferox* are, according to tappers interviewed, not picked on a large-scale for ornamental purposes during the harvesting of leaves for juice extraction. Similarly plants are not uprooted to supply the dried plant trade and stem sections and dried leaves are taken from plants which have died from disease or drought. Dead leaves could also be taken from those harvested for crystalline bitters and left to dry after extraction is completed.

The primary fuel consumed at this stage for boiling aloe sap is wood, gathered from shrubs, dead aloe plants or, where wood is scarce, trucked in from other areas. CNC staff in the Riversdale district were not aware of this use of resources and had no legal problem with it. The impact of this activity on surrounding vegetation is unknown but may add to the problems mentioned by McDonald (1991).

b. Impact of Fire

On normal *A. ferox* plants that have not been harvested, dead leaves hang down around the stem forming a protective 'skirt' to ground level. The dead leaves function as an insulating layer to protect the main stem from damage by fire. Where *A. ferox* is undisturbed it resists fire and can live 140 to 150 years, sometimes in dense stands of more than 2,000 individuals per hectare (Holland and Fuggle, 1982, in McDonald, 1991). Removal of the leaves exposes the main stem to potential fire-

damage and subsequent death of the whole plant (Bond, 1983). According to McDonald (1991), the removal of leaves may also debilitate plants and make them more sensitive to fire damage. Holland and Fuggle (1982, in McDonald, 1991) showed that disturbance by grazing animals and fires exerted a profound impact on relic populations of *A. ferox* by reducing rates of recruitment. However, this danger may be purely local as Van Jaarsveld (pers. comm., 1992) states that this species is very common in semi-desert karroo regions where fire is not generally a problem.

c. Impact of Agriculture

Attention was focused on the impact of injudicious veld management on the demography of *A erox* by Holland and Fuggle (1982, in McDonald, 1991). They observed that although *A. ferox* was common and ubiquitous, the species faced large-scale reduction in numbers, as land was trans-formed for agricultural purposes. They proposed that local extinction may have resulted from the exploitation of marginal lands. In support of this, McDonald (1991) observed that land adjacent to road reserves had been completely transformed from Renosterveld and thicket to dry land pastures for sheep. Furthermore, overgrazing threatened the survival of *A. ferox* and other succulent species as a result of accelerated soil erosion. The spread of a number of exotic plant species (e.g. *Opuntia spp.* and *Agave spp.*). has caused serious ecological problems in South Africa (Hardy and Fabian, 1992). *Opuntia* plants are found growing amongst *A. ferox* in the southern Cape but no research has been conducted into the effect these plants have on *A. ferox* populations.

Hilton-Taylor (pers. comm., 1993) does not regard *A. ferox* as a South African Red Data Book species despite the fact that it is subject to much commercial utilisation and is under pressure from agriculture operations. Habitat destruction can pose a threat to *A. ferox*, but generally much less so than for many other plants because much of *A. ferox* habitat is in areas unsuitable for alternative development. The Agricultural Extension Officer based in Riversdale confirmed that *A. ferox* is not currently being destroyed at any significant level for agricultural development mainly because any land suitable for crops has already been put into production. Furthermore, the official stated that many landowners view *A. ferox* as an economically important crop and will not summarily destroy the plants; if plants have to be removed they are generally planted on the borders of fields so that the resource is not lost (Steyn, pers. comm., 1994).

d. Impact of Insects

According to one Herbertsdale agent, the majority of beetles and insects found on aloes do little serious damage. However, aloe tappers in Herbertsdale and Muller (pers. comm., 1994) reported that approximately six years ago a leaf miner insect was first noted attacking and killing *A. ferox* plants. The insect was described by Spencer (1991). According to Urban (1991), a red and black discoloration and withering progresses from the oldest to the youngest leaves. Immediate cause of the dieback was a leaf mining larvae of a species of black fly *Penetagromyza aloephaga* (Diptera: Agromyzidae), that increased during that period from less than one to up to about 300 per leaf. The miner bores into the tissues containing bitters and lays its eggs. The larvae when hatched burrow around the leaves and can eventually kill the plant. Simultaneously, its parasitoids, including *Pediobius spp.* (Hymenoptera: Eulophidae) that can achieve more than 30% parasitism had become locally extinct. Apparently the susceptibility of aloes to the leaf miner was enhanced by drought. Urban (1991) concluded that the rise in borer populations was caused by insecticides killing off borer predators. Some local landowners believe that the insect was introduced on purpose but were unable to give reasons for this view.

Muller (pers. comm., 1994) estimated that it took the borer six years to spread throughout the Langeberg mountains where a large part of the industry is based. He reported that mainly older plants had died and that the young regrowth of plants were not as vigorous but did seem to be resistant to the borer. From the flush of aloe seedlings appearing it has been surmised that young plants are held back while older plants are alive. Aloe tappers also reported that since the miner epidemic many aloe seedlings had appeared. The seedlings present at the time of the research were between 10 and 15 cm in height and the tappers estimated them to be nine months old. Most plants seen during the 1994 season had not been harvested for over two years because the miner had damaged them severely. During this time the plants had grown well and still had the ring of insect damaged leaves on them left by the tappers. It appears that the resource has recovered from the miner but until the young plants reach the harvestable height of 0.4 metre in about three years time there may be a temporary shortage of plants.

Urban (1991) has claimed that the miner problem is aggravated by aloe tapping, however, tappers dispute this saying that removal of infected leaves can slow the spread of the miner. According to Urban (1991), the problem could be solved by watering aloe plantations where feasible; avoiding over-exploitation, especially during drought and changing from preventive chemical spraying, which kills pest insect predators, to integrated pest management.

7. Retail Trade

According to Brown (1994), *A. ferox* was cited several times during a pharmacy survey as being one of the most frequently sold 'packed lines'. These are pre-packaged and generally low cost patent (non-scheduled) medicines and chemicals. The market is competitive, with several companies supplying extract in lump as well as powdered form. Use of *A. ferox* appears to be largely restricted to black communities with powdered aloe the preferred form, however, its higher price often means that greater quantities of crystalline extract (lump) are sold. Some pharmacies report a preference for packaging labelled 'Cape Aloe', rather than just 'Aloe'. It was found that near so-called 'townships', customers preferred boxed extract to bottled extract.

The Marketing Department of the Pharmaceutical Society of South Africa provided the following data concerning the number of retail pharmacies in South Africa:

Regional breakdown*	Cape Province	729
	Transvaal	414
	Natal	471
	Orange Free State	148
Total number of pharmacies in South Africa		2762

*Records at the Society for the new South African provinces have not yet been updated and may exclude pharmacies located in the now defunct 'Homelands'.

a. Pharmacies

Estimated figures for aloe product units sold per month by 25 pharmacies are based on figures given by staff responsible for ordering patent medicines. Unlike ethical (scheduled) medicines, for which most pharmacies have a computerised ordering system, accurate records of patent (non-scheduled) lines bought and sold are not generally kept.

The average monthly number of packets of powdered aloe sold was 23 (range 2 to 120 depending on location). Pharmacies located on the borders of 'townships', such as Alexandra, sold the highest amounts. The most commonly sold weight of a pack of aloe powder was 25 g (range 25g to 50g) and 15 grams for lump (range 15g to 25g). Given the estimated number of pharmacies in South Africa as 2,762 and assuming average sales of 23 units per month per pharmacy, the total weight of *A. ferox* sold each year (assuming uniform 15g per unit for lump and powder) amounts to 0.95 tons per month or 11.4 tons per annum. This figure excluded the quantities of crystalline bitters included in Friar's Balsam, Turlington's remedy and other patent medicines where bitters formed a minor part of their ingredients.

b. Wholesale Industries that Supply Pharmacies

There are approximately five national and regional suppliers of *A. ferox* product lines to pharmacies in South Africa. Owing to the competitive nature of the pharmaceutical wholesale trade, data on turnover and prices was difficult to obtain and the information presented here is incomplete. One of the largest suppliers used a total of approximately 400 kg crystalline bitters in its production lines during 1994, which averages 33 kg per month. This figure includes the 10 kg of crystalline bitters used to manufacture their main patent medicine and the 200 kg used to produce the powdered aloes line. This company, in conjunction with five other wholesalers, jointly produced 3,111 kg aloe lump and 1,931 kg aloe powder during 1994; these estimates are regarded as conservative.

c. Pharmaceutical Packaging Companies

Many of these companies were not prepared to disclose their production volumes. One company reported using 90 kg of crystalline bitters on a monthly basis, during 1994, which converts to an annual production of 1,080 kg. Another company reported they were awaiting *A. ferox* crystalline bitters from Germany as recently produced local supplies, through insufficient boiling, had been too sticky. The 'toffee' crystalline bitters reportedly does not conform to the 'British Pharmaceutical Standards' to which the company claimed to adhere. Furthermore, it was reported that existing machinery in South Africa becomes too easily clogged and hence not much aloe powder is manufactured locally.

d. Pharmaceutical Wholesale and Pharmaceutical Company Suppliers

Some companies purchase crystalline bitters supplies from Port Elizabeth either through local branches or from individual agents or tappers. Companies sometimes find the supply of crystalline bitters to be unreliable during spring (September and October) and times of drought (December and January) and so orders for this period are generally put through early. At least one company sends extract to Johannesburg for processing where it was estimated that the turnover rate was between one and two tons per month (approximately 12 to 24 tons per annum). According to Brown (1994) one company supplying wholesalers and pharmaceutical companies claimed that some stock is sold for the export market, but quantities were not given. It has been claimed that individual farmers export crystalline bitters in large quantities and that the estimated turnover from Port Elizabeth could be 30 to 40 tons per month to the local and international markets combined (Brown, 1994).

Total annual production reported by two companies, different from those mentioned above, was 1,600 kg each of aloe lump and aloe powder during 1994 (Total: 3,200 kg). Another reported that approximate turnover was four tons for 1991 and three tons for 1992, but that because of severe competition they had pulled out of the market during 1993. Their crystalline bitters was supplied by agents based in the Transkei. A major supplier in the Eastern Cape to Cape Town pharmaceutical companies reported an approximate turnover of 0.5 tonne to one tonne per month (Total: 6,000 to 12,000 kg per annum) (Brown, 1994).

At least one company is supplied with aloe lump directly from farm workers in the Jansenville (near Graaff-Reinet), Kareedouw (near Humansdorp) and Alexandria (between Port Elizabeth and Grahamstown) districts. There is very little quality control with extract being supplied in old paraffin and ice cream tins. There are apparently problems with bricks being placed in the bottom of tins to increase their weight.

According to Brown (1994) one of the main individual agents supplying the local market and pharmaceutical companies in Port Elizabeth is also heavily involved in export. Research shows that no export permits have been issued to this agent; possible explanations are that he either sells directly to exporters who are issued permits, or that he ships directly from Port Elizabeth without formal documentation. The agent stated that business in the second half of 1994 has been quiet compared to previous years and estimated that total sales amounted to approximately 8,400 kg per annum or on average 400 kg to 500 kg per month, with less being sold in winter. This trader believes that former home-lands of the Ciskei and Transkei are the best areas for gathering crystalline bitters and approximately 100 individual farm workers in these regions supply him, at undisclosed prices.

An aloe broker in the Grahamstown district traded approximately 15 tons of extract during 1994, which he stated was low compared to previous years. Reasons given for the depressed market were the international recession and stockpiling by the international market in the months prior to the April election in South Africa when sales averaged six to eight tons per month. It appears that his customers are not restricted to the pharmaceutical trade with ten percent of this agent's stock being exported to the liquor industry for inclusion as the 'bitters' component (Brown, 1994).

B. International Trade

According to Botha (*in litt.*, 1992(a)) and aloe tappers *A. ferox* is the only species used for the collection of extract on a commercial basis. This is supported by South African export statistics which show the export of *A. ferox* extract only. Many other *Aloe* species are exported annually in the form of plants and seed, but rarely in the form of dried plant material and never in the form of extract.
In this study the following analyses of trade data were completed:

1. Comparison of Customs Data with CITES Permit Data

South African customs statistics, like many other countries, do not distinguish aloe products at the commodity level, simply listing them under the general title of 'other vegetable'. Eurostat data from the European Community (EC), compiled by Oldfield (1992) for the period 1988 to 1991, is the only other source of customs data. These data are mixed with small export quantities of other plant species. However, Oldfield judged the effect of their inclusion to have had a minimal impact on the category total. According to these figures, adjusted downwards to account for the mass of non-aloe products, approximately 400 tons of crystalline bitters were imported into the EC each year. South Africa was reported to have contributed an average of 183 tons per annum.

To assess the accuracy of these figures the EC customs information was compared to selected South African CITES export data. Average CITES exports to EC countries (namely, Germany, Spain, France, Great Britain, Italy, Netherlands) over the period 1981 to 1994 were approximately 133 tons per annum (Table 1) and 117 tons per annum for the period 1988 to 1991. The latter figure represents a reporting deficit by South Africa of 66 tons per annum in its CITES permits when compared to the EC customs data.

Table 1: Total Quantity (kg) of *A. ferox* Extract Exported from South Africa to EC Countries for the Period 1981 to 1994.

SUM OF QUANTITY			COUNTRY OF DESTINATION					
YEAR	UNIT	DE*	ES	FR	GB	IT	NL	GRAND TOTAL
1981	kg	183,157	1,000	3,007	5,000	50,788	16,633	**259,585**
1982	kg	102,312	0	9,005	54,688	0	0	**166,005**
1983	kg	36,850	3,000	15,784	0	83,263	0	**138,897**
1984	kg	27,284	0	12,772	0	19,780	0	**59,836**
1985	kg	116,091	0	3,000	16,629	0	0	**135,721**
1986	kg	132,346	0	5,011	0	0	0	**137,357**
1987	kg	38,236	4,043	3,016	96	16,017	0	**61,408**
1988	kg	100,523	8,049	7,702	7,015	0	0	**123,289**
1989	kg	81,367	13,160	8,580	5,003	29,427	0	**137,537**
1990	kg	86,064	5,515	9,181	0	27,906	0	**128,666**
1991	kg	57,842	0	0	0	21,275	0	**79,117**
1992	kg	130,231	5,000	0	0	25,210	0	**160,441**
1993	kg	69,810	10,007	5,089	4,007	53,735	0	**142,648**
1994	kg	100,689	0	0	0	34,092	0	**134,782**
GRAND TOTAL		**1,262,802**	**49,774**	**82,149**	**92,438**	**361,494**	**16,633**	**1,865,290**

Source: CITES Export Permit Information.

2. Analysis of Errors and Omissions in South Africa's CITES Annual Reports

Oldfield (1992) reports that many exporting countries do not report trade in aloe parts and derivatives in their CITES annual reports. For example, the largely undocumented export of crystalline bitters from Kenya was noted at several CITES Plants Committee meetings after it had been detected through review of Eurostat Customs data. South Africa does report a substantial part of its *A. ferox* trade in CITES annual reports, but these data have often been subject to serious omissions which reflect clerical errors and undocumented or illegal trade. South Africa annual reports from 1988 to 1992 were inspected for erroneous reporting. There appears to have been a gradual improvement in the accuracy of reporting over the five years reviewed with 1992 being the most accurate reflection of data on CITES permits.

Examples of the most common mistakes in annual reports are:

a. "Description" heading – incorrect plant part or derivative e.g. dried trunks are listed as plant segments; extract listed as dried trunk segments.

b. "Quantity" heading – volumes of item traded are not always accurate e.g. under permit number 41/1988, 3,564 kg is reported as 356 kg; 18/1988, reported as 1,800 without the kg notation; 61/1988C, 7,842 pieces reported as 3,098; 104/1988C, 10,000 kg reported as 5 tons; 155/1989, 7,930 kg reported as the equivalent in tons; 134/1990C reported as 2 grams of seed but it was actually for 49 grams; 95/1991C, 15,036 kg reported as 1,503.6 kg; 53/1992C reported as 3,000 kg extract but 30,000 kg on permit; 82/1992C reported as 6,600 kg but 7,600 kg on permit; frequently volume, quantity or mass units are omitted.

*see Appendix 1 for index to ISO country codes.

c. "Remarks" heading – dry plant material that has been harvested from the wild is occasionally listed as being "cultivated" or "artificially propagated".

d. One case of possible fraudulent use of permits detected in 1988. Permit number 18/1988C was reported as being replaced by permit number 38/1988C, however, both these permits were reported in the annual report as having been used for export. Furthermore Japan reported receiving shipments under both these permits. The possible reason for this use could be that the original document with the shipper was not cancelled while internal documents were notated. The reason for the cancellation is not known.

e. "Permit Number" – in 1989 permit number 110/1989C was mistakenly duplicated and issued for both aloe plant pieces (misreported as 8,948.7 kg extract instead of 11,934 pieces) and one *A. plicatilis* seedling which was reported as being an *A. ferox* seedling. Permit number 108/1989C was reported as being for dried aloe leaf but was in fact issued for one live *Anacampseros lanigera* plant. Permit number 32/1990C was reported to include an *A. ferox* seedling but the permit was for 18 seedlings of various *Aloe* species, not including *A. ferox*. Permits 54/1990 and 55/1990 were included as *A. ferox* but were in fact unrelated species (*A. plicatilis* and *Euphorbia spp.* respectively).

f. Cancelled permits – There are only two instances where permits cancelled by CNC were reported in the annual report for that year i.e. 120/1991C and 66/1989C.

g. Missing permits – The following permit numbers (Table 2) were left out of the annual reports for the year concerned and in some cases led to substantial under reporting of trade figures.

Table 2: Permits for *A. ferox* Parts and Derivatives Omitted from South African CITES Annual Reports for the Period 1988 to 1992.

YEAR	PERMIT NUMBER
1988	44/1988C; 75/1988C; 102/1988C; 105/1988C; 117/1988C; 140/1988C; 150/1988C; 162/1988C; 175/1988C;
1989	25/1989C; 49/1989C; 104/1989C
1990	27/1990C;
1991	No Missing Permits
1992	No Missing Permits

Source: CITES Annual Reports and CITES Permits.

3. Compilation and Analysis of CITES Permit Data

No trade in extract of *Aloe* species other than *A. ferox* was detected in South African CITES data during this study, however, Oldfield (1992) lists extract (1.4 tons per annum) of *A. arborescens* being traded between the USA and Japan (for the period 1983 to 1989).

Oldfield (1992) reports that the main countries recorded as exporting aloe parts and derivatives in CITES statistics are South Africa and the USA, concentrating on *A. ferox* and *A. vera* respectively. The reason for this may be partly that these countries, unlike many others, regard these derivatives as 'readily recognisable' and therefore require CITES documentation. The quantity of *A. ferox* extract exports reported by WCMC summarised CITES data (1983 to 1989) was approximately 1,370 tons. This is low compared to a total for the same period compiled from CITES permits of 1,853 tons representing a reporting shortfall by South Africa in its annual report of 483 tons or 66 tons per annum.

This figure is identical to the deficit noted in section 1 above (Comparison of Customs Data with CITES Permit Data).

CITES trade in *A. ferox* parts and derivatives from South Africa are given in Chart 1 and Tables 3, 4, 5, 6, 7 and 8. During the period 1981 to 1994 South Africa exported approximately 3,533 tons of crystalline bitters, 1,249,305 pieces (PIE), 4,896 kg, 335 cartons (CTN) and 84,209 unknown (UNK) items of dried aloe parts (including dried flowers, dried leaf, dried trunk, flower stems, vases) and 2,868 live plants.

a. *Aloe ferox* Extract

Oldfield (1992) reports that in about 1982 or 1983 there was a dramatic increase in total production of crystalline bitters for export to Europe and North America. However, documented export figures for that period do not support that statement, nor that of Bond (1983) who reported up to 600 tons extract being exported each year, as a peak in exports was only reached in 1986. This indicates that the crystalline bitters originated from a country other than South Africa. Reported average exports from South Africa (1981 to 1994) are 252 tons per annum with a maximum of 376 tons in 1986 and a minimum of 134 tons in 1991 (Table 3). Over the past 14 years, the largest reported importers of extract have been Germany (1,263 tons) and Japan (678 tons), followed by Argentina (364 tons), Canada (129 tons), Italy (361 tons), Thailand (261 tons) United States (177 tons), and several other countries with imports of less than 100 tons over the same period (Chart 1). Germany and Japan have been the most consistent destinations for extract with average reported exports of 90 tons and 48 tons per annum respectively. The dip in exports during 1990 and 1991 was probably due to several reasons such as drought, the effects of widespread attack by leaf miner insects as suggested by Botha (*in litt.*, 1992(a)) and the switching of the German market to alternative extracts (Newton, 1994).

Three out of 15 countries for which exports were reported (Argentina; Brazil; Sri Lanka) are developing countries, while the balance of 12 countries are developed industrial nations which account for the majority of reported exports. The exports to Japan, France and Germany were sometimes labelled as "**Black Rhino Brand**" or "**Mossel Bay Prime**" aloe.

Chart 1: Total Quantity of *A. ferox* Extract Exported from South Africa to 15 International Destinations, for the Period Chart 1 p28

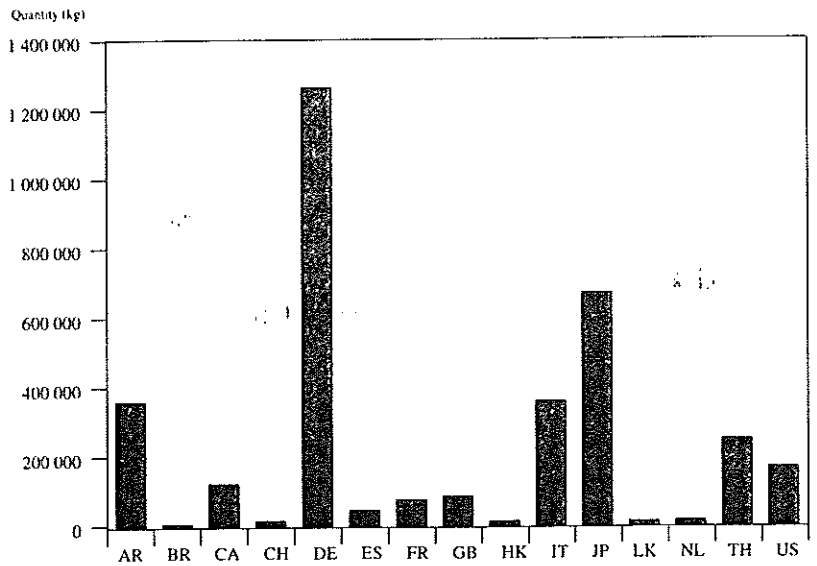


Table 3: Total Quantity of *A. ferox* Extract Exported from South Africa for the Period 1981 to 1994.

	COUNTRY OF DESTINATION															
YEAR	**AR**	**BR**	**CA**	**CH**	**DE**	**ES**	**FR**	**GB**	**HK**	**IT**	**JP**	**LK**	**NL**	**TH**	**US**	**GRAND TOTAL (kg)**
1981	20,004	0	16,644	0	183,157	1,000	3,007	5,000	0	50,788	8,210	0	16,633	5,000	8,779	**318,222**
1982	0	0	16,432	0	102,312	0	9,005	54,688	0	0	47,503	500	0	25,000	31,901	**287,342**
1983	52,732	2,200	16,650	5,005	36,850	3,000	15,784	0	0	83,263	26,769	816	0	11,081	19,097	**273,247**
1984	10,000	0	16,845	0	27,284	0	12,772	0	0	19,780	29,503	10,000	0	23,371	24,542	**174,097**
1985	0	0	10,646	10,010	116,091	0	3,001	16,629	0	0	33,666	0	0	34,288	14,066	**238,396**
1986	0	0	50,515	0	132,346	0	5,011	0	0	0	93,014	1,000	0	23,333	71,069	**376,289**
1987	179,607	0	0	0	38,236	4,043	3,016	96	3,000	16,017	46,395	0	0	16,000	0	**306,410**
1988	0	0	0	0	100,523	8,049	7,702	7,015	2,993	0	80,862	2,000	0	39,020	0	**248,164**
1989	0	1,000	0	0	81,367	13,160	8,580	5,003	2,983	29,428	19,130	0	0	77,107	0	**237,757**
1990	5,000	0	0	0	86,064	5,515	9,181	0	5,915	27,906	41,975	0	0	6,608	0	**188,164**
1991	5,000	0	0	0	57,842	0	0	0	0	21,275	47,405	1,000	0	0	1,051	**133,573**
1992[1]	18,000	500	0	0	130,231	5,000	0	0	0	25,210	111,184	2,000	0	0	2,980	**295,225**
1993	36,000	0	0	0	69,810	10,007	5,089	4,007	0	53,735	35,241	4,500	0	0	2,291	**222,684**
1994	37,157	0	1,647	0	100,689	0	0	0	0	34,092	48,036	1,500	0	0	1,316	**233,436**
GRAND TOTAL (kg)	**363,500**	**3,700**	**129,379**	**15,015**	**1,262,802**	**49,774**	**82,149**	**92,438**	**14,890**	**361,494**	**677,893**	**23,316**	**16,633**	**260,808**	**177,092**	**3,533,008**

Source: CITES Export Permit Information.

[1] the export figures for the US includes an amount of 1107kg *A. ferox* bitters powder

Table 4: Total Quantities, Descriptions and Measurement Units Used to Describe Shipments of Dried *A. ferox* Plant Parts Exported from South Africa to all Destinations for the Period 1981 to 1994.

SUM OF QUANTITY		DESCRIPTION									
YEAR	UNIT	DRIED CROWN	DEAD PLANT	DRIED FLOWER	DRIED LEAF	DRIED PIECES	DRIED TRUNK	MIXED FLOWER, LEAF, STEM	MIXED LEAF, STEM, TRUNK	UNIDENTIFIED DRIED PARTS	GRAND TOTAL
1981	PIECES	0	0	0	0	0	0	0	0	19,746	**19,746**
	UNKNOWN	0	0	0	0	0	0	0	0	9,705	**9,705**
1982	PIECES	0	0	11,370	630	0	87,402	0	0	23,354	**122,756**
	UNKNOWN	0	0	530	15,919	0	0	0	0	200	**16,649**
1983	CARTONS	0	0	0	0	0	0	31	0	0	**31**
	PIECES	0	0	4,340	11,910	0	88,823	0	0	9,140	**114,213**
	UNKNOWN	0	0	2,760	240	0	0	0	0	0	**3,000**
1984	CARTONS	0	0	0	0	0	57	0	0	0	**57**
	PIECES	82	0	2,540	50,525	0	43,446	0	0	0	**96,593**
	UNKNOWN	0	0	0	5,820	0	0	0	0	2,566	**8,386**
1985	PIECES	0	1,001	2,220	42,940	0	58,403	0	0	840	**105,404**
	UNKNOWN	0	0	1,520	2,400	0	0	0	0	0	**3,920**
1986	kg	0	0	0	480	0	0	0	30	0	**510**
	PIECES	0	1,100	2,860	80,419.3	0	45,716	0	0	0	**130,095.3**
1987	CARTONS	0	0	0	0	0	111	0	0	0	**111**
	PIECES	0	0	3,500	25,280	0	61,182	0	0	0	**89,962**
1988	PIECES	0	0	2,940	23,610	0	130,501	0	0	286	**157,337**
1989	PIECES	0	0	330	21,920	0	99,122	0	0	12,605	**133,977**
	UNKNOWN	0	0	3,300	0	0	0	0	0	0	**3,300**
1990	CARTONS	0	0	0	30	0	0	0	0	0	**30**
	PIECES	0	0	660	38,123	0	6,413	0	0	0	**45,196**
1991	kg	0	0	0	0	0	1.6	0	0	0	**1.6**
	CARTONS	0	0	0	0	0	106	0	0	0	**106**
	PIECES	0	0	0	57,633	0	54,224	0	0	6,027	**117,884**
	UNKNOWN	0	0	0	1,250	0	37,342	0	0	657	**39,249**
1992	PIECES	0	0	103	21,980	6,560	29,622	0	0	0	**58,265**
1993	kg	0	0	1	0	0	3,654	0	0	0	**3,655**
	PIECES	0	0	2,080	27,400	0	12,742	0	0	0	**42,222**
1994	kg	0	0	0	0	0	730	0	0	0	**730**
	PIECES	0	0	3,220	9,160	0	1,775	0	0	0	**14,155**

Source: CITES Export Permit Information.

b. Dried *Aloe ferox* Parts

There appears to be a brisk demand for dried *A. ferox* parts but, as no studies were conducted into how the trade translates into whole plants consumed, it was not possible to accurately determine the impact of the industry on wild populations. A factor hindering efforts to assess impact was the inconsistent way in which plant parts or measurement units are recorded on South African CITES permits. For instance, it was impossible to accurately translate a mass (e.g. kilograms) of dried material into a whole plant equivalent, and hence into a wild plant harvest assessment, as shapes and sizes of parts vary considerably. In Table 4, details of total trade volumes and the array of descriptions and measurement units used to describe shipments are given. However, despite inconsistencies, it seems probable that in comparison with the large wild populations, the size of the dried part trade is negligible. Furthermore, the fact that most dried parts are said to be derived from plants dead of natural causes, would suggest that there is little pressure on wild populations of *A. ferox*.

In order to give an idea of the relative size of the export trade between South Africa and recipient countries the export data was split up on the basis of measurement unit. Table 5 illustrates that Germany and United States of America were the only countries importing dried plant material in kilogram shipments. The United States of America dominates the trade with imports of almost five tons dried plant. In Table 6, the main reported importers of dried *A. ferox* 'PIECES' were Germany, the United States of America and Netherlands for the period 1981 to 1994. These three countries account for 82% of the total trade in dried aloe pieces (excluding kg, carton and unknown quantity units). In both Tables 7 and 8, although quantity units are vague, the position of Germany and especially the United States of America as the largest importers of dried plant material is confirmed.

In total twenty countries were reported to have imported aloe parts of which 11 were EC member countries (Tables 5, 6, 7, 8). All of these, excepting Hungary, can be regarded as industrially advanced countries. The United States was the only country that reported importing dried aloe parts in their CITES annual reports(Table 13).

Table 5: Total Quantity (kg) of Dried *A. ferox* Plant Parts Exported from South Africa to Importing Countries for the Period 1981 to 1994.

SUM OF QUANTITY		COUNTRY OF IMPORT		
YEAR	UNIT	DE	US	GRAND TOTAL
1986	kg	480	30	510
1991	kg	0	1.6	1.6
1993	kg	0	3,655	3,655
1994	kg	0	730	730
GRAND TOTAL		480	4,416.6	4,896.6

Source: CITES Export Permit Information.

Table 6: Total Quantity (Pieces - PIE), of Dried *A. ferox* Plant Parts Exported from South Africa to Importing Countries for the Period 1981 to 1994.

SUM OF QUANTITY	COUNTRY OF IMPORT																				
YEAR	UNIT	??	AT	AU	BE	CA	CH	DE	ES	FR	GB	GR	HU	IL	IT	JP	NL	PT	SE	TW	US	GRAND TOTAL
1981	PIE	0	0	0	606	0	0	14,241	0	0	0	0	0	0	0	0	0	0	30	4	4,595	19,746
1982	PIE	0	0	0	830	1,077	0	55,500	0	0	0	0	0	0	0	3,862	18,183	0	0	0	43,304	122,756
1983	PIE	0	1,556	0	3,432	1,164	0	42,631	0	0	0	0	0	0	0	0	21,960	0	0	0	43,470	114,213
1984	PIE	0	3,986	0	1,264	1,000	840	39,120	0	0	0	1,560	0	0	0	0	13,355	0	0	2,600	32,868	96,593
1985	PIE	0	6,486	0	0	2,220	0	16,782	0	0	0	0	0	34,722	0		25,568	0	0	0	19,626	105,404
1986	PIE	0	1,100	0	4,560	0	0	59,772.3	0	8,200	0	0	0	0	0	0	29,645	0	0	300	26,518	130,095.3
1987	PIE	0	7,242	0	1,210	0	0	32,195	0	0	0	4,800	0	0	0	500	30,200	0	0	0	13,815	89,962
1988	PIE	0	7,842	0	0	0	0	38,021	0	0	0	0	0	0	0	3,627	21,476	100	0	11,934	74,337	157,337
1989	PIE	0	14,411	500	1,007	0	0	57,681	0	0	0	0	0	0	0	1,065	23,965	0	11,934	693	22,721	133,977
1990	PIE	0	0	0	0	0	2,020	12,719	2,100	0	0	0	0	0	9,990	975	17,392	0	0	0	0	45,196
1991	PIE	0	11,000	0	0	0	0	36,611	8,504	0	1,496	0	0	0	2,214	0	14,610	0	0	585	42,864	117,884
1992	PIE	0	2,070	0	0	0	2,500	21,658	1,800	0	0	11,462	0	103	2,873	0	6,744	0	0	0	9,055	58,265
1993	PIE	1,600	500	0	0	0	0	12,600	0	0	760	1,880	280	600	1,250	0	15,738	0	0	0	7,294	42,222
1994	PIE	0	0	0	0	0	0	4,173	0	0	0	1,012	280	1,220	0	0	970	0	0	6,500	0	14,155
GRAND TOTAL		**1,600**	**56,193**	**500**	**12,909**	**5,461**	**5,360**	**443,704.3**	**12,404**	**8,200**	**2,256**	**20,714**	**280**	**1,923**	**51,049**	**10,029**	**239,806**	**100**	**24,172**	**10,678**	**340,467**	**1,247,805**

Source: CITES Export Permit Information.

Table 7: Total Quantity (page 00) (Unknown Units - UNK), of Dried A. ferox Plant Parts Exported from South Africa to Importing Countries for the Period 1981 to 1994.

SUM OF QUANTITY		COUNTRY OF IMPORT							
YEAR	UNIT	BE	CA	CH	DE	NL	TW	US	GRAND TOTAL
1981	UNK	720	0	0	7,625	1,060	0	300	9,705
1982	UNK	0	5,699	0	10,320	630	0	0	16,649
1983	UNK	0	0	0	2,520	480	0	0	3,000
1984	UNK	0	2,500	66	4,420	1,400	0	0	8,386
1985	UNK	0	0	0	3,920	0	0	0	3,920
1989	UNK	0	0	0	3,300	0	0	0	3,300
1991	UNK	0	0	0	2,251	6,657	620	29,721	39,249
GRAND TOTAL		720	8,199	66	34,356	10,227	620	30,021	84,209

Source: CITES Export Permit Information.

Table 8: Total Quantity (page 00) (Cartons - CTN), of Dried *A. ferox* Plant Parts Exported from South Africa to Importing Countries (CTRY IMP) for the Period 1981 to 1994.

SUM OF QUANTITY		COUNTRY OF IMPORT					
YEAR	UNIT	ES	GB	JP	NL	US	GRAND TOTAL
1983	CTN	0	31	0	0	0	31
1984	CTN	0	0	0	0	57	57
1987	CTN	0	0	111	0	0	111
1990	CTN	0	0	30	0	0	30
1991	CTN	11	12	0	37	46	106
GRAND TOTAL		11	43	141	37	103	335

Source: CITES Export Permit Information.

c. Export of *Aloe ferox* Plants and Seeds

The export of plants and seeds does not represent a large industry and over the past 14 years only 75 grams of seed, two seeds and 2,868 individual plants have been reported as exported (Table 9). Only 50 plants were reported as wild-collected and the rest were marked as artificially propagated. In comparing these data to that in Table 10, which lists the international availability of *A. ferox* plants and seeds, it is interesting to note that in the Netherlands and United States seeds have been offered for sale in quantities up to 10,000 per container. German and British nurseries are offering lots of 1,000 seeds for sale. The amount of seed on the market far exceeds South Africa's total exports over the past 14 years, and the source of the seed is unknown. Furthermore, the low prices being charged for plants and seed indicates that supply is not restricted.

The exports of plants reported above contrast starkly with WCMC data presented by Oldfield (1992) which documents a trade in *A. ferox* plants averaging 12,585 live specimens per annum from 1983 through 1989. Comparison of WCMC data for that period with actual permits revealed inaccuracies caused by erroneous reporting within South Africa's CITES annual reports. For instance, many of the entries for live plants were in reality for dried plant pieces.

Table 9: Total Quantity of *A. ferox* Plants (LIV) and Seeds (SEE), in Units (UN) and Grams (G), Exported from South Africa for the Period 1981 to 1994.

IMPORT/ EXPORT	YEAR	SPECIES	TERM	QUANTITY	UNIT	COUNTRY	COUNTRY OF EXPORT	PERMIT NO	PURPOSE	SOURCE
E	1984	*A. ferox*	LIV	4.00	UN	US	ZA	052/1984	T	A
E	1985	*A. ferox*	LIV	6.00	UN	US	ZA	94/1985	S	A
E	1986	*A. ferox*	LIV	100.00	UN	JP	ZA	121/1986	T	A
E	1986	*A. ferox*	LIV	20.00	UN	AT	ZA	135/1986	T	A
E	1986	*A. ferox*	LIV	1.00	UN	JP	ZA	31/1986	T	A
E	1986	*A. ferox*	LIV	6.00	UN	AU	ZA	37/1986	T	A
E	1987	*A. ferox*	LIV	30.00	UN	JP	ZA	047/1987	T	A
E	1988	*A. ferox*	LIV	100.00	UN	IT	ZA	119/1988	T	
E	1988	*A. ferox*	LIV	1.00	UN	JP	ZA	173/1988	T	A
E	1989	*A. ferox*	LIV	2,500.00	UN	CH	ZA	121/1989	T	A
E	1989	*A. ferox*	LIV	10.00	UN	NA	ZA	143/1989	T	A
E	1989	*A. ferox*	LIV	7.00	UN	US	ZA	147/1989	T	A
E	1990	*A. ferox*	LIV	1.00	UN	JP	ZA	27/1990	S	A
E	1990	*A. ferox*	LIV	20.00	UN	IT	ZA	66/1990	T	A
E	1990	*A. ferox*	SEE	49.00	G	IT	ZA	134/1990	T	
E	1991	*A. ferox*	LIV	1.00	UN	US	ZA	125/1991	T	A
E	1991	*A. ferox*	SEE	26.00	G	IT	ZA	35/1991	T	A
E	1993	*A. ferox*	LIV	10.00	UN	DE	ZA	08761TA	T	A
E	1994	*A. ferox*	SEE	2.00	UN	DE	ZA	114/1994CP	T	A
E	1994	*A. ferox*	LIV	1.00	UN	NL	ZA	10863TP	T	A
E	1994	*A. ferox*	LIV	50.00	UN	NA	ZA	56/94CP	T	W

Source: CITES Export Permit Information.

Table 10: International Availability of *A. ferox* Plants and Seed.

CATNO	SPECIES	TYPE	UNITSIZE	SIZE	SOURCE	UNITSVOL	VOLUME	POTSIZE	PRICE (ZA Rand)	PRICE) (US$
1993GB19	*A. ferox*	SUP	UN		A				13.45	4.11
1993GB16	*A. ferox*	SUP	UN		U				5.38	1.65
1993GB10	*A. ferox*	SUL	UN		A				8.31	2.54
1994GB04	*A. ferox*	SUL	UN		U			5	8.16	2.30
1993GB15	*A. ferox*	SUL	UN		U			6	17.11	5.23
1994DD02	*A. ferox*	SUL	UN		U				2.74	0.77
1993NL01	*A. ferox*	SD	SD	10,000	U	B	1.00		14.06	4.30
1994DE02	*A. ferox*	SD	SD	23	U	PK	1.00		0.32	0.09
1994DE02	*A. ferox*	SD	SD	100	U	PK	1.00		0.96	0.27
1994DE02	*A. ferox*	SD	SD	1,000	U	PK	1.00		3.66	1.03
1994DD02	*A. ferox*	SD	SD	20	U	PK	1.00		0.37	0.10
1994DD02	*A. ferox*	SD	SD	100	U	PK	1.00		1.10	0.31
1994GB03	*A. ferox*	SD	SD	15	U	PK	1.00		1.09	0.31
1994GB03	*A. ferox*	SD	SD	100	U	PK	1.00		5.44	1.53
1993ZA08	*A. ferox*	SUL	UN		U				4.00	1.22
1993ZA08	*A. ferox*	SUL	UN		U				8.00	2.45
1993ZA04	*A. ferox*	SD	SD	1,000	U	PK	1.00		6.00	1.83
1993ZA07	*A. ferox*	SD	SD		W	PK	1.00		3.50	1.07
1993ZA07	*A. ferox*	SD	SD	100	W	PK	1.00		6.00	1.83
1994ZA03	*A. ferox*	SD	SD		U	PK	1.00		Free seed	
1994US01	*A. ferox*	SUL	UN		U				10.65	3.00
1994US17	*A. ferox*	SUL	UN		A				10.65	3.00
1994US29	*A. ferox*	SUL	UN		U			9	12.43	3.50
1994US09	*A. ferox*	SD	SD	1,000	U	B	1.00		16.87	4.75
1994US09	*A. ferox*	SD	SD	10,000	U	B	1.00		159.80	45.00
1994GB13	*A. ferox*	SD	SD	19	U	PK	1.00		1.09	0.31
1994GB13	*A. ferox*	SD	SD	100	U	PK	1.00		5.44	1.53

1994ZA08	*A. ferox*	SUL	UN		U				4.50	1.27
1994ZA09	*A. ferox*	SD	SD		W	PK	1.00		3.50	0.99
1994ZA09	*A. ferox*	SD	SD	100	W	PK	1.00		5.00	1.41
1992US01	*A. ferox*	SUL	UN		U				9.98	3.50
1992US01	*A. ferox*	SUL	UN		U				15.68	5.50
1992US01	*A. ferox*	SUL	UN		U				21.38	7.50
1992US01	*A. ferox*	SUL	UN		U				28.51	10.00
1992US01	*A. ferox*	SUL	UN		U				42.76	15.00
1994GB15	*A. ferox*	SD	SD		W	PK	1.00		10.88	3.06
1994GB15	*A. ferox*	SD	SD	100	W	PK	1.00		16.32	4.60
1994GB15	*A. ferox*	SD	SD	1.000	W	PK	1.00		32.64	9.19
1994NL03	*A. ferox*	SUL	UN		U			9	13.64	3.84
1987ZA01	*A. ferox*	SUL	UN		U				2.00	0.98
1987ZA01	*A. ferox*	SUL	UN		U				5.00	2.45
1986ZA02	*A. ferox*	SUL	UN		U				1.50	0.66
1986ZA02	*A. ferox*	SUL	UN		U				3.00	1.32
1991US01	*A. ferox*	SL OR SUL	UN		A				9.66	3.50
1994CS01	*A. ferox*	SD	SD	10	U	PK	1.00		0.49	0.14
1994CS01	*A. ferox*	SUL	UN		U				1.24	0.35
1994CS02	*A. ferox*	SUL	UN		U				5.33	1.50

Source: TRAFFIC Network.

KEY TO COLUMN ABBREVIATIONS:

CATNO: 1994US01 = year in which price offered/country code/information source number

SPECIES: Scientific name of plant

TYPE: SL=Seedling; SD=Seed; SUP=Succulent Plant; CAU=Plant with Caudex; SUS=Stem Succulent; SUL=Leaf Succulent.

UNIT SIZE: UN=Unit (Single item); SD=Seed

SIZE: Size of plant in centimetres

SOURCE: U=Unknown; A=Artificially Propagated; W=Wild-collected

UNITSVOL: Volume of pot or type of container e.g. PK=packet; B=box

VOLUME: Either volume of container or number of plants/unit on offer

POTSIZE: Diameter of pot in centimetres

PRICE (ZARand): prices in ZA Rand

PRICE (US$)): prices in United States of America Dollars

Table 11: Imports of *A. ferox* and *Aloe spp.* from South Africa as Reported by Importing Countries for the Period 1982 to 1991.

IMPORT/ EXPORT	YEAR	APP	SPECIES	TERM	QUANTITY	UNIT	COUNTRY	COUNTRY EXPORT	COUNTRY OF ORIGIN	PURPOSE OF IMPORT	SOURCE
I	1982	2	*Aloe spp.*	FLO	241	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	EXT	2,450	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	EXT	4,000	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	EXT	5,000	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	EXT	5,000	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	EXT	5,000	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	LIV	2	CAR	ZA		JP	T	
I	1983	2	*Aloe spp.*	LIV	300	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	LIV	3,000	kg	ZA		JP	T	
I	1983	2	*Aloe spp.*	LIV	5,000	kg	ZA		JP	T	
I	1984	2	*A. ferox*	LIV	4	UN	ZA		US	T	A
I	1985	2	*Aloe spp.*	EXT	100	kg	FR	ZA	JP	T	
I	1985	2	*Aloe spp.*	EXT	150	kg	FR	ZA	JP	T	
I	1985		*Aloe spp.*	EXT	150	kg	FR	ZA	JP	T	
I	1985	2	*Aloe spp.*	EXT	150	kg	FR	ZA	JP	T	
I	1985	2	*A. ferox*	EXT	5,000	kg	ZA		JP	T	
I	1985	2	*A. ferox*	LIV	6	UN	ZA		US	T	A
I	1986	2	*Aloe spp.*	EXT	200	kg	FR	ZA	JP	T	
I	1986	2	*Aloe spp.*	EXT	200	kg	FR	ZA	JP	T	
I	1986	2	*Aloe spp.*	EXT	240	kg	FR	ZA	JP	T	
I	1986	2	*Aloe spp.*	EXT	300	kg	FR	ZA	JP	T	
I	1986	2	*Aloe spp.*	EXT	500	kg	FR	ZA	JP	T	
I	1986	2	*Aloe spp.*	EXT	500	kg	FR	ZA	JP	T	
I	1987	2	*Aloe spp.*	EXT	20	kg	FR	ZA	JP	T	
I	1987	2	*Aloe spp.*	EXT	30	kg	FR	ZA	JP	T	
I	1987	2	*Aloe spp.*	EXT	30	kg	FR	ZA	JP	T	
I	1987	2	*Aloe spp.*	EXT	200	kg	FR	ZA	JP	T	
I	1987	2	*Aloe spp.*	EXT	300	kg	FR	ZA	JP	T	
I	1987	2	*Aloe spp.*	EXT	300	kg	FR	ZA	JP	T	
I	1987	2	*A. ferox*	EXT	4	CAR	ZA		JP	T	
I	1987	2	*A. ferox*	EXT	5,000	kg	ZA		JP	T	
I	1987	2	*A. ferox*	EXT	5,000	kg	ZA		JP	T	
I	1987	2	*A. ferox*	EXT	6,023	kg	ZA		JP	T	
I	1987	2	*A. ferox*	EXT	7,371	kg	ZA		JP	T	

I	1987	2	*A. ferox*	EXT	18,000	kg	ZA		JP	T	
I	1988	2	*Aloe spp.*	LIV	300	kg	FR	ZA	JP	T	
I	1988	2	*A. ferox*	LIV	740	kg	ZA		JP	T	A
I	1988	2	*A. ferox*	LIV	2,001	kg	ZA		JP	T	A
I[2]	1988	2	*A. ferox*	LIV	18,000	kg	ZA		JP	T	A
I[2]	1988	2	*A. ferox*	LIV	18,000	kg	ZA		JP	T	A
I	1988	2	*A. ferox*	LIV	5,000	kg	ZA		JP	T	A
I[3]	1988	2	*A. ferox*	LIV	180	PIE	ZA		US	T	A
I	1989	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	100	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	250	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	280	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	300	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	300	kg	FR	ZA	JP	T	
I	1989	2	*Aloe spp.*	LIV	350	kg	FR	ZA	JP	T	
I[4]	1989	2	*A. ferox.*	LIV	6,453	kg	ZA		JP	T	
I[5]	1989	2	*A. ferox.*	LIV	1,994	kg	ZA		JP	T	
I[5]	1989	2	*A. ferox.*	LIV	2,101	kg	ZA		JP	T	
I	1989	2	*A. ferox*	LIV	5,000	kg	ZA		JP	T	
I[5]	1989	2	*A. ferox*	LIV	5,035	kg	ZA		JP	T	
I	1990	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	50	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	300	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	300	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	300	kg	FR	ZA	JP	T	P
I	1990	2	*Aloe spp.*	LIV	350	kg	FR	ZA	JP	T	P
I	1990	2	*A. ferox*	EXT	50	kg	ZA		JP	T	W
I[6]	1990	2	*A. ferox*	EXT	1,065	kg	ZA		JP	T	W
I[7]	1990	2	*A. ferox*	EXT	5,000	kg	ZA		JP	T	W
I	1990	2	*A. ferox*	EXT	6,992	kg	ZA		JP	T	W
I	1990	2	*A. ferox*	EXT	18,000	kg	ZA		JP	T	W
I[8]	1991	2	*A. ferox*	DPL	1.6	kg	ZA		US	T	W

KEY TO COLUMN ABBREVIATIONS:
APP: CITES Appendix. **SPECIES:** Scientific name of plant. **TERM:** EXT = Extract; DPL=Dried Plant; LIV=Live Plant.. **UNIT:** kg = kilograms; CTN = Cartons; PIE = Pieces; UN = Single Unit. **PURPOSE:** T = Trade
SOURCE: W = Wild-collected; A = Artificially Propagated; P = Unknown, but assumed to be Propagated

[2] this permit replaced by permit number 38/88 by CNC but still untilised for export
[3] reported as live (LIV) but according to permit is dreid plant material (DPL); reported as 1 shipment (SHP) but is actually 180 pieces (PIE).
[4] reported as live (LIV) but according to permit is extract (EXT); no units noted by importer by are reported as TINS on permit and has been converted to kg as follows 239 tins* 27kg = 6453kg
[5] as with other permits these three examples have been reported as live (LIV) but according to permits are extract (EXT)
[6] not reported by CNC as an export; CNC permit sequence ends at 163/90.
[7] reported as 3500kg by CNC but as 5000kg by importing country. In addition the permit states the destination as Italy however, Japan reports the import
[8] reported as live (LIV) but according to permit is dried plant material (DPL); reported as 4 in QTY column by importing country but is actually 1.6kg of vases on permit

4. Exports from South Africa Reported by Importing Countries

While analysing data obtained from WCMC for all countries reporting imports of *A.ferox* and *Aloe spp.* parts and derivatives (Table 11) it became apparent that importing countries often recorded *A ferox* as *Aloe spp.* in their annual reports. Given this obfuscation certain assumptions were made to standardise the data before calculating the total trade volumes given in this section.

Thus in calculating total crystalline bitters volumes reported by importers, all figures with kilogram units declared as EXT and LIV were added together to give a trade total for crystalline bitters for both South Africa and France. Summarised data, taking into account the above assumptions*, of trade in *A. ferox* and *Aloe spp.* derivatives as reported by importing countries (namely Japan and the United States of America) are given in Table 12. A year-by-year breakdown of South Africa's exports to Japan and the United States of America are given in Table 13.

The approximately 172 tons of extract (kg EXT plus kg LIV), reported as imports from South Africa during the period 1982 to 1991 (Table 12 and 13), is a small proportion of South Africa's actual exports for the same period (Table 3). One possible reason for this under-reporting could be that many countries do not regard crystalline bitters as 'readily recognisable' and therefore do not subject it to CITES controls. It is surprising that Germany did not report any trade with South Africa as that country is normally strict about reporting derivative imports. Germany is South Africa's largest *A. ferox* derivative trading partner.

In Table 11 and 12 it can be seen that France reported re-exporting approximately 6.9 tons (kg LIV plus kg EXT), generally in 50 to 300 kg lots, of extract to Japan. These shipments could not be compared to South Africa's export data, however, it could be added to Japan's imports bringing that country's total to approximately 685 tons over 14 years. From these data it appears that when *A. ferox* was exported to Japan from France, the former reported the transaction, however, when South Africa exported directly to Japan the latter country rarely reported the South African export permit numbers in their annual report. This made checking for mistakes difficult and the data is considered incomplete.

Table 12: Total Quantity of *A. ferox* and *Aloe spp.* Parts and Derivatives Exported from South Africa (ZA) and France (FR), as Reported by Japan and United States of America for the Period 1982 to 1991.

SUM OF QUANTITY			UNITS		
COUNTRY OF EXPORT	TERM	CARTON	kg	SHIPMENT	UNIT
FR	EXT	0	3,370	0	0
	LIV[a]	0	3, 530	0	0
ZA	DPL	0	1.6	0	0
	EXT	4	114,534	0	0
	FLO	0	241	0	0
	LIV[a]	2	57,041	1	10

Source: WCMC data.

[a]Marked LIV but assumed to be kilograms of extracts (EXT)

*Assumptions: a) Under 'SPECIES' column all entries labelled with the generic term '*Aloe spp*' were removed unless followed in the 'TERM' column by the codes 'EXT' (extract), DPL' (dried plant), 'FLO' (flower) or 'DER' (derivative). The term 'DER' (derivative) was assumed to mean extract (EXT) and entries have been changed to the latter term b) Under the 'TERM' column if the term 'LIV' appeared the entry was retained if followed in the 'UNITS' column by the units 'kg' (kilogram), 'PIE' (pieces) or 'CAR' (cartons) as these terms are often used to refer to *A. ferox* parts and derivatives.

Table 13: Total Quantity of *A. ferox* and *Aloe spp.* Parts and Derivatives Exported by South Africa, as Reported by Japan and United States of America, for the Period 1982 to 1991.

SUM OF QUANTITY		TERM, UNIT							
		DRIED PLANT (DPL)	EXTRACT (EXT)		DRIED FLOWERS (FLO)	LIVE PLANTS (LIV)			
CTRY TRADE	YEAR	kg (CAR)	CARTONS	kg	kg	CARTONS (CAR)	kg	SHIPMENT (SHP)	UNITS (UN)
JP	1982	0	0	0	241	0	0	0	0
	1983	0	0	21,450	0	2	8,300	0	0
	1985	0	0	5,000	0	0	0	0	0
	1986	0	0	0	0	0	0	0	0
	1987	0	4	41,394	0	0	0	0	0
	1988	0	0	0	0	0	43,741	0	0
	1989	0	0	0	0	0	20,583	0	0
	1990	0	0	31,107	0	0	0	0	0
JP Sum		0	4	98,951	241	2	72,624	0	0
US	1984	0	0	0	0	0	0	0	4
	1985	0	0	0	0	0	0	0	6
	1988	0	0	0	0	0	0	1	0
	1991	1.6	0	0	0	0	0	0	0
US Sum		1.6	0	0	0	0	0	1	10
GRAND TOTAL		1.6	4	98,951	241	2	72,624	1	10

Source: WCMC data.

C. Pricing Structure of Aloe Products

1. Aloe Bitters – Crystalline (lump)

While the Gouritz valley is recognised as having the best quality aloe product there is competition from other producer countries, for example the United States of America, which limits the prices that can be demanded from the market place. Export amounts are typically of the order of one to ten tons. According to some South African traders, the extract is sometimes re-exported to South Africa, however, no indication of this has been detected in CITES permits.

The prices paid for aloe bitter extract varies widely depending on the source, the quality, the manner in which it is dried and the skill of the seller in negotiating a competitive price. Fees (26% to 40% if applicable) charged by landowners and agents must be subtracted from the tappers' gross income determined using the figures quoted below.

As can be seen from Tables 15 and 16, a premium price is obtained for extract originating in the districts surrounding Albertinia, Buysplaas, Herbertsdale and van Wyksdorp. This premium is to be expected as importing countries demand the high aloin content extract found in the above mentioned areas. The lower price paid for Port Elizabeth, Uniondale, Karroo, Oudtshoorn and Somerset East extract reflects its lower aloin content.

During the period 1980 to 1985, CNC permit records showed that exports of extract were based on the receipt of 62 consignments from Albertinia, 32 from Herbertsdale, 14 from Port Elizabeth (including Swartkops), seven from Uniondale, six from Oudtshoorn, five from van Wyksdorp, four from Somerset East, and one from an unidentified Karroo source. Over this period, Albertinia contributed over 53% of all extract sold to exporters. The three areas supplying best quality extract, namely, Albertinia, Herbertsdale and van Wyksdorp contributed over 84% of the extract sold to exporters (Table 14). It must be noted that the extract is not necessarily exported immediately and parts of consignments received from agents/tappers during the year are used to make up export orders dispatched in the same or following seasons. From 1986 onwards, price information was difficult to obtain possibly because of an increase in competition between dealers and their need to keep price details confidential.

The skill required for negotiating a price is obvious when one considers the price paid by various traders for 'Bitter Aloe' blocks brought in by casual tappers. At a time when the expected price for extract was R7.00 (US$ 2.46) to R7.50 (US$ 2.63) per kg (1992/1993), one trader in the region stated that he was paying R5 (US$ 1.75) per kg. The same trader claimed that he obtained R9.50 (US$ 3.33) per kg for the same crystalline bitters from the exporter. With the collapse of the market in June 1994, the price being paid ranged from R0.75 (US$ 0.21) per kg to R4.50 (US$ 1.27) per kg. Another agent claimed that in 1985 he was paying R1 (US$ 0.45) per kg crystalline bitters when the expected rate was R3 (US$ 1.35) to R4 (US$ 1.79) per kg. The same agent, however, was paying R7 (US$ 2.46) per kg in 1992 which was the same as the expected rate of that time.

Another agent claimed that the total tonnage that could be sold in one year was 105 tons and complained that the rest had to be stored; in this way he managed to keep the price paid to tappers to a minimum. A landowner in the Albertinia district, however, stated that 15 years ago (1979) he used to pay tappers R3 (US$ 3.57) per kg (Muller, pers. comm., 1994), when the average price was approximately R1 (US$ 1.19) per kg. In contrast an agent stated that, up until the leaf miner plague wiped out many plants in Herbertsdale in the early 1990s, he paid R2,50 (US$ 0.95) per kg, but during the 1992/1993 season tappers were being paid R7,50 (US$ 2.63) per kg. This person maintains that the

Table 14: Volumes (kg) of *A. ferox* Extract Sold to Exporters and Prices (ZA Rands and US$) Obtained by Agents and Aloe Tappers from Exporters Normally Associated With the Export Trade.

VOLUME AND PRICE		YEAR						
LOCATION		1980	1981	1982	1983	1984	1985	GRAND TOTAL
ALBERTINIA	Volume (kg)	7,341.60	106,286.80	62,861.70	34,477.14	4,417.20	17,325.80	232,710.24
	Price (ZA Rand)	11,745.76	158,419.20	96,913.30	65,321.98	12,099.00	53,638.85	398,138.09
	Price (US$)	15,058.67	180,021.81	88,911.28	58,848.63	8,175.00	24,053.30	375,068.69
HERBERTSDALE	Volume (kg)	0	75,447.80	15,658.00	19,536.00	6,460.00	11,993.00	129,094.80
	Price (ZA Rand)	0	105,951.00	23,767.10	38,656.10	19,588.00	47,972.00	235,934.20
	Price (US$)	0	120,398.86	21,804.68	34,825.32	13,235.14	21,512.11	211,776.11
KARROO ALOES	Volume (kg)	0	3,124.00	0	0	0	0	3,124.00
	Price (ZA Rand)	0	3,905.00	0	0	0	0	3,905.00
	Price (US$)	0	4,437.50	0	0	0	0	4,437.50
OUDTSHOORN	Volume (kg)	930.80	2,325.60	0	0	0	5,686.40	8,942.80
	Price (ZA Rand)	930.80	2,409.10	0	0	0	13,078.72	16,418.62
	Price (US$)	1,193.33	2,737.61	0	0	0	0	3,930.94
PORT ELIZABETH (P.E.)	Volume (kg)	8,460.10	2,013.20	2,717.00	0	0	0	13,190.30
	Price (ZA Rand)	7,505.46	1,811.88	3,396.25	0	0	0	12,713.59
	Price (US$)	9,622.38	2,058.95	3,115.83	0	0	0	14,797.16
SWARTKOPS (P.E.)	Volume (kg)	5,896.20	5,175.80	0	0	0	0	11,072.00
	Price (ZA Rand)	5,601.39	4,658.22	0	0	0	0	10,259.61
	Price (US$)	7,181.27	5,293.43	0	0	0	0	12,474.70
UNIONDALE	Volume (kg)	0	22,612.00	9,407.00	0	0	0	32,019.00
	Price (ZA Rand)	0	29,191.10	13,894.30	0	0	0	43,085.40
	Price (US$)	0	33,171.70	12,747.06	0	0	0	45,918.76
VAN WYKSDORP	Volume (kg)	1,149.60	449.20	343.70	319.60	0	0	2,262.10
	Price (ZA Rand)	1,838.84	718.72	532.74	607.24	0	0	3,697.54
	Price (US$)	2,357.49	816.73	488.75	547.06	0	0	4,210.03
GRAND TOTAL	**Volume (kg)**	23,778.30	217,434.40	90,987.40	54,332.74	10,877.00	35,005.20	432,415.04
	Price (ZA Rand)	27,622.25	307,064.10	138,504.00	104,585.30	31,687.00	114,689.60	724,152.25
	Price (US$)	35,413.14	348,936.47	127,067.88	94,220.99	21,410.14	51,430.31	678,478.93

Source: Cape Nature Conservation.

Table 15: Average Prices Paid, in ZA Rand (US$), for *A. ferox* Bitter Crystals from Various Sources by Exporters to Agents and Tappers Over the Period 1980 to 1985 and 1992 to 1994.

AVERAGE PRICE IN ZA RAND (US$)/kg	YEAR								
LOCATION	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1992**	**1993**	**1994**
ALBERTINIA	1.60 (2.05)	1.53 (1.74)	1.51 (1.39)	2.01 (1.81)	2.70(1.82)	3.41 (1.53)	6.00 (2.10)	7.75 (2.37)	9.00 (2.54)
BUYSPLAAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00 (2.14)	0.00
HERBERTSDALE	0.00	1.42 (1.61)	1.53 (1.40)	1.98 (1.78)	3.00(2.03)	4.00 (1.79)	0.00	7.50 (2.29)	8.75 (2.46)
KARROO ALOES	0.00	1.25 (1.42)	0.00	0.00	0.00	0.00	0.00	0.00	0.0
OUDTSHOORN	1.00 (1.28)	1.03 (1.17)	0.00	0.00	0.00	2.30 (1.03)	0.00	0.00	0.00
PORT ELIZABETH	0.86 (1.10)	0.90 (1.02)	1.25 (1.15)	0.00	0.00	0.00	0.00	0.00	0.00
PORT ELIZABETH	0.95 (1.22)	0.90 (1.02)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SWARTKOPS									
SOMERSET EAST,	0.00	0.93 (1.06)	1.15 (1.06)	0.00	0.00	0.00	0.00	0.00	0.00
EAST LONDON									
UNIONDALE	0.00	1.27 (1.44)	1.45 (1.33)	0.00	0.00	0.00	0.00	0.00	0.00
VAN WYKSDORP	1.60 (2.05)	1.60 (1.82)	1.55 (1.42)	1.90 (1.71)	0.00	0.00	0.00	0.00	0.00

Source: Cape Nature Conservation.

Table 16: Maximum Prices, in ZA Rand (US$) Paid for A. ferox Bitter Crystals from Various Sources by Exporters to Agents and Tappers Over the Period 1980 to 1985 and 1992 to 1994 [10]

MAXIMUM PRICE IN ZA RAND (US$)/kg	YEAR								
LOCATION	1980	1981	1982	1983	1984	1985	1992	1993	1994
ALBERTINIA	1.6 (2.05)	1.9 (2.16)	1.7 (1.56)	2.3 (2.07)	2.8 (1.89)	4 (1.79)	7(2.46)	8.5 (2.60)	9 (2.54)
BUYSPLAAS	0	0	0	0	0	0	0	7 (2.14)	0
HERBERTSDALE	0	1.5 (1.70)	1.6 (1.47)	2.2 (1.98)	3.7 (2.50)	4 (1.79)	0	7.5 (2.29)	9.5 (2.68)
KARROO ALOES	0	1.25 (1.42)	0	0	0	0	0	0	0
OUDTSHOORN	1 (1.28)	1.1 (1.25)	0	0	0	2.3 (1.03)	0	0	0
PORT ELIZABETH	0.95 (1.22)	0.9 (1.02)	1.25 (1.15)	0	0	0	0	0	0
PORT ELIZABETH, SWARTKOPS	0.95 (1.22)	0.9 (1.02)	0	0	0	0	0	0	0
SOMERSET EAST, EAST LONDON	0	0.95 (1.08)	1.2 (1.10)	0	0	0	0	0	0
UNIONDALE	0	1.4 (1.60)	1.5 (1.38)	0	0	0	0	0	0
VAN WYKSDORP	1.6(2.05)	1.6 (1.82)	1.55 (1.42)	1.9 (1.71)	0	0	0	0	0
HIGHEST PRICE PAID[11]	1.6(2.05)	1.9 (2.16)	1.7 (1.56)	2.3 (2.07)	3.7 (2.50)	4 (1.79)	7(2.46)	8.5 (2.60)	9.5 (2.68)

Source: Cape Nature Conservation.

[10] If these prices were paid to an intermediate agent or general dealer by an exporter then it can be expected that the price obtained by tappers from the agent would be anything from approximately 26%to 40% lower than the quoted price due to commission.

[11] this price excludes that paid for spray-dried aloe bitters which fetches a premium over the field dried aloe extract.

plague helped get the industry back onto its feet because the shortage of crystalline bitters helped to drive up the price. However, one of the largest exporters reported that the decrease in demand over that period was due to the German market temporarily switching to alternative plant extracts such as rhubarb. These examples demonstrate the variation in market structure, attitudes and norms.

In comparison to South Africa, in the Baringo area of Kenya, local people are paid 20 Kenyan Shillings per 20 litres of liquid extract (1 UK Sterling = Ksh 66 = ZA Rand 5.50 (Oldfield, 1992)). Assuming that the liquid has to be reduced by two thirds to produce crystalline bitters the price expected per kilogram of extract in 1992 would have been about R0.82 (US$ 0.29), a low price rarely paid in South Africa by pharmaceutical wholesalers. It must be noted that this low price is partly due to the lower bitters content of the Kenyan aloe sap.

The price for *A. ferox* extract in January 1993 was R7.50 (US$ 2.29) per kg. Therefore, the maximum potential income for Herbertsdale tappers producing 151,200 kg extract was R1,134,000 (US$ 346,788.99). However, after a 33% landowner's commission had been deducted only R748,440 (US$ 228.88) remained for distribution to the work-force. The net income per person (40 person workforce) is approximately R18,700 (US$ 5,718.65) before costs of provisions and transport are subtracted. If it is assumed that each expedition leads to a retail transaction of R30,000 (US$ 9,174.31)then total costs for seven expeditions per annum are R210,000 (US$ 64,220.18) and the earnings per person is reduced to about R13,461 (US$ 4,116.51). If the agent charges R1 (US$ 0.31) per kg for transport costs then net annual income is reduced to R9,681 (R10,000 or US$ 3,058.10) which is slightly above South Africa's per capita income of approximately R700 (US$214) per month.

It must be borne in mind that this income is not uniform especially during periods of drought when tappers cannot harvest and therefore do not earn a wage. For instance during the 1992/1993 season, the Herbertsdale community could not work for three months due to extended drought. This long period without income aggravated the discontent generated by the never ending debt crisis caused by agents through the marketing structure. The tappers maintained that by eliminating agents they could increase their income and hence avoid being caught out during drought years.

The Herbertsdale tappers proved this contention during 1994 when a large proportion bypassed their normal agent and sold their product directly to the primary agent supplying exporters. Aloe tappers reported that although the landowner's commission had to be paid, savings were made on transport, food and their former agent's commission. Transport was arranged with individual landowners and costs were based on distance travelled rather than on a percentage of production.

In addition, the tappers received R9.50 (US$ 2.68) per kg from the exporter's agent who also informed them that the demand for crystalline bitters at that time was unlimited which is contrary to what they had been told in the past. The potential gross income for the Herbertsdale community increased during 1994 to R1,436,400 (US$ 404,619.71), after landowner's commission (33%) to R958,078, (US$ 269,881.12) after transport costs to R946,878 (US$ 266,726.19) and after food and running expenses to R918,878 (US$ 258,838.87) which translates into an annual per capita income of R22,972 (US$ 6,470.99), an increase of over 100%. However, this is a market that is susceptible to periodic fluctuation. The latest being a June 1994 collapse in demand due to a health scare caused by a German academic announcing that aloe bitters are damaging to human mucus membranes (Newton, 1994). This slump consequently decreased the income earned by all sectors associated with the export market.

During 1992/1993, the 40 tappers of Buysplaas, although paid a lower rate of R7 (US$ 2.46) per kg, were charged 33% commission and approximately R210,000 (US$ 73,684.21) for living expenses,

they made their own travel arrangements thus keeping costs down. Although their transport costs are not known their estimated annual per capita income, based on 150 tonne per annum production, was R12,000 (US$ 4,210.53). Tappers throughout this region benefited from higher prices in 1994 and income would also have increased but without details of their agents, transport and food costs it is not possible to calculate this figure accurately.

The retail price of extract on domestic markets varies according to the traders position in the market hierarchy. Pharmacies in South Africa trade an estimated 11.4 tons per annum at prices given in Table 17. The recommended retail price for a 25g pack of powder was R3.30 (US$ 0.93), and R2.30 (US$0.65) for a 15g pack of lump (Brown, 1994). For aloe lump, this converts to R153 (US$ 43.10) per kg representing a 1700% increase from the January 1994 price of R9 (US$ 2.54) per kg paid to tappers. However, no single operation receives this profit and pharmacies receive only a 30% to 50% mark-up on the price they pay to the wholesaler. Potential income to South African pharmacies (assuming 30% mark-up) based on sales of 11,400 kg lump is a conservative R523.260 (US$ 147,397.18) per annum. After paying Value Added Tax (VAT) to the government this is reduced to R450,003 (US$ 126,761.40).

Table 17: Price Structure, in ZA Rands (US$) of a Wholesaling Supplier to the Pharmacy Trade

PRODUCT	COST	TRADE	RECOMMENDED RETAIL PRICE
15g lump	R1,45 (0.41)	R1,77 (0.50)	R2,30 (0.65)
25g lump	R1,38 (0.39)	R1,97 (0.55)	R2,95 (0.83)
25g Powder	R1,54 (0.43)	R2,20 (0.62)	R3,30 (0.93)

Source: Brown (1994)
Note: Prices include 14% VAT

Overall, wholesale companies packaged 3,111 kg aloe lump and 1,931 kg aloe powder during 1994. The price paid to tappers for lump was reported to be R6 (US$ 1.69) per kg but the cost of packaging lump was claimed by wholesalers to be R97 (US$ 27.32) per kg (Table 17) which seems high considering that no processes other than re-packaging are necessary. If it is sold to pharmacies at R118 (US$ 33.24) per kg, then the retail transaction on production of 5,042 kg is R105,882 (US$ 29,825.92) per annum but is likely to be higher given that production costs appear to be inflated.

Pharmaceutical packaging industry's were reluctant to disclose production volumes or prices. One company reported packaging 90 kg of crystalline bitters on a monthly basis which converts to an annual production of 1,080 kg. The percentage mark-up by the company depends on the buy-in price. Individual suppliers were more open about their dealings and were paying tappers between R0.75 (US$ 0.21) and R3.00 (US$ 0.85) per kg to tappers, depending on quality, and receiving R8 (US$ 2.25) to R9 (US$ 2.54) per kg for lump and R11 (US$ 3.10) per kg for powder from wholesalers (Brown, 1994). The low price of R0.75 (US$ 0.21) raises speculation as to whether this extract may not originate from Kenya. However, there is no evidence to support this argument, indeed the cost of transporting the product to South Africa could discourage such trade. As most of these suppliers seem to export a large proportion of their stock, it is not possible to calculate the portion of their income generated by national consumption, although the tonnage sold may be expected not to exceed that sold by pharmacies. Similarly, as price details for export are not available it is not possible to calculate income due to that activity.

2. Crystalline Bitters - Powdered by Spray Drying

During 1992, the estimated production of powdered bitters amounted to 1,000 kg and at the going rate of R12 (US$ 4.21) per kg this would result in a net income of R12,000 (US$ 4,210.53). In contrast to this, CITES export data shows that during 1992, 1,107 kg of powder was exported to the United States.

3. Aloe Gel

According to Muller (pers. comm., 1994) sales of *A. ferox* gels are reported to be increasing slowly now that technical problems in the South African industry have been solved. In 1993, tappers or landowners sold leaves to the gel processing industry for approximately R50 (US$ 15.29) to R80 (US$ 24.46) per tonne, earning themselves at least R1,650 (US$ 504.59) to R2,640 (US$ 807.34) per annum. According to Pettitt (pers. comm., 1993), approximately two tons of leaves yields 1 kg gel powder. During 1992, a production unit operating at one-third capacity, used between 15 and 33 tons leaves for processing (Botha, *in litt.*, 1992(a)). During 1991, it was estimated that 100 tons of leaf was salvaged for processing, but apparently not all was used for gel manufacture. When leaf is available it is possible for South African manufacturers, at present production levels, to produce two kg of gel per day (Pettitt, pers. comm., 1993) and, up to 50 kg per annum (Botha, *in litt.*, 1992(a)). Based on the production estimates given above approximately 100 tons of leaf is utilised per annum.

Muller (pers. comm., 1994) reported that *A. ferox* gel powders are approximately seven times more concentrated than imported *A. vera* powders and can be diluted. *Aloe ferox* plants also contain more gel than *A. vera*, thus extraction is more cost-efficient and prices can be reduced to approximately half that of *A. vera* (R500 (US$ 140.85) per kg vs. R1,000 (US$ 281.69) per kg) and still remain competitive. During 1992, the price for dried aloe gel powder was R600 (US$ 210.53) per kg and total income for 50 kg of production was R30,000 (US$ 10,526.32). Production volumes in 1992 were insignificant in comparison with crystalline bitters production.

Production volumes and prices obtained for packaged tertiary products are not available, however, utilising the industry standard that 5.6 parts carrier is mixed with 1 part genuine gel powder (85% carrier (ml): 15% aloe gel (grams)), some estimates of product mark-up can be calculated. A bottle of cleansing cream was advertised during 1992/1993 at R12.60 (US$ 4.42) per 250 ml. The estimated content of genuine gel powder is therefore 37.9 grams, and without taking production and packaging costs into account the price per kilogram is R332.45 (US$ 93.65) which is apparently below normal gel production costs. However, the main mark-up appears to be on the smaller volume products, for instance a 50 ml bottle of night cream selling for R17.50 (US$ 4.93) contains 7.58 g gel and this converts to a per kg price of R2,309 (US$ 650.42) which is almost 400% above the normal selling price of *A. ferox* gel and about 200% above that of *A. vera*.

4. Dried Aloe Pieces

Items made from dried aloe stems and other parts are found on sale throughout the production area and during 1992/1993 were reported to sell for between R2 (US$ 0.70) and R8 (US$ 2.81) depending on the size of the section which varied between 5 cm (2") and 25.4 cm (10"). During a brief market survey conducted during 1994 varnished trunk sections mounted on varnished tree trunk or thin wooden bases were observed to be retailing for between R1.90 (US$ 0.54) and R2.80 (US$ 0.79) for 5 cm sections; R6.80 (US$ 1.92) and R7.10 (US$ 2.00) for 12 cm sections; R10.10 (US$ 2.85) for 20

cm sections and R19.80 (US$ 5.58) for 5 cm section mounted on 5 cm length of tree trunk. The wholesale prices paid by exporters for unprocessed aloe trunks are given in Table 18. Other items of dried aloe sold wholesale to exporters, during the period 1983 to 1986, are Ringleaf (R0.045 (US$ 0.025) per item); Coppercurls Medium and Large (R0.049 (US$ 0.028) and R0.06 (US$ 0.03) per item respectively) and Aloe Leaf (30.48 cm and 38.1 cm lengths at R0.035 (US$ 0.020) and R0.04 (US$ 0.02) per item respectively). The quantities of parts sold on the South African market was not determined and income from this sector was not calculated.

An export market exists and during 1993 it was reported that dried trunk segments were priced at approximately US$4 per 25,4 cm section in the United States. The number of dried aloe pieces exported during 1981 to 1994 was 340,467 and the estimated income from international trade, assuming a constant US$ 2 per item, is US$681,000 or approximately R2,383,269

5. International Consumer Market Prices

Oldfield (1992) reported that attempts to obtain accurate price data were frustrated by variation in published figures, lack of response to enquiries and the nature of aggregated data for international trade in drug products.

Similarly, in South Africa nobody was able or willing to disclose the prices obtained from importing countries. Conflicting opinions about the ease of finding a market for aloe products were encountered with some agents saying that the market can absorb all production while others stated that the maximum amount the exporters can take is restricted to ten tons per six week cycle. This latter agent said he had tried to raise the price but that the market was very sensitive and, if the price went too high, then importers switched to alternatives, especially Kenyan aloe products. The same agent said that production in his area was approximately 15 tons crystalline bitters per six week cycle or approximately 105 tons per annum. The researchers discovered subsequently that this area produces at least 150 tons per annum and the agent was possibly trying to downplay activity to justify his place in the market. Furthermore, in justifying his high profit margin, he claimed that the aloe export business is risky because overseas traders are sometimes unreliable payers with the result that he has to have sufficient capital to carry the bad debt.

6. Commission to Landowners

Commissions are normally 33% of the gross sale price but, depending on conditions in the field and yield, can range from 26% to 40% and higher. Some landowners have bought extra land with the proceeds from the aloe industry (Muller, pers. comm., 1994).

D. Illegal Trade

One Albertinia based agent mentioned exporting three tons of crystalline bitters to Hong Kong during 1992, and according to Brown (1994), a Port Elizabeth-based company and an agent supplying wholesalers and pharmaceutical companies claimed that some stock was sold for the export market, but no quantities were given.

Furthermore, it has been claimed that individual farmers in the Port Elizabeth district export crystalline bitters in large quantities and that the estimated turnover could be 30 to 40 tons per month to the local and international markets combined (Brown, 1994). Assuming 20 tons per month is exported, this amounts to 240 tons per annum.

Table 18: Average Price (Rand) Paid by Exporters for Dried *A. ferox* Trunk Segments per Individual Section (1983 - 1986).

AVERAGE PRICE		DESCRIPTION				
DATE	SEGMENT 7.5CM	SEGMENT 10CM	SEGMENT 12.5CM	SEGMENT 15CM	SEGMENT 17.5CM	GRAND TOTAL
04-83	0.14 (0.08)	0.18 (0.10)	0.23 (0.13)	0.27 (0.15)	0.34 (0.19)	**0.23 (0.13)**
04-85	#N/A	0.22 (0.12)	0.28 (0.16)	0.33 (0.19)	0.40 (0.22)	**0.31 (0.17)**
07-85	0.16 (0.09)	0.22 (0.12)	#N/A	0.33 (0.19)	#N/A	**0.24 (0.13)**
08-85	0.16 (0.09)	0.23 (0.13)	0.29 (0.16)	0.33 0.19)	0.45 (0.25)	**0.27 (0.15)**
03-86	0.18 (0.10)	0.24 (0.13)	0.30 (0.17)	0.36 (0.20)	0.45 (0.25)	**0.31 (0.17)**
04-86	0.16 (0.09)	0.24 (0.13)	0.30 (0.17)	#N/A	0.45 (0.25)	**0.29 (0.16)**
08-86	0.18 (0.10)	0.24 (0.13)	0.30 (0.17)	0.36 (0.20)	0.45 (0.25)	**0.31 (0.17)**
GRAND TOTAL	**0.16 (0.09)**	**0.22 (0.12)**	**0.28 (0.16)**	**0.33 (0.19)**	**0.42 (0..24)**	**0.28 (0.16)**

Source: CNC Permit Data.
#N/A = Prices not available

A Grahamstown agent dealing in relatively small amounts of extract reported a turnover of approximately five tons of crystalline bitters per month (approximately 60 tons per annum). Apparently all his stock goes to the European export market (Brown, 1994). Similarly, another small trader from Port Elizabeth, although not interviewed, was alleged to supply only the export trade (Brown, 1994).

The undocumented trade for 1994 amounts to an estimated 300 tons. Research conducted into all the above mentioned instances revealed that no export permits had been issued for any of these companies, agents or individuals. Possible explanations are that traders sell directly to exporters who possess export permits or that they are unaware of, or ignore, South African provincial legislation and CITES measures and ship aloe products without formal documentation. If the former is true then at least part of the undocumented trade would be covered by the annual production estimate of 400 tons per annum thus reducing the severity of the illegal trade estimate. With limited available data it has not been possible to estimate the proportion of undocumented trade that is covered by legal exports.

Evidence supporting the existence of undocumented or illegal trade is that EC customs statistics shows that EC countries imported 66 tons per annum more crystalline bitters than examination of South African CITES permits revealed over the same period (1988 to 1991). Coincidentally, the quantity of *A. ferox* extract exports reported by South Africa in its annual reports from 1983 to 1989 as reported in Oldfield (1992), was approximately 1,370 tons. This is low compared to a total for the same period, compiled from examination of actual CITES permits, of 1,853 tons. This represents a reporting shortfall by South Africa of 483 tons during the seven year period or 66 tons per annum. South Africa therefore under-reported exports to the same level as EC customs data exceeded South Africa's permitted exports. The two data sets overlap for only two years so it is not possible to make further deductions about these data.

Possible explanations for under-reporting are:

- under-declaration of exports from South Africa,
- illegal export of extract from South Africa,
- mistaken entry and reporting of weight measurements by EC customs authorities,
- omission of CITES export permits by the South African Management Authority, during compilation of annual reports.

The possibility of undocumented exports has been raised by the National Botanical Institute in the past (Botha, *in litt.*, 1992(b)) and is supported in this report by the finding that an estimated undocumented export trade amounting to 300 tons *A. ferox* extract occurred during 1994.

PLANT TRADE REGULATIONS

A. Nature Conservation Regulations

With the establishment of the Union of South Africa in 1910, the responsibility for wildlife protection was mandated to the four provinces and this arrangement has remained virtually unchanged since (Glavovic, 1993 in Hilton-Taylor and Smith, 1994).

The export of plants indigenous to South Africa is controlled at national level by relevant sections of the provincial ordinances and at international level by CITES. CITES provisions are given legal standing at two levels in South Africa. Firstly, CITES is included in the Environmental Conservation Act (ECA) of 1989 through a clause referring to "International Conventions". CITES is not specifically referred to and there is doubt about whether this reference has legal standing. Secondly, CITES is incorporated in the Ordinances of the four former provincial Nature Conservation Authorities and the Department of Sea Fisheries. Each former province, plus the Department of Sea Fisheries, has it's own Management and Scientific Authority. The four provincial authorities are Cape Nature Conservation; The Chief Directorate Environmental Conservation - Orange Free State Nature Conservation; The Chief Directorate Environmental Conservation - Transvaal Nature Conservation and Natal Parks Board. Under South Africa's new political dispensation the responsibility to issue CITES permits remains .Rested with the four original formit issuing offices despite the fact that their provincial names here changed. The four offices are Free State Department of Environment Affairs and Tourism, Gauteng Department of Agriculture and Environment Affairs, KwaZulu Natal Parks Board and Western Cape Nature Conservation. The Department of Environment Affairs, based in Pretoria, acts as the co-ordinating body for all provincial Management Authorities and as chair of the CITES Working Group which meets on a regular basis to discuss CITES issues. It is not necessary for the group to meet in order to pass resolutions as this can be done by fax and mutual agreement (Bodasing and Mulliken, 1996).

The ECA consists of a body of legislation with various sections. The Provincial Ordinances (PO's) are supported by a number of schedules. Circumstances under which taxa and populations listed in the various schedules can be traded are given in the body of the Ordinances. Changes made to the CITES Appendices at CITES Conferences of the Parties are automatically taken up into each of the PO's except in the case of Natal where the schedule has to be specifically updated. Each province can make its ordinance more effective by adopting policy documents which are not included in the PO but are enforceable simply on a clause that the Director has the discretion to make policy binding (Bodasing and Mulliken, 1996).

According to CITES, all parts and derivatives of *A. ferox* are subject to the terms of the Convention except seeds and pollen; and seedlings or tissue cultures obtained *in vitro*, in solid or liquid media, and transported in sterile containers. The *A. ferox* export industry involves many parts and several derivatives of the plant. All recognisable parts such as leaves, stems, stem sections, flowers and inflorescences are subject to normal CITES permit requirements. However, crystalline bitters and aloe gel are not 'readily recognisable' and few South African officials would be able to identify their origin if export agents did not declare them on CITES permits. Fortunately many traders do report exports but this is a relatively recent change as just over 15 years ago many traders did not realise that

CITES export permits were required until the matter was brought to their attention by conservation authorities. Presently there is evidence suggesting that a significant, undocumented trade still exists. In this trade exporters either are unaware of CITES and non-CITES export provisions or they purposefully avoid these measures. The fact that South Africa records its trade in *A. ferox* derivatives reflects well on this country's CITES authorities. Several western countries, for instance the Netherlands and France, may not regard this type of derivative 'readily recognisable' as defined by the Convention and therefore do not always insist on CITES documentation.

Taxa of Aloaceae occur in all of South Africa's new provinces, however *A. ferox* occurs only in the Eastern Cape Province, Kwazulu/Natal, Western Cape Province, Lesotho, and Free State Province. *A. ferox* plants and products are traded almost exclusively through Western Cape Province but the relevant sections of the other provincial ordinances and Lesotho's legislation have been included in this section. As the provincial system in South Africa is undergoing significant changes and each new province does not yet have its own nature conservation legislation, the ordinances have been listed according to the old provincial nature conservation department structure namely, Cape Nature Conservation, Transvaal Nature Conservation, Orange Free State Nature Conservation and Natal Parks Board.

1. Cape Nature Conservation

In the Cape Province, the protection of aloes is governed by Ordinance 19 of 1974. Under the new South African constitution, 1994, the Cape Nature Conservation Ordinance is applied to the activities of the aloe industry in the Western and Eastern Cape Provinces.

The Cape Nature Conservation Ordinance was promulgated on 21 February 1975. Chapter VI (Sections 62 to 72 and their respective sub-sections) of this ordinance controls the "Protection of Flora". The ordinance is appended by Schedule 3 listing "Endangered Flora", Schedule 4 listing "Protected Flora" and Schedule 5 listing "Noxious Aquatic Growths".

All indigenous *Aloe* species fall into Schedule 4, except *A. pillansii*, *A. buhrii* and *A. erinacea* which fall under Schedule 3, and *A. ferox* which is specifically excluded from Schedule 4 and is classified simply as "indigenous unprotected flora". The exclusion of *A. ferox* from Schedule 4 means that this species is afforded minimal protection in the Cape Province. Sections relevant for *A. ferox* as an indigenous unprotected species are listed in Appendix 4.

2. Transvaal Nature Conservation

All the species of aloe indigenous to the Transvaal are protected by the Nature Conservation Ordinance 12 of 1983, with the exception of *A. aculeata, A. ammophila A. arborescens, A. barbetoniae, A. castanea, A. davyana, A. globuligemma, A. grandidentata, A. lutescens, A. marlothii, A. mutans, A. parvibracteata, A. transvaalensis* and *A. wickensii* and all species not occurring naturally in the Transvaal (Hilton-Taylor and Smith., 1994). Thus *A. ferox* is not protected in the Transvaal as it is not an indigenous species.

3. Orange Free State Nature Conservation

Ordinance 8 of 1969 of the Orange Free State makes provision for the protection of all 11 species of aloe, including *A. ferox*, that occur in the province. These species are covered under Schedule six "Protected Plants" and Section three of the Ordinance.

4. Natal Parks Board

Chapter XI "Protected Indigenous Plants" of the Nature Conservation Ordinance (No.15 of 1974) of Natal decrees all plants indigenous to the Republic of South Africa as "Protected", including *A. ferox*, except those listed in Schedules 10 ("Unprotected Indigenous Plants") and 12 ("Specially Protected Indigenous Plants") of the Ordinance (Hilton-Taylor and Smith., 1994).

5. Lesotho

In Lesotho, flora is protected by the Historical Monuments, Relics, Fauna and Flora Act (Act No 41) of 1967, which set out regulations protecting the flora of Lesotho. This Act also made provision for the formation of the Protection and Preservation Commission whose responsibility it is to enforce the Act. The first item in the schedule of protected flora provides for the protection of all *Aloe* species (including *A. ferox*). Enforcement of this Act appears to be weak and some species such as *A polyphylla* are now endangered. Lesotho is not a signatory to CITES (Hilton-Taylor and Smith., 1994).

B. Plant Health Regulations

For the export of crystalline bitters, phytosanitary certificates are not generally required by the Department of Agriculture, but some countries may demand them under certain circumstances. However, for live plant export phytosanitary certificates are required. The plants are examined at the point of exit by phytosanitary staff and must meet the requirements as set out in the International Plant Protection Convention, April 1951, signed in Rome to prevent the spread of harmful organisms. It is South Africa's duty to provide guarantees that the plant health conditions of importing countries are met. Some of the requirements are that the plants must be free of soil, dead leaves and symptoms of disease. The onus is on the exporter to see that overseas regulations are complied with. There are no designated ports of exit, but there are phytosanitary staff at all major South African ports who enforce the South African Agricultural Pest Act, 36 of 1983. There are several smaller international air and sea ports in South Africa which do not have phytosanitary inspectors, but this research has not attempted to quantify the amount of *A. ferox* products leaving through these facilities.

In addition, when CITES plants are exported it is reported that Department of Agriculture staff are required to inform nature conservation officials of the shipment and the shipper that CITES documents are necessary. However, there is evidence to suggest that this does not always occur.

C. Customs Regulations

The export of *A. ferox* is controlled by the Customs and Excise Act 91 of 1964. Documentation required for export is a Customs and Excise export declaration accompanied by an exchange control bank form. No officer of the South African Customs Service (SACS) has powers under the provincial nature conservation ordinances, however, when CITES-listed plants are being imported or exported the accompanying documentation is meant to be examined by SACS officers and, if it is missing, the shipment can be stopped. In practice, this rarely happens. There is currently no export restriction on *A. ferox* extract.

D. Implementation of Legislation

Evidence that aloe tapping is practiced in the road reserves of the entire southern Cape and Eastern Cape Province is visible for all to see alongside many roads in the region. The practise is widespread and apparently repeated on an 18-month cycle. The perception, held by some scientists and members of the public, that the harvesting of *A. ferox* leaves for extract in road reserves is unlawful is

without basis as there is no formal monitoring or law enforcement of this activity (Burgers, pers. comm., 1993). Some CNC conservation officials stated that a blind eye has been turned to this activity because they are satisfied that it does not represent a significant threat to the species. Regardless, CNC staff in Riversdale say that they enforce the requirement for a permit wherever possible*; furthermore, permission is required from the Chief Road Engineer to harvest alongside the road. Apparently these harvesting permits are rarely issued (Adams, pers. comm., 1994), however, roadside harvesting is common, demonstrating that the regulations are not only ignored but are also not enforced. Adams (pers. comm., 1994) reports that monitoring of harvesters and harvesting techniques is done on an *ad hoc* basis but that there are plans to make this a more formal activity in the future.

Cape Nature Conservation view this industry as being small and not a significant threat to the survival of *A. ferox* populations and their policy is not to interfere (Burgers, pers. comm., 1993). A study of the industry was conducted by CNC during 1975 and formed the basis for a decision not to prosecute aloe tappers collecting material in road reserves and other protected areas (Neethling, pers. comm., 1993). The Port Elizabeth office of CNC has also conducted studies in that region, based on applications to harvest leaves for extract collection, and have concluded that it does not represent a threat to the species in that region (Briers, pers. comm., 1993). None of the reports on which the policy decisions were taken are currently available.

With regard to the regulations demanding that the written permission of the landowner is obtained before picking unprotected indigenous flora, it seems that several procedures are followed, namely:

- landowners invite the tappers to work on their farms, or
- the agent arranges for them to work on farms with the landowner's permission, or
- the tappers arrange with the landowner to work on farms, or
- farm workers obtain the permission of their employer to harvest.

Apparently in the above-mentioned cases, written permission is not always given with verbal consent being the norm. A CNC officer reported that if he finds people harvesting aloes without written permission he always proceeds to the owner, and if verbal consent has been issued then this is accepted. The situation regarding illegal harvesting on government owned public land and protected areas, excluding roadsides, was not investigated.

CITES permit requirements appear to be met by some aloe extract exporters. However, there is evidence indicating that other exporters, mainly in the Eastern Cape, operate without export documents. Similarly agents brokering aloe parts and derivatives domestically sometimes avoid domestic regulations by not registering as 'Flora Dealers' and trade illegally in *A. ferox* commodities. This situation may be more common than is apparent.

MANAGEMENT STRATEGY

A. History and Aims

The aloe industry is not subject to a formal management strategy. The fact that South Africa has government structures with explicit or *de facto* planning processes for setting policy priorities, allocating resources and dividing authority and responsibility amongst government agencies, between national

* For a person who wants to set up in business harvesting aloes (or other plants), the following procedure is followed by CNC staff in Riversdale 1) The applicant fills out application form. 2) A CNC nature conservation official visits the area and determines the carrying capacity and viability of the stand for commercial exploitation. Although this determination is performed it was clear that standard environmental impact assessment procedures are generally not being followed. 3) if the inspecting official is satisfied the permit is issued (Adams *pers. comm.* 1994).

and local governments and between governments and the private sector seems to be purely co-incidental to the present state of the aloe industry. This perception arises from the uncoordinated attempts made by nature conservation staff, in the past and present, to study all the socio-economic and environmental impacts of the industry. Fundamental management decisions have been made on the basis of studies apparently lacking intimate knowledge or concern for biodiversity conservation. This situation arises from the fact that South Africa has no national biodiversity planning strategy.

B. Population Monitoring

Little formal population monitoring of *A. ferox* has been carried out by government or non-government organisations in the past and there are no set plans for future monitoring. Some officials have stated that it is essential and should be developed in the future. The basis for the policy of non-interference seems to be the view that the plant is not endangered.

C. Commercial Harvesting

The fact that commercial harvesting of *A. ferox* does not appear to be endangering the species appears to be the sole reason for the limited application of legislative controls and placement of the species in the lowest protection level possible in the ordinance of CNC (i.e. "indigenous unprotected flora"). That no official interviewed has been aware of the use of local vegetation as firewood to boil extract, or that trampling influences seedling recruitment, does not seem to have been taken into account when deciding this policy. Certainly, it appears that the limited manage-ment applied by nature conservation departments has tended to be from a top down perspective and negotiation with stakeholders in the industry has been limited to law enforcement (mainly permit inspection). The industry has seen little interference from authorities possibly because of the perceived abundance of the species, the employment potential for locals, and foreign exchange earned for the country during a time when trade sanctions were in place.

The aloe tapping communities, who depend on the resource for a living, have until recently been a 'forgotten' group of people who live in places such as Herbertsdale and Buysplaas. However, with the installation of electricity in some communities and the allocation of land for houses, these people are experiencing greater contact with surrounding communities and the country at large. These communities realised that they can play a significant role in the market and some have cut out the middlemen who reduced their profits. The tappers have never formally adopted a manage-ment strategy for their business, but have simply passed on their traditional practices from one generation to the next. For a combination of reasons but largely by default, the informal manage-ment plan in place has led to the conservation of the aloe resource for the following reasons:

1. **Private ownership of land.** A large proportion of the aloe resource occurs on private land. The landowners benefit from the industry by receiving commission which enables some to purchase additional land or improve their farms. This self interest stops landowners from destroying aloe plants on marginal lands and encourages them to transplant specimens removed during development of arable lands. No studies have been done which compare income from crops versus that from crystalline bitters, or which measure the amount of aloe harvested on government-owned land or protected areas.
2. **Need to keep plants alive for next season's crop.** The same plants are harvested on an 18-month to three-year cycle and there is a vested interest in making sure that the plants survive from one harvesting season to the next.
3. **The wide distribution of the resource.** *A. ferox* grows over a large part of South Africa in habitats ranging from easily accessible valleys to inaccessible mountain ridges. This ensures

the survival of the species in the wild even if agricultural development has decreased its range on arable lands.

4. **Communities depend on the resource.** Many different communities are dependent on, or have vested interests in, the industry. For instance, full-time tappers depend on the resource for their income, farmers benefit from commissions, members of factory co-operatives benefit from income generated, farm-workers and landowners benefit during times of unemployment and drought because the resource offers employment and income, and finally, agents and exporters make good profits from the resource. However, it is not purely the financial benefits which encourage resource conservation. Most significantly, the sense of immediacy between tappers, farmers and the resource engenders a conservation interest which extends to the plants non-commercial properties and uses.

5. **Superior bitters content of resource.** *A. ferox* extract is in demand because of its superior bitters content which is only produced by plants growing in certain indigenous habitats. It will be difficult to find similar growing conditions outside of South Africa which may mean that there will always be a demand for the product in South Africa.

6. **Higher returns on crystalline bitters than other products.** The low prices obtained for dried aloe pieces, compared to those for extract, and the low demand by the horticultural trade may help to prevent the harvest of live plants for drying or for ornamental use. So far it is more profitable to produce extract in spite of higher labour input. In this way live plants are retained and the species conserved.

7. **Small size of industry.** The lack of secondary and tertiary processing has kept local demand down to some extent but as markets expand and demand accelerates a greater burden could be placed on the resource.

8. **Lack of global interest.** The local industry is not globalised and people who may over exploit the resource have not generally entered the market. The scenario of irresponsible harvest and management must be avoided because over-utilisation is likely to be a short-term option leading to the collapse of the industry.

D. Current Season Restrictions

As far back as 1795, Thunberg (in Mc Carthy and van Oudtshoorn, 1966) noted that tapping may be performed at all times of the year, but during and immediately after the rainy season, the leaves yield a more copious but thinner bitters sap. Tapping normally occurs on days that are calm and clear as windy weather shrinks the leaf and reduces the amount of juice produced because it coagulates and seals wounds sooner.

Tappers do not harvest plants if they are in a drought-stressed condition. Experience has demonstrated that the leaves curl up and are difficult to stack, while the bitters sap is more viscose with reduced yields of up to 75%. The survival of the plant is also adversely affected. Experienced tappers are able to reach consensus on the desirability of harvesting at any stage.

After long periods of drought, approximately 5 cm (2 inches) rain is required for the plants to grow again, but even after rain there is a ten day waiting period. Aloe tappers indicate that on average one month of the year (December or January) is too dry for harvesting, however, during 1992/1993 the Herbertsdale community was forced into inactivity for three months. People that have been involved with the industry for many years such as Muller (pers. comm., 1994) agree that it is not possible to tap aloes on average for about three months per annum.

E. Traditional Practices

According to Muller (pers. comm., 1994), tappers always boil sap on Fridays and this tradition is so firmly entrenched that they will refuse to harvest on that day even if conditions are perfect and the rest of the week has been unfavourable. The crystalline bitters is sold to shops on Saturdays. Boiling the bitters sap in the field is a tradition and it takes a skilled tapper to judge how far to boil the liquid without burning the crystalline bitters. The same basins dug into the soil in the collecting areas tend to be used from one season to the next thereby limiting environmental degradation. On average, full-time tappers harvest healthy plants every 18 to 24 months, however, individual landowners may only permit harvesting every three to four years.

Senior tappers supervise the activities of less experienced tappers to ensure that plants are not killed by the harvesting procedure. Leaves are cut from approximately the lower third of the rosette, generally those that are beginning to hang down. About ten to 15 of the youngest leaves surrounding the crown are left. The tappers report that if the leaf is cut too close to the plant's stem the protective sealing action of the extract is not activated and the plant can become infested with insects and pathogens. In practice, any cut leaving less than 20 to 30 mm of leaf base is frowned upon. The quality of individuals work seems to vary and some tear leaves more than others, but all are aware of the importance of keeping the plant alive.

Young plants up to a height of 40 cm are not harvested by the tappers in Herbertsdale. No harvesting is done on windy or cold days as these conditions are supposedly not favourable for the rapid flow of extract. On windy days, the bitters sap seals the leaf too quickly and there is insufficient drainage, and on cold days the juice flows very slowly and also seals the wounds. Aloe tappers reported that when the south-eastern wind blows, the sap flows for longer maybe because of increased moisture in the air. On the other hand, on days when the north-western wind blows the sap does not flow well.

Plants which have been weakened by disease or pests are not harvested, mainly because the yield of juice is low, but also because the tappers believe harvesting will weaken the plant further and possibly kill it. During the leaf borer epidemic caused by *Penetagromyza* sp. in the early 1990s many plants were not harvested. However, by the time of the 1993 season many of those plants had recovered and were being harvested.

F. Non-Commercial Harvesting

This activity is limited to land-owners and local people who harvest extract for traditional remedies for humans or livestock and is not done on a large-scale. The harvest of dried aloe parts or live plants for non-commercial trade is apparently negligible.

SUMMARY OF HARVEST PROBLEMS AND BENEFITS

A. Summary of Problems

1. Trade Problems

- The activities of an unspecified number of independent casual tappers makes quantification of this sector of the industry difficult.
- Prices obtained for aloe products vary and seem to depend on the negotiation skills of the seller as well as international market whims. The sensitivity of overseas markets to health scares and other pressures can be disastrous for aloe tapping communities who may depend on the commodity for their livelihood.

- The presence of a suspected illegal trade in crystalline bitters and the fact that some flora dealers do not have licenses to trade in indigenous plant commodities indicates ignorance and/or avoidance of regulations by traders and lack of educational and/or enforcement efforts by South Africa's wildlife authorities.

2. **Conservation Problems**

- The localised impact of harvest on the plants, specifically the effects on flowering and recruitment of *A. ferox* seedlings, is unknown and may be harmful in the long-term.
- Although the removal of leaves does not normally kill *A. ferox* plants, the impact of harvest on the life span of *A. ferox* plants is unknown and may be detrimental to the survival of harvested plant populations in the long term.
- Firewood gathered from surrounding vegetation is used to boil bitters sap, thus creating an environmental impact the effects of which are unknown.
- Opinions differ on the impact of fire on the survival of harvested plants, which lack a protective 'skirt' of dried leaves, and more research is required to address this issue.

3. **Socio-economic Problems**

- The presence of too many middlemen have in some instances decreased income for tappers to such an extent that they get into a never-ending debt crisis and cannot meet their current expenses.
- The younger generation is not keen to work in the aloe tapping industry like their parents' because they have brighter prospects in the cities and some perceive their parents activities as undesirable. This may lead to loss of knowledge about sustainable harvest techniques in the future which could lead to damaging effects on the species.
- Income earned by aloe tappers are not uniform and are also affected by adverse climatic conditions when extract cannot be gathered. Periods of inactivity average two months per annum.

B. Summary of Benefits

1. Trade Benefits

South African *A. ferox* extract from Riversdale, Mossel Bay, Herbertsdale, Albertinia and Van Wyksdorp is in demand world-wide because of its high bitters content and this gives South Africa an advantage in international markets. Prices for extract from these areas are higher than other districts or countries producing crystalline bitters.

- Gel can be extracted more economically from *A. ferox* than *A. vera* and this gives South Africa an edge when competing on overseas markets, especially because not all *A. vera* products contain genuine aloe gels.
- *A. ferox* plants have a life span of approximately 150 years, and assuming harvest does not compromise their health, production could continue for most of this time without the need to locate or establish new plant sources.
- Repeated harvest of aloe plants helps to maintain high bitters (aloin) content.
- The trade in dried plants does not apparently have a significant impact on live plant populations.

- The prices obtained for dried parts are low and do not compete with profits derived from extract which requires living plants.

- The horticultural trade in wild-collected plants appears to be negligible and may not currently represent a threat to the species.

2. **Conservation Benefits**

- Tappers normally leave a sufficient length of leaf base to prevent damage to the stem's vascular tissues, and to keep to a minimum microbial infection or insect infestation.

- The impact of agricultural development has in the past destroyed *A. ferox* habitat, but it appears that this form of land use is on the decline and loss of habitat seems unlikely to be a significant threat to the survival of the species in the future.

- The impact of insects does not appear to be a threat to the species survival but can transiently reduce the quantity of harvestable plants.

- *Aloe ferox* has a wide distribution over many different habitat types where many inaccessible or non-utilised plant populations remain to serve as a genome reservoir against potential species extinction in production areas. In this way the species is protected against extinction.

- Drainage basins scraped into the ground for the collection of extract are used repeatedly thus limiting the impact on the environment.

3. **Socio-economic Benefits**

- The resource is commonly available for use as traditional human or animal medicine or in alcoholic beverages of various descriptions. The non-commercial harvest of *A. ferox* for traditional uses is an insignificant part of the market and cannot be seen as having a negative impact on wild populations.

- Employment for many communities is created by the aloe industry and some may earn their entire living from the industry.

CONCLUSIONS AND RECOMMENDATIONS

In this study it has become evident that *A. ferox* is the only species used in South Africa for the extraction of bitters sap and aloe gels. Small plantations of the exotic *A. vera* do exist, however, their commercial impact appears to be negligible. Wild stocks of *A. ferox* bear an estimated 95% of the harvesting pressures, with plantations established by individual landowners and aloe tappers, accounting for the remaining five percent. This dependence on wild plants places enormous pressure on the species. The leaves of approximately ten million plants are harvested to produce an estimated 400 tons crystalline bitters per annum. In addition, there appears to be an undocumented trade of about 300 tons per annum, which would increase this figure to approximately 17 million plants. These estimates also serve to illustrate the size of *A. ferox* plant populations in South Africa. As only leaves are harvested, the plants themselves continue to grow and it is currently assumed that most plants survive 18 to 36 months to the next harvest. However, as no scientific research has been conducted into survival rates, this assumption remains unconfirmed and plant mortalities may be higher than reported during the course of this study. On the other hand, whatever

the actual mortality rate, it would have to be very high in order to negatively affect the population status of the vast wild populations.

In addition other physical and biological factors may also help to protect the species and offset mortalities induced by bad harvest techniques. *A. ferox* is not only a populous species but it is also widespread. Included in its range are several mountainous areas where tappers do not venture as transporting of the final product would be difficult. Tapping of *A. ferox* in areas with low plant densities is rarely practiced as the harvesters would expend too much energy relative to the amount of bitters sap collected. Another advantage is that the species is a prolific seed producer. The seed can lie dormant for long periods until conditions become favourable for germination, for instance when neighbouring adult plants die thus removing factors inhibiting germination. The seedlings grow fast, reaching harvestable age within three to four years, and quickly replace any dead plants.

The average daily production of crystalline bitters (derived from bitters sap) per person is estimated at between 15 kg and 16 kg. The annual production of crystalline bitters and aloe gel generates income of about R4 million (US$ 1,223,241.50) to rural communities alone. Together with estimated undocumented trade of 300 tons per annum this amount could almost be doubled. Income generated represents a livelihood to thousands of South Africans, however, the commodity is largely unprocessed and additional value-added income to a larger population of South Africans from refining remains unrealised. The seriousness of this is particularly notable when national pharmaceutical companies import processed *A. ferox* bitters – originally grown in South Africa – from industrial countries such as Germany for incorporation into domestic products. Furthermore, many cosmetic preparations sold in South Africa contain *A. vera*. This is imported as a refined product which reduces the market share of *A. ferox* derivatives once again limiting income to South Africans. Despite the fact that the South African market could be expanded and value added to aloe products through beneficiation, crystalline bitters, bitters powder and aloe gel still have a small but important place in the local pharmaceutical, muthi and cosmetics industry. All retail pharmacies surveyed had at least some stock, and turnover was nearly always high compared to other packed lines stocked in the pharmacies. This was particularly true in areas serving communities dependent on traditional medicines for health care. The impact of the domestic trade on the *A. ferox* resource appears to be negligible.

Based on estimated annual production figures and after accounting for average exports of 252 tons per annum, approximately 150 tons per annum remains in South Africa either for storage or internal consumption. As domestic demand is small, it is thought that the majority goes into storage, for future legal or undocumented export. In addition to annual production there is an illegal or undocumented trade of about 300 tons per annum which appears to originate from the Port Elizabeth area. At least some of this quantity may be accounted for in the 150 tons remaining in storage and either exported without documentation or consumed domestically. If this is so then the undocumented trade situation may not be as severe as first proposed. The fact that irregular trade exists, does not appear to threaten the survival of the species, however, it may indicate a lack of knowledge amongst traders regarding export controls and poor law enforcement by the authorities. This is not surprising as conservation authorities have in the past admitted to turning a blind eye to these activities based on the view that the trade does not threaten the species. This view was not based on a formal environmental impact assessment, but on research conducted in the 1970's when accurate trade data were not available. Indeed, the relaxed attitude of the South African government has probably helped the industry to flourish. Although it must be recognised that South Africa has one of the best documented trades in aloe products in the world, the country's CITES annual reports have regularly excluded or misreported significant volumes of trade data. This reflects poorly on the country's CITES Management and Scientific Authorities.

The main markets for crystalline bitters are industrialised countries such as Germany and the United States. Over the period 1981 to 1994, South Africa documented exports of approximately 3,533 tons of crystalline bitters (252 tons per annum) to 15 international destinations. Germany represented the most important trading partner with imports amounting to 1,263 tons. Interestingly, importing countries reported receiving a total of 114 tons extract from South Africa during the period 1982 to 1991 which is far less than South Africa's recorded exports. There are several reasons for this discrepancy which include careless or non-existent reporting by importing countries. Countries that fail to document imports may simply be following a policy that crystalline bitters and aloe gels are not a 'readily recognisable' CITES-listed derivative and therefore do not require documentation.

With regard to the ornamental uses of aloes, there is less dependence on *A. ferox* with limited use made of several other indigenous *Aloe* species for the export market. Over the period 1981 to 1994, South Africa exported 1,249,305 pieces, 4,896 kg, 335 cartons and 84,209 unknown items of dried *A. ferox* plant and 2,868 live plants and a limited amount of seed to 20 international destinations. All dried aloe material sold for ornamental purposes was reported to have originated from plants that had died of natural causes. This argument was used regularly to explain that the trade did not represent a threat to the survival of *A. ferox*, but it is clear that this position has not been corroborated by scientific research. Further formal research into this aspect of the industry is necessary to assess whether it is only dead plants that are harvested or if live plants are also used to obtain dried material. However, it is likely that collection of live plants would have to be considerable before any effect on wild resources becomes obvious.

There is no formal management strategy for the *A. ferox* industry, nor is there a strategy catering for the industry's impact on the surrounding environment. There is no doubt that the industry does disturb the habitat in the harvest area. One of the most frequently mentioned concerns involves the reduction of seedling recruitment due to disturbance of the area around harvested aloe plants, and the impact of leaf removal on flowering and seed production. This concern has been based on surveys conducted in the 1980s and early 1990s. However, when faced with TRAFFIC's observations that seedlings rapidly replace mature plants once the latter have died, it remains to be seen whether those surveys were conducted over a sufficient period of time to pick up annual and seasonal fluctuations in recruitment. Further research is required to assess the impact that harvest has on seedling recruitment.

A second concern is that of habitat modification caused by the conversion of virgin land to agricultural use. It has been determined that this was a problem in the past but is not currently the case as most arable land has already been converted to agriculture. However, other forms of habitat modification such as overgrazing and soil erosion caused by cattle, sheep, and aloe tappers still impacts on the aloe habitat. The extent of this damage remains to be quantified.

Thirdly, there is concern about the effects of fire on harvested plants which lack a 'skirt' of dead leaves normally found on wild plants. Fire may be damaging in highly vegetated areas but in drier Karroo areas, with relatively little vegetation where most *A. ferox* plants are found, the effects are thought to be minimal and therefore a low threat to the species. The issue was not directly addressed in this project and further studies are required to assess this issue.

The reasons for the industry's success and apparent sustainability are numerous. Possibly the most important are that the commodity produced from the aloes is valuable to a wide range of people who depend on its sale for income. As is usual with many other wildlife commodities, the people most dependent on the resource are those that harvest it in the wild. It is also these people who in the past have received the lowest income for their labour. Next in line for benefits are the landowners whose earnings from aloes are additional to their regular income, and for whom the resource is convenient

because it keeps farm workers busy during agricultural down-time. These benefits appear to be sufficient incentive for landowners to preserve the resource. Finally, traders are generally not dependent on the resource for a wage, although *A. ferox* derivatives may be a significant part of their business. It is this group with the least direct contact with the resource who have the greatest potential for over-utilisation if they were given the chance by landowners and aloe tappers. The farmers in some cases appear to act as a buffer between the tappers and the traders. This is manifested by the way that farmers only select tappers with a good reputation for sustain-able harvesting. However, most tappers do discipline themselves; this is clear on public land such as road reserves, where plants are harvested in a similar manner to those on private land.

Another important reason for the longevity of the aloe tapping industry may be that crystalline bitters and aloe gels are the most valuable commodities produced from *A. ferox*. As the production of these commodities requires the harvest of living leaves, plants are not killed for other parts and derivatives with a lower commercial value. Despite this 'commercial protection' the value of crystalline bitters and aloe gels are recognised and the temptation exists to overharvest plants to maximise income. However, the plants seem highly resilient to this heavy harvesting and there are apparently few mortalities.

There are several social norms that appear to alleviate pressure on the resource. Firstly, the culture and skills of aloe tapping have been passed down through the generations as a family tradition. The rules of the harvest have also been passed on and tappers appear to adhere to them. Secondly, responsible full-time tappers train the part-time tappers they employ during the harvest season. This theoretically prevents the abuse of the resource. Thirdly, tappers apparently have a set of rules by which they determine whether to harvest or not under various climatic conditions such as wind or heat. These restrictions automatically limit the harvest. Finally, crystalline bitters has been accepted in whole communities' as being valuable and a measure of faith in the product is that it has become a barter item between tappers and farmers, farmers and shopkeepers, and middlemen and traders. This shows confidence by the community that the product will always have value; ultimately this helps to create stability within the community.

There are many lessons that can be learned from the *A. ferox* industry for application to wild plant resources which are currently utilised in a non-sustainable manner. However, it must be recognised that not one of the factors discussed above leads to sustainable use on its own. The use of *A. ferox* is based on ingrained social interaction and self-interest between the main beneficiaries of the resource (aloe tappers and landowners) in the production area, on established harvest techniques, as well as on the natural resilience of the species to withstand harvest. In addition, the vast population of the species allows tappers to effectively rotate harvest from one population to the next and not be tempted to revisit an area before the plants have had a chance to recover.

Up to now, there has been little international interest in taking over the harvest of *A. ferox*, and it remains firmly in the hands of local tappers and landowners. However, as industrial development expands in South Africa, there will be an increased demand on natural resources, hence it is important that conservation of *A. ferox* and other genetic resources be integrated into regional management and protected area reviews. This will help prevent irresponsible use of resources by traders with no interest in the survival of the habitat or species. As the situation exists today, *A. ferox* can be used as a flagship species that is being sustainably harvested to increase support for conservation. However, there are outstanding questions that need to be answered and consequently further careful research and management is necessary. The development of a formal management plan, reflecting the opinions and management styles of local communities', would improve and expand legal mechanisms to ensure the protection of the species.

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APPENDIX 1: Key to ISO Country Codes

AR	Argentina	HK	Hong Kong
AT	Austria	HU	Hungary
AU	Australia	IL	Israel
BE	Belgium	IT	Italy
BR	Brazil	JP	Japan
CA	Canada	LK	Sri Lanka
CH	Switzerland	NA	Namibia
DE	Germany	NL	Netherlands
ES	Spain	PT	Portugal
FR	France	TH	Thailand
GB	Great Britain	TW	Taiwan
GR	Greece	US	United States of America

APPENDIX 2: Assumptions and conclusions used to estimate the total production of bitters extract by Herbertsdale based tappers.

Assuming:	5 litres sap produced per leaf pile (range 2 to 6 litres)
Assuming:	9 piles leaves created per tapper/day (range 7 to 12)
Assuming:	1,000 leaves in one pile (large range depending on leaf size)
Assuming:	25 leaves harvested per plant
Assuming:	40 plants harvested for one pile (range 25 to 50)
Assuming:	5 tappers per team
Assuming:	6 day week
Assuming:	6 week long expedition
Assuming:	7 expeditions per annum
Assuming:	8 teams in the field
Therefore	5 litres produced per 40 plants or 1 pile
Therefore	total volume produced by one team building 45 piles per day = 225 litres
Therefore	number of litres produced per 8 teams per day = 1,800 litres
Therefore	number of litres produced per six day week = 10,800 litres
Therefore	number of litres produced per six week expedition = 64,800 litres
Therefore	number of litres produced per annum (7 expeditions) = 453,600 litres

APPENDIX 3: Assumptions and conclusions used to estimate the total number of leaves and plants harvested annually throughout the aloe tapping region.

Assuming:	9 piles of leaves created per tapper/day (range 7 to 12)
Assuming:	1,000 leaves in one pile (variation depending on leaf size)
Assuming:	25 leaves harvested per plant
Assuming:	40 plants harvested for one pile (range 25 to 50)
Assuming:	5 tappers per team
Assuming:	6 day week
Assuming:	6 week long expedition
Assuming:	7 expeditions per annum
Assuming:	8 teams in the field
Therefore	number of leaf piles per day per team = 45
Therefore	number of plants per day per team = 1,800
Therefore	number of plants utilised per tapper each day = 360 plants = 9,000 leaves
Therefore	number of plants utilised by 8 teams per day = 14,400

Therefore number of plants utilised in six days = 86,400
Therefore number of plants utilised over 6 weeks = 518,400
Therefore number of plants utilised by 8 teams over 7 expeditions = 3,628,800
Therefore number of leaves utilised per annum = 90,720,000

APPENDIX 4: Sections of CNC Ordinance No 19, of 1974, Relevant to *A. ferox*.

Section 63.1.a; b.i and ii; c. – Prohibition on picking of certain flora.

No person shall –

(a) uproot the plant in the process of picking the flower of any flora;

No person shall,

(b) without a permit –
  (i) pick any endangered or protected flora, or
  (ii) pick any flora on a public road or on the land on either side of such road within a distance of ninety metres from the centre of such road, or,

No person shall –

(c) pick any protected or indigenous unprotected flora on land of which he is not the owner, without the permission of the owner of such land or of any person authorised by such owner to grant such permission.

Section 63.2.a,b and c – Prohibition on picking of certain flora.

(2) No permission granted in terms of subsection (1)(c) shall be valid unless it is reduced to writing and reflects –
  (a) the full names and address of the owner of the land concerned or of the person authorised to grant such permission;
  (b) the full name and address of the person to whom permission is granted, and
  (c) the number and species of flora, the date or dates on which such flora may be picked and the land in respect of which permission is granted,

  and is signed and dated by such owner or the person authorised by him.

Section 63.3 – Prohibition on picking of certain flora.

The provisions of subsection (1) (b) shall not apply to the owner of any land, any relative of such owner and any full-time employee of such owner acting on the instructions or with the consent of such owner, in respect of any protected or indigenous unprotected flora on such land.

Section 68.1 and 2 – Places for sale of indigenous unprotected flora.

(1) A local authority may in respect of the sale of indigenous unprotected flora within its area of jurisdiction set aside such places as it may deem suitable for the sale of such flora, erect such shelters or other structures as it may deem necessary thereon and notwithstanding anything to the contrary contained in the Licences Ordinance, 1981 (Ordinance 17 of 1981), when issuing a licence contemplated by Item 32 of the First Schedule to such ordinance authorising the holder of such licence to carry on the business of selling, bartering or exchanging flowers or offering or exposing flowers for sale, barter or exchange, restrict the carrying on of such business in respect of indigenous unprotected flora to any place so set aside.

(2) No person shall sell any indigenous unprotected flora at any place other than a place set aside in terms of subsection (1) or on the premises of a registered flora seller or registered flora grower (see Section 65).

Section 69.a,b and c – Sale of indigenous unprotected flora by owner of land.

Notwithstanding the provisions of section 68(2), an owner of land on which indigenous unprotected flora is being propagated or cultivated or on which such flora occurs in a natural state may sell such flora which has been so propagated or cultivated or which so occurs to any person -

(a) on such land;
(b) at a place set aside in terms of Section 68(1), or
(c) carrying on business under a licence issued to him under Section 65(2).

Section 70.a and b – Export and importation of flora.

No person shall without a permit –

(a) export any flora from the province; provided that the provisions of this paragraph shall not apply to the export by any person of any flora, except endangered flora and protected flora referred to in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973, which he legally obtained from any registered flora grower or registered flora seller who is the holder of a permit to export such flora contemplated by this paragraph; pro-vided further that such person, while he is exporting such flora, shall be in posses-sion, in addition to any document contemplated by Sections 71 and 72, of a docu-ment in which the number and date of such export permit of such flora grower or flora seller are reflected, or

(b) import into the Province any protected flora specified in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973.

Section 71 – Donation of flora

The provisions of Sections 41 and 43 shall apply mutatis mutandis in respect of the donation of any flora by any person to any other person.

Section 41 – Donation or sale of wild animal or carcass thereof.

No person shall donate or sell any wild animal or the carcass of such animal to any other person unless, when he delivers such animal or carcass to such other person, he furnishes such other person with a written document signed by him reflecting –

(a) the full name and address of such first mentioned person,
(b) the full name and address of such other person,
(c) the number and species of wild animals or carcasses so donated or sold,
(d) the date on which such animal or carcass was so donated or sold, and
(e) a statement by him that he has donated or sold such animal or carcass to such other person.

Section 43 – Documents relating to permission to hunt or to the donation of wild animals or the carcasses thereof to be retained for certain period

Every document referred to in Sections 39 and 41 shall be retained by the person to whom it was furnished for a period of at least two months from the date on which it was furnished or while such person is in possession of the wild animal or carcass to which it relates, whichever is the longest period.

Section 72 – Possession of flora

The provisions of Sections 42 and 43 shall apply mutatis mutandis in respect of any person found in possession of any flora.

Section 42 – Possession of wild animal or carcass thereof

(1) Any person found in possession of any wild animal or the carcass of any such animal shall be guilty of an offence unless, in the event of –
   (a) the animal having been hunted by him on the land of any other person, he is in possession of the written permission contemplated by Section 39, or
   (b) his having acquired such animal or carcass from any other person, he is in possession of a written document contemplated by section 41.

(2) The provisions of subsection (1) shall not apply in any case where a relative or full-time employee of any owner of land is found in possession of a wild animal or the carcass of any such animal which such relative or employee has hunted on the land of such owner with his permission or which such owner has sold or donated to such relative or employee.

Section 86 – Penalties

(1) Any person convicted of an offence under this ordinance shall, subject to the provisions of subsection (2), be liable, in the case of –

   (c) a contravention of Section 27(1), 29, 31, 40, 41, 42(1), 44(1)(a), (b) or (e) or 46 or 58 (c) involving any protected wild animal other than the an African elephant, 63(1) involving protected or indigenous unprotected flora, 64, 66 or 70, to a fine not exceeding ten thousand rands or to imprisonment for a period not exceeding two years or to both such fine and such imprisonment, and to a fine not exceeding three times the commercial value of any such protected wild animal or the carcass thereof or any such flora in respect of which the offence was committed, and

   (d) any other offence in terms of this ordinance or any contravention of any other provision of this ordinance in respect of which no specific penalty is prescribed, to a fine not exceeding five thousand rands or to imprisonment for a period not exceeding one year or to both such fine and such imprisonment, and to a fine not exceeding three times the commercial value of any wild animal or the carcass thereof or any flora in respect of which the offence was committed.

(2) Where a penalty is specifically prescribed by regulation for a contravention of or failure to comply with any regulation, a person convicted of any such contravention or failure shall be liable only to the penalty so prescribed.

Endangered Wildlife Trust

The TRAFFIC Network is the world's largest wildlife trade monitoring programme with offices covering most parts of the world. TRAFFIC is supported by WWF (World Wide Fund For Nature) and IUCN (the World Conservation Union) to monitor trade in and utilisation of wild plants and animals. TRAFFIC in South Africa is supported by WWF South Africa, Endangered Wildlife Trust, The Green Trust, Mazda Wildlife Fund and the Tony and Lisette Lewis Foundation. It works in close co-operation with the Secretariat of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES). As the majority of its funding is provided by WWF, the Network is administered by the WWF Programme Committee on behalf of WWF and IUCN.

TRAFFIC East/Southern Africa in South Africa is based at the headquarters of the Endangered Wildlife Trust.

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