Appendix 5.16

Journal Paper

Title:	A summary of knowledge on *Sclerocarya birrea* subsp. *caffra* with emphasis on its importance as a non-timber forest product in South and southern Africa. Part 1: Taxonomy, ecology, traditional uses and role in rural livelihoods
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A summary of knowledge on *Sclerocarya birrea* subsp. *caffra* with emphasis on its importance as a non-timber forest product in South and southern Africa.
Part 1: Taxonomy, ecology, traditional uses and role in rural livelihoods

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SYNOPSIS

Sclerocarya birrea (marula) is a widespread species throughout the semi-arid, deciduous savannas of much of sub-Saharan Africa. It is widely used by rural populations in most countries in which it is found. It has multiple uses, including the fruits, kernels, oil, bark, wood and leaves. Because of these multiple uses, and its significance in the landscape, several African cultures have specific beliefs and ceremonies associated with this species, and it is often maintained in homestead and arable plots. Because of the widespread occurrence, potentially high fruit production and use of *S. birrea* it has frequently been identified as a key species to support the development of rural enterprises based on the fruit, beer, oil or nuts and therefore as a species for potential domestication. Localised breeding and cultivation initiatives commenced in the 1970s and some continue. Interest in this species was renewed after the development of a highly successful liqueur using extracts from the fruit. This has developed further in southern Africa over the last 3 to 5 years, especially commercialisation initiatives orientated towards befitting the rural poor. Recently, the UK Department for International Development (DFID) initiated a project to examine the impacts of commercialisation of non-timber forest products, such as marula, on the livelihood capital of the rural poor. As a first phase, the research team compiled a comprehensive literature review of S. *birrea*, with emphasis on possible commercialisation. This is to be published in two parts. The first part here deals with the taxonomy, ecology and its subsistence use and cultural value to rural households. The second part of the review will focus on issues relating to specific properties of the marula, management, intellectual property and its potential commercialisation.

INTRODUCTION

Sclerocarya birrea (marula) is a common and widespread species throughout the semi-arid, deciduous savannas of much of sub-Saharan Africa (Peters, 1988). It is frequently a community dominant and hence is a keystone species in plant and animal community ecology and productivity. It is not only important as a dominant tree species in plant communities, but it is also widely used by rural populations in most countries in which it is found (Palmer and Pitman, 1972; Shone, 1979; Walker, 1989; Shackleton et al., 2000). It has multiple uses, including the fruits that are eaten fresh or fermented to make a beer, the kernels are eaten or the oil extracted, the leaves are browsed by livestock and have medicinal uses, as does the bark. The wood is carved into utilitarian items such as spoons and plates as well as decorative animal figures. Because of these multiple uses, and its significance in the landscape, several African cultures have specific beliefs and ceremonies associated with this species (Walker, 1989). A significant proportion of households nurture seedlings of *S. birrea* that germinate in the grounds of their homestead or arable fields, and maintain adult trees in an agroforestry situation (High and Shackleton, 2000; Shackleton et al., 2000). Others plant seedlings or propagate trees via stem cuttings.

Because of the widespread occurrence, potentially high fruit production and use of *S. birrea*, it has frequently been identified as a key species to support the development of rural enterprises based on the fruit, beer, or nuts and therefore as a species for potential domestication (Taylor and Moss, 1983; Holtzhausen et al., 1990; Nerd and Mizrahi, 1993; Leakey and Simons, 1998, Leakey & Tomich 1999). Localised breeding and cultivation initiatives commenced in the 1970s and some continue. Interest in this species was renewed after the development of a highly successful liqueur using extracts from the fruit. This has developed further in southern Africa over the last 3 to 5 years, especially commercialisation initiatives orientated towards befitting the rural poor, including initiatives in Botswana, Namibia and South Africa (e.g. Taylor and Moss, 1983; Barton 2001, Maree and Doyer, 2001).

Recently, the UK Department for International Development (DFID) has initiated a project to examine the impacts of commercialisation of non-timber forest products, such as marula, on the livelihood capital of the rural poor. As a first phase, the research team compiled a comprehensive literature review of S. *birrea*. This is to be published in two parts. The first part here deals with the taxonomy, ecology and its subsistence use and cultural value by rural households. The second part of the review will focus on issues relating to commercialisation.

TAXONOMY AND SPECIES DESCRIPTION

Sclerocarya birrea (A.Rich.) Hochst, is a member of the Anacardiaceae, along with 650 species and 70 genera of mainly tropical or subtropical evergreen or deciduous trees, shrubs and woody vines. There are four species of *Sclerocarya* (Mabberley 1993), a genus named for its hard seed (or 'nut'): *Sclero* = hard, *carya* = walnut. All are African, with *S. birrea* the most widely distributed. Other species, such as *Sclerocarya gillettii* (a Kenyan endemic) have a much narrower distribution. In keeping with the widespread cultural use of the species, the species name *birrea* is derived from *birr*, a local West African name for the tree (Palmer and Pitman 1972).

The marula is typical of the family Anacardiaceae in several ways, including resin ducts in the bark, dioecy and the production of fleshy fruits by female trees. Although *S. birrea* is usually considered a dioecious species, occasional trees with male flowers may bear a few female flowers. For example, Baijnath (1983) found that out of a random sample of 119 trees, 104 (87.4%) were dioecious, with the remaining 15 (12.3%) being predominantly male flowered with a few female flowers on the lowermost 1 - 2 inflorescences. Neither von Teichmann (1982) nor Baijnath (1983) found bisexual flowers.

Like *S. gillettii* (Beentje 1994) and some well-known crop plants in the Anacardiaceae, such as the mango (*Mangifera indica*) and mombin (*Spondias*), marula fruit pulp is edible. In addition, like fellow Anacardiaceae, such as the cashew (*Anacardium occidentale*) and pistachio (*Pistacia vera*), *S. birrea* produces edible nuts. Three subspecies of *S. birrea* are recognized:

- *Sclerocarya birrea* subsp. *caffra* (Sond.) Kokwaro, the focus of this study. This subspecies is the most ubiquitous and occurs in east tropical Africa (Kenya, Tanzania), south tropical Africa (Angola, Malawi, Mozambique, Zambia and Zimbabwe) and southern Africa (Botswana, Namibia, South Africa and Swaziland) and is also recorded from Madagascar (Flora Zambesiaca 1966, Fox and Norwood Young 1982, Arnold and de Wet 1993, SEPASAL 2001). The southern end of its range is the coastal belt of southern KwaZulu-Natal, South Africa near Port Shepstone at approximately 31^0 S. Within South Africa, it is common in the savanna areas of northern KwaZulu-Natal, Mpumalanga, Northern and North-west Provinces.
- *Sclerocarya birrea* subsp. *multifoliolata* (Engl.) Kokwaro. This subspecies occurs in mixed deciduous woodland and wooded grassland in Tanzania (Flora of Tropical East Africa 1952).
- *Sclerocarya birrea* subsp. *birrea* which occurs through west, north-east and east tropical Africa across a range of vegetation types, principally mixed deciduous woodland, wooded grassland and through the open dry savannas of Northern Tropical Africa and the Sahelian region.

While the last two subspecies respectively have one and two synonyms. *S. birrea* subsp. *caffra* has six synonyms: *Sclerocarya caffra* Sond., *Chemiphar subglauca* Engl., *Poupartia caffra* (Sond.) H. Perrier, *Sclerocarya schweinfurthiana* Schinz, *Sclerocarya caffra* Sond. var. *dentata* Engl. and *Sclerocarya caffra* Sond. var. *oblongifoliata* Engl. (Arnold and de Wet 1993).

S. birrea subsp. *caffra* trees are deciduous reaching 7 – 17 m in height. The fruit size is variable, but is roughly plum-sized. Marula fruits abscise before ripening; at this stage the skin colour is green and the fruit is firm. The ripe fruits have a thick yellow peel and a translucent whitish flesh. Although Watt and Breyer-Brandwijk (1962) describe the outer skin as having "a pungent apple-like odour" and marula pulp flavour as a mixture of "litchi, apple, guava and pineapple", the fruit size and flavour vary from tree to tree. This is well known to local people in southern Africa, whether subsistence or commercial farmers. In Northern Province, for example, Pedi people recognize three varieties of marula trees and fruit based on the scent and flavour of the fruit:

- *morula o mobose* which bear sweet, palatable fruits. Quin (1959) records this category of female trees as commonly being surrounded by thorn-brush fencing to prevent fallen fruits from being eaten by livestock or game animals;
- *morula wa gobaba* where the fruits are sour and unpopular; and
- *morula wa go nkga* which bears fruits which are disliked due to their "objectionable odour".

The above example of fine differentiation of fruit types in the Pedi terminology reflects the social importance of this species, as do four additional widespread features which typify the folk taxonomy of *S. birrea* subsp. *caffra* in southern Africa. Firstly, the widespread use of the same term for the tree across many southern and south-central African languages (which have been adopted as loan words into the Afrikaans and English names for the species). Examples of this are the names *marula* or *morula* used for the tree in Lovedu, Pedi and Tswana (and the closely related terms *muua* in KiKamba and *mura* in the Meru language in Kenya), *umganu* in siNbebele, Zulu and siSwati and *omwoogo* (or *omyoongo* pl.) in KwaNayama Owambo in Namibia and *muongo* in Gwembe Thonga in the Zambezi valley (with closely related terms in East Africa, such as *mngongo* in kiSwahili, Digo, Pare and Zara) and the related names *mfula* (ChiChewa and Yao) in Malawi and *mpfura* (Shona) in Zimbabwe and *mafula* (Venda) in South Africa. Secondly, that a species-specific name is sometimes given to the marula kernel rather than the general name for 'kernel'. An example of the differentiation of marula kernels are the terms *ongongo* (s) *eegongo* (pl.) in KwaNyama Owambo (Rodin 1985) instead of *exuku*, the general name for a kernel. In other cases, the common name for a kernel is retained (such as *umongo* for the marula kernel as well as general term in Zulu). Thirdly, the use of *S. birrea* as a reference point in folk classification of similar looking trees also in the Anacardiaceae, such as *Lannea schweinfurthii* (*umganu-nkomo* (Zulu), False Marula (English), Baster maroela (Afrikaans)) and fourthly, as would be expected from local people's observation of fruit-bearing (female) and non-fruit bearing mature trees (males), the common recognition of *S. birrea* dioecy, with the analogy to female trees as 'cows' and males as 'bulls'.

ECOLOGY AND PRODUCTIVITY

There has been surprisingly little autecological research on *S. birrea* subsp. *caffra,* in southern Africa considering its ubiquitous distribution and household and commercial importance. Available data, for example those on fruit production, tend to be highly variable and often restricted to a few trees. Indeed, the same data appear to be cited repeatedly in the literature.

In terms of habitat requirements *Sclerocarya birrea* subsp *caffra* can be found in a diversity of vegetation types; typically, open, deciduous savanna, but it is also a component of semi-deciduous forest along the KwaZulu-Natal seaboard of South Africa (Johnson and Johnson 1993).

No specific studies have been done on this species precise habitat requirements except in the Kruger National Park (Jacobs 2001). Instead, what exists is simply a collection of observations. In terms of soils, *S. birrea* is reported from a wide variety of soils from deep sands on granite, to basaltic clays, although a preference for well-drained soils has been commented upon (Lewis 1987). A key factor limiting its distribution appears to be its sensitivity to frost (von Breitenbach 1965, Palmer and Pitman 1972, Johnson and Johnson 1993). Altitudinal range is from sea-level to 1 800 m. Mean annual rainfall (MAR) ranges from 200 to 1 500 mm (Peters 1988), but more typically between 400 to approximately 1 000 mm per annum (Shone 1979, Peters 1988, Bandeira *et al*. 1999).

Densities

There has been no systematic appraisal of the densities and productive capacity of *S. birrea* throughout its range. Existing data are largely a coincidental result from other work recording densities of all woody species for vegetation mapping or characterisation purposes. This needs to be rectified.

Shackleton (1997) undertook a detailed inventory of woody biomass based on random replicated transects in three protected areas along a rainfall gradient in the central lowveld, South Africa. This provided data on the highest absolute and relative abundance of *S. birrea* at intermediate rainfall (500 – 850 mm) (Table 1).

INSERT TABLE 1

In comparison, the density of mature trees in Timbavati communal lands in the same region was reported by Shackleton (1996) to be 7.5 per hectare, whereas the density of all stems (not just adults) was 41.9 per ha. This is similar to the 8 trees (> 2 m tall) per hectare reported by Lombard *et al*. (2000) for Gottenburg communal lands in the Bushbuckridge region. In the Lebombo mountains of Mozambique, Bandeira *et al*. (1999) reported a density of 37.5 stems per hectare for individuals greater than 1.5 m tall. The average DBH was 17.1 cm. In Luangwa valley (Zambia), Lewis (1987) undertook a complete population inventory and found a mean density of 14.8 trees per hectare, with a mean height of 7.6 m.

Growth rates

According to Johnson and Johnson (1993), height growth of newly germinated stems is approximately 70 cm per year, and that flowering occurs after four years. Shone (1979) reported that trees planted in "the correct environment and given ample water" will increase in height by approximately 1 m per year, with a range of 0.3 to 2.0 m depending upon the suitability of the local environment. These rates are for trees planted in gardens. Under formal cultivation, growth rates can be accelerated. Van Wyk and Gericke (2000) cite figures from Israel of 12-year old trees producing 500 kg of fruit per year. Nerd and Mizrahi (1993) provide data from four-year old trees planted in Israel, with mean heights of between 3 m and 6 m, circumferences of 40 - 58 cm, and with 25 % of the planted trees producing an average of 27 kg of fruit.

In terms of wild populations, Shackleton (in press) monitored 44 adult individuals across 16 localities for five years and found a strong positive relationship between mean diameter increment and stem diameter. Using this relationship, a 15 cm diameter tree has a mean annual increment of approximately 3.5 mm per year while one of 30 cm diameter grows by 2.5 mm per year. On this basis, a 1 cm diameter recruit will take 37 years to reach 15 cm diameter, or 87 years to attain a diameter of 30 cm. These are upper estimates because the sample trees were already adults, and therefore demonstrating diminishing growth rates.

Fruit production

Fruit production data for wild trees are scanty and often anecdotal. Some reports of numbers of fruits per tree include:

- Four trees at Zebedelia estate produced between 21 667 and 91 272 fruits each in the 1951/52 season, with an average yield of 550 kg (Quin 1959).
- 163 000 fruits produced by four trees at Zebedelia estate in Northern Province (Palmer and Pitman 1972).
- 9 601 fruits or 270.3 kg from one tree near Tzaneen in the north-eastern Transvaal (Shone 1979).
- 226 000 fruits in one month (April) (not entire season) from 111 trees tagged trees in Luangwa, Zambia (Lewis 1987).
- 2 000 fruits from one tree in the western Transvaal (Peters 1988).
- An average yield across 11 trees in Botswana of 36 550 (ranging between 17 445 to 66 622) fruits or 550 kg per tree (SEPASAL 2000) , (Peters 1988).
- Approximately 70 000 fruits per tree, or 570 kg (Roodt 1988).
- Average of 35 000 fruits in the wild in Botswana (Taylor *et al.* 1996).
- 2 100 – 9 100 fruits in a season (Arnold *et al.* 1985).

The ratio of number of fruits to mass of fruits differs widely between these reports, indicating either extremely wide differences in the mass of individual fruits, or relatively crude extrapolations of mass.

In comparison to the above Shackleton (in press) reported on fruit yields from marked 64 trees of variable sizes. Mean mass of fruit produced during the first season was 36.8 $\pm$ 7.8 kg per tree. This corresponded to 1 753 $\pm$ 343 fruits, with a mean mass of 20.6 $\pm$ 0.7 g. Production during the second season was negligible, just a few fruit per tree, even at the wettest locality. Such a wide inter-annual variation in the production of fruits represents a challenge to sustainable commercialisation initiatives, as has been commented on for other non-timber forest products from semi-arid lands (Boffa *et al*. 1996). The yield per tree during the first season is an order of magnitude less than the figures cited above, suggesting that they were measured from exceptionally large trees, or from exceptionally productive trees, or during an above average season. Recent data from Todd (2001) for 122 trees surveyed in the 1999/2000 season gave a mean yield of 17.4 kg of fruit per tree, although it was noted that some fruit may have already been collected at some sites. During the 1993/94 season, the amount of fruit produced was positively related to size of the tree (Shackleton in press).

Ecosystem functions

The importance of *S. birrea* to local rural human populations is well documented (see below). It is also important in the ecology of other plants and animals. It grows into a large tree, and is often a community dominant comprising more than 20 % of total woody biomass (Table 1). Because of its large size, it produces a large area with a cool sub-canopy environment. In arid and semi-arid areas sub-canopy environments are key resource areas, being characterised by higher moisture and nutrient levels than open environments (Belsky *et al*. 1989, Griffieon and O'Connor 1990). These conditions are conducive to different assemblages of sub-canopy woody plants, grasses and forbs. Removal of a large dominant species may result in the loss of these sub-canopy species.

The dominance and large size of *S. birrea* also make the crown of the tree an important habitat for small vertebrates and invertebrates, as well as parasitic plants. *S. birrea* is the favoured host for woodroses, which are important for the livelihoods of rural curio traders (Dzerefos 1996)

Several vertebrate and invertebrate species make use of the fruits. These include elephants, rhinoceros, warthogs, kudu, baboons, vervet monkeys, zebras, porcupines, and millipedes. There is no work on what proportion of the diet or nutrient intake *S. birrea* contributes for these animal species. Foliage is browsed by elephants, kudu, giraffe, nyala and domestic cattle (Palmer and Pitman 1972), as well as by at least eight species of butterfly and moth larvae (Pooley 1993, Kroon 1999), including several emperor moth (Saturniid) caterpillars, some of which are a popular food in southern Africa. Palmer and Pitman (1972) state that water-filled holes in the trunks of *S. birrea* are important breeding grounds for mosquitoes, more so than any other tree species in the two million hectare Kruger National Park.

USES WITHIN RURAL LIVELIHOODS

Sclerocarya birrea trees and products have long formed an integral part of the lives, food security and spirituality of indigenous communities living within the distribution of this highly valued and versatile species (e.g. Krige 1937, Quin 1959, Fox and Norwood Young 1983, Gomez 1988, SIDA 1992, Shackleton *et al.* 2000). Indeed, archaeological evidence indicates that this species has been used from the earliest of times (Shone 1979).

Local use and trade in fruits and kernels

Sclerocarya birrea fruit and kernels form an important component of the diet of rural people. (Liengme 1981, Cunningham 1988, Shackleton *et al*. 2000). Fresh fruit is widely consumed, particularly by children (Cunningham 1988, McGregor 1995, Cavendish 1999), providing a rich source of vitamin C. Fruits are also collected and processed into juice, alcoholic beverages (wine and beer) and jam, extending the shelf life of the product and prolonging availability and consumption beyond the two to three month fruiting season. It has been reported that marula beer can be stored for up to two to three years if sealed in clay or plastic containers and buried underground (Shone 1979, Shackleton *et al.* 2000). In West Africa, the juice is boiled down to a thick black consistency and used for sweetening porridge (Dalziel 1948, Palmer and Pitman 1961). The use of marula juice as an additive to variety of sorghum, maize and millet porridges (*Bog⊥bΛ Bja Marula*) has also been recorded for the Pedi by Quin (1959).

Data from Bushbuckridge, South Africa indicate that *S. birrea* is amongst the most commonly used wild fruit species, with 59 – 77 % of households reporting consuming marula fruits between four to five times per week during fruiting season (Shackleton 1996, Shackleton *et al.* 2000). This figure does not capture opportunistic consumption by children when they are away from the homestead, either herding livestock or walking to and from school, so consumption rates are likely to be considerably higher. In the same area, about 2 % of households were found to sell marula products, mainly beer and kernels (Shackleton 1996). Similar high frequencies of fruit use for subsistence purposes (between 83 – 100 % of respondents) are reflected in unpublished data from northern KwaZulu-Natal, South Africa, Inhaca Island, Mozambique, and Zimbabwe (Cunningham *et al.* unpubl.). Research on the use of wild plants in the Goba area of the Lebombo Mountains, Mozambique also highlights the popularity of marula for household use. Using pairwise ranking, *S. birrea* emerged, after *Trichelia emetica* and *Strychnos madagascarensis,* as one of the most preferred fruit species out of a total of 34 species (Bandeira *et al.* 1999). However, this popularity is not consistent across the region. In Malawi, for instance, the fruit appears to be much less frequently used than in other southern African countries and a study on indigenous fruit trees in this country indicated that *S. birrea* was not ranked as an important species (Ngulube 2000, P. du Plessis pers. comm.). Similarly, in the Kavango region of Namibia, *S. birrea* is sometimes used to make a distilled alcohol but almost never used for beer or juice. Fresh fruits are never eaten in this region and the nuts are seldom extracted (P. du Plessis pers. comm.).

Ireland (1999) working in Sekhukhuneland in Northern Province, South Africa (where Quin did his work in 1959) found that households harvested an average of 36 kg of marula fruits per season in Makua village, whilst the average household consumption rate was only 4.5 kg in nearby Manganeng. She attributed this difference to the much greater effort required to collect fruit in Manganeng. In this village there are no *S. birrea* trees in or close to the village. The gross annual value of marula fruit use was estimated to be US$41 and US$7 per household for each village respectively (Ireland 1999). In both villages marula fruit was collected in greater amounts than any other wild resource. Twenty five percent of households in Manganeng and 65 % of households in Makua were harvesting *S. birrea* fruits and other wild products for household use, whilst the remaining households used these wild resources on an irregular and *ad hoc* basis.

A number of resource valuation studies have indicated that indigenous fruits, after fuelwood and wild vegetables, contribute a significant proportion to the overall economic value of wild resources consumed by households (Cavendish 1999, Shackleton and Shackleton 2000, Shackleton *et al.* in press). In Bushbuckridge, South Africa most of the value of wild fruit, approximately US$30 per household per year (Shackleton and Shackleton 2000), can be attributed to marula, and it is expected that a similar pattern would apply in other areas where *S. birrea* is dominant. In another study in the same region, the average annual value of marula products harvested from trees on home plots and fields (i.e. land to which households have individual usufruct rights) was estimated at US$116 per annum (High and Shackleton 2000). Approximately 40 % of households had retained or nurtured marula trees on their land.

Marula beer is brewed by a majority of households (often more than eat the fresh fruit) and has been shown to be key in building and maintaining social networks. It is commonly used for work parties, or as a "thank you" for services rendered or anticipated (Gumbo *et al.* 1990, Shackleton *et al.* 1995, Kadzere 2000). Men, in particular, argue strongly that the sharing of marula beer with friends and neighbours helps to cement reciprocal relations and obligations. Indeed, the marula season coincides with one of the few times of the year when most male migrant workers are home (Shackleton *et al.* 1995). Thus, drinking parties are not just social events, but a time for renewing relationships and planning the year ahead. So popular is the beer, that in the past, certain communities had a ruling that no man may carry arms during the beer season for fear of the damage he may do his neighbour whilst under the influence of this intoxicating drink (Palmer and Pitman 1961).

The process to brew the alcohol varies from region to region and between communities and ethnic groups (Quin 1959, Shone 1979, Liengme 1981, ANU 1999). However, all methods follow the same basic steps. The skins are slit with a knife or fork (often made from bone in the past) and the fruits squeezed over a clay pot or plastic container to release the flesh and juice. Water is added and the container placed in a warm place. The thick scum that forms on the surface is removed after one day, and the fruits worked through again to remove the pips. The juice is then left to ferment in an airtight container for a few days before it is ready to drink. In some cases the skins are left on the fruits at the initial step and removed later (Liengme 1981). Sugar is sometimes added to speed up fermentation and to sweeten the beer. Households sometimes reserve a portion of the brew, which is buried underground and kept until Easter when the men come home again (Chiloane pers. comm.). The sediment produced during the brewing process is reported to have aphrodisiac properties and may be drunk by men to enhance their libido (F. Chiloane pers. comm.).

S. birrea nuts are processed by women for both home use and sale. The 2-3 nutritious oil and protein rich kernels (see Section 1) known as *k⊥k⊥* in Pedi (analogous to the word *m⊥k⊥* for bone marrow), *eegongo* in KwaNayama Owambo, and *umongo* in Zulu are extracted manually from the pips using a range of techniques specific to different parts of the plant's distribution range. On the sandy coastal plain of the Ingavuma district, South Africa, decortication is achieved by cracking the nuts against a stone slab, and then removing the kernels individually with a sharp needle-like tool (Cunningham 1988). The hard rock required for the "hammer" and "anvil" comprises volcanic rock from the Lebombo mountains that is washed down onto the Pongola floodplain. People have been known to carry these rocks to their homesteads as far as 40 km away. Persistent cracking results in pits in the rock, which increase in number as some pits get too deep and new ones are started (Cunningham 1988). In areas where households do not have access to hard rocks other techniques are used. In parts of Namibia, the marula nuts are cracked against an axe blade (or other large piece of iron) using a block of hard wood (e.g. *Terminalia sericea*). In other cases the opposite action is used. An axe is used to cut open the operculum end of the pip whilst it rests on a wooden block, and thereafter a small piece of metal, such as a flattened nail, is used to prise out the kernel (Lombard *et al.* 2000). In some areas, e.g. Bushbuckridge, South Africa, the nuts are boiled or heated in the fire prior to decortication (Lombard *et al*. 2000). This is said to make extraction simpler as the lids of the fruit locules come off more easily (von Tiechman 1983). The sharp tools used to extract the kernels (known as *oluvela* in KwaNyama Owambo, and *modukulo* or *modikola* in Northern Province, South Africa) vary and may be made from metal, bone or a thorn such as that of *Acacia karoo*.

Whatever the process used, hand extraction is a skilled and arduous task as the shells are hard, and if the kernels are to be sold, they need to be whole. Gumbo *et al.* (1990) recorded approximately 24 working hours to fill an 800 g tin with kernels. Research on the marketing of wild products in Zimbabwe revealed that the *S. birrea* nut market was one of the few wild resource markets limited by supply (Campbell and Brigham 1993, Brigham *et al.* 1996). It was pointed out that if technical constraints on extraction could be overcome, this product had considerable market potential. However, it is the difficult extraction process and high labour input that gives the kernels a relatively high value on the market. Indeed, some stakeholders are concerned that improved technology could result in an important value-adding step being removed from households to more centralised facilities (Lombard *et al.* 2000).

Data on the use of the nut resource are very variable across the region. In some areas, kernels appear to be little used despite their nutritional properties and potential cash value. For example, in Northern Province, South Africa marula kernels were extracted and stored by only 11 % of households (Shackleton *et al.* 2000). In Zimbabwe, McGregor (1995) found only one household (2 % of the sample) that extracted *S. birrea* kernels, and this was on an occasional basis. In Kavango (Namibia) the nuts are almost never used (P. du Plessis pers. comm.). By contrast, marula nuts form an important dietary supplement, especially for poorer and elderly households, on the sandy coastal plains of

Inhambane Province and Inhaca Island, Mozambique (Cunningham *et al.* unpubl.). On Inhaca Island 100 % (n = 40) of people interviewed indicated that they extracted and consumed marula kernels. Similar high levels of use were found in Owambo (Namibia) Northern KwaZulu-Natal (South Africa) and Mbengarewa (Zimbabwe) where 95 %, 97 % and 98 % of households respectively made use of this resource (Cunningham *et al.* 1992, Cunningham *et al.* unpubl.).

Kernels are either roasted or eaten raw as a snack, or mixed with wild herbs and served as a relish with the main meal. Quin (1959) reports how the Pedi of Sekhukhuneland used marula embryos to flavour a green leaf relish *(M⊥r⊥go wa dik⊥k⊥)*. Kernels are also ground into a powder and mixed with sorghum stew (*Tsh⊥l⊥ le dik⊥k⊥*) (Quin 1959) and soups (Peters 1988), or stamped to form a cake which can be eaten alone (Peters 1988). The kernels can be stored for several months, and Krige (1937) reports how the Phalaborwa of Northern Province subsisted largely on a diet of stored kernels mixed with wild herbs or meat during the dry season. Cunningham (1985) mentions that the Thembe-Tonga still store nuts, and that this becomes an important source of food in winter and drought years. The nuts are often stored off the ground on raised platforms or in suspended "nets" (made of strings of bark in the past) (von Teichman 1983). In Namibia oil is traditionally extracted from the kernel with a pestle and mortar aided by careful use of small amounts of warm water (CRIAA SA-DC unpubl. data). The oil and cake thus prepared can be used for at least one year.

Other uses of the kernels include as a meat preservative (Palmer and Pitman 1972, Peters 1988, Holtzhausen 1993) and as a source of oil for skin moisturiser (Coates Palgrave 1972, ANU 1999, van Wyk and Gericke 2000). Traditionally, Zulu people reportedly crush the nuts and boil them with water, skimming off the oil, which they massage, into the skin as a cosmetic (Coates Palgrave 1972). In the past this oil was used to preserve and soften the traditional skin shirts (*sidwaba)* that they used to wear (Watt and Breyer-Brandwijk 1962). A similar use was also observed in Namibia (Rodin 1985). It is this indigenous knowledge upon which current marula oil commercialisation initiatives have built. Kernels have also been used as illuminants and apparently burn with a bright flame (Palmer and Pitman 1961, SEPASAL 2001). The gift of kernels is considered a mark of great friendship (Palmer and Pitman 1961).

Despite the key role played by marula and other wild fruits in rural households, there is evidence that use may be declining in some areas in favour of exotic fruits (Gomez 1988, McGregor 1995). Wilson (1989 cited in Clarke *et al.* 1996) suggested that a decline in the use of fruit and nuts of *S. birrea* in Zimbabwe could be due to the absence of nut cracking technologies, and the same factor may explain the reduction in the frequency of wild fruit porridges observed by McGregor (1995). However, such declines in use can also be attributed to the increase in the availability of agricultural substitutes

(Clarke *et al.* 1996). By contrast, in Northern Province, South Africa wild fruits were consumed more frequently than exotic fruits. Few families could afford the cost of purchasing commercially grown fruits, and most had limited access to land and water to cultivate their own (Shackleton *et al.* 2000). Overall, only 17 % of households in this region felt that dietary preferences were moving away from indigenous fruits, although Hansen (1998) did record a statistically significant decline in wild fruit use between the "past" (99 % of households) and "present" (77 % of households). This decline was ascribed to the fact that children, as the primary gatherers of wild fruits, where now spending a significant proportion of their time in school rather than roaming the bush (Hansen 1998). A decrease in fruit tree abundance was considered another contributing factor (Shackleton *et al.* 2000). *S. birrea* is, however, likely to continue to be important for beer brewing as there are few substitutes for the uniquely flavoured beverage it produces.

Over the past few decades there has been a noticeable growth in the local (endogenous) trade of marula and other wild products as household demands for disposable income increase (e.g. McGregor 1995, Brigham *et al.* 1996, Shackleton *et al.* 2000). Traditionally, across a range of ethnic groupings, the sale of marula beer and other products was strictly taboo. Whilst this appears to have become largely redundant, there are still some areas, such as northern Maputaland in South Africa, where such customary norms continue to be respected (Cunningham 1989). Cases in which men have refused to allow their wives to sell beer have also been recorded (Shackleton *et al.* 1995).

Women are mainly involved in trading in marula products, and income from sales tends to be highly variable (Shackleton *et al.* 2000). In Bushbuckridge (South Africa), Shackleton *et al.* (2000) found that some 15 % of households surveyed were trading in various indigenous fruit (both processed and raw), earning on average between US$87 and US$149 per annum. The principal fruits/fruit products sold were from *S. birrea*, *Strychnos madagascariensis* and *Strychnos spinosa* and most trading took place in summer (73 % of traders). The most profitable business reported an income of as much as US$820 per month for a limited period from selling *S. birrea* beer during winter (Shackleton *et al.* 2000). There are clear indicators that trade in marula and other wild plant products is increasing. For example, in the 2000/2001 marula season we observed over eight marula beer stalls on a 10-20 km stretch of road between Bushbuckridge and Thulamahashe. Such roadside vendors were rarely seen a few years ago. Beer was selling for slightly less than US$1 per 2 l bottle at these stalls. A similar trend has been observed in Namibia. In the past marula beer was made only for home consumption, but now can be found for sale in most street markets. Prices vary according to location and proximity to the resource. For example, one litre of beer sells for US$0.23 (N$2) in rural areas, US$0.37 (N$3) in urban markets within the production area (occasionally for US$0.62 (N$5) early in the season or if very superior quality), and up to US$1 (N$8) in urban centres far from the production area (P. du Plessis pers comm.). There are also reports of marula beer and wine being sold in Zimbabwe (Gumbo *et al.* 1990), Swaziland (despite it being illegal) (Edje 2000) and the former Venda, South Africa (Mabogo 1990). Kernels are also often sold and fetch much higher prices than fruits on the local market at US$3.71/kg as opposed to US$0.02/kg for fruits (Shackleton and Shackleton 2000). Although incomes from selling wild fruit products are generally low, they provide an important source of cash for women and are often used to help pay school fees or purchase any requirements children might need for school (uniforms, books) (Shackleton and Shackleton 1997). Children also often sell wild fruits to neighbouring households or at school for pocket money, or exchange fruits that they have collected for other food such as milk and meat.

Use and trade in carving wood

Marula wood has been traditionally used for carving pestles and mortars, bowls, drums, beehives and stools (Dalziel 1948, Watt and Bryer-Brandwijk 1962, Mbuya *et al.* 1994, Clarke *et al*. 1996) and even, in some areas (e.g. Malawi), for making canoes (Coates Palgrave 1956). In Madagascar the wood is used to make ox wagon wheels (P. Phillipson pers. comm.). It is a soft, splinter free wood that is easily carved, but tends to be susceptible to infestations of woodborer (Watt and Breyer-Brandwijk 1962), Lyctus beetle and sap stain fungi (Immelman *et al.* 1973). A survey of *S. birrea* use in three southern African countries revealed that in Mbengarewa (western Zimbabwe) 55 % of households were using marula wood to make utensils, whereas none in northern KwaZulu Natal or Inhaca Island reported using the wood for this purpose (Cunningham *et al.* unpubl.). In the Mutanda Resettlement Area, Zimbabwe, *S. birrea* formed one of the three most popular species for making musical instruments (Grundy *et al*. 1993).

In the region bordering the Kruger National Park in South Africa, *S. birrea* forms the highest volume of wood used in the growing local woodcarving industry (Steenkamp 1999). In 1998 approximately 33 cubic metres of marula wood entered the market (Steenkamp 1999). Trees are harvested to carve animal figurines (giraffes, leopards and antelope) ranging in size from less than 30 cm to more than 2 m tall. These are sold mainly at the roadside to tourists (Steenkamp 1999). The carvers purport to use only male trees, but local community members declare that female trees are also being harvested as pressure on the existing resource base increases (Shackleton and Steenkamp submitted). This potential conflict of interests is of concern to development workers in the region, particularly since marula fruits are not just important for household consumption but are also being widely traded. The use of marula for commercial carving has also been reported in Zimbabwe (Braedt and Standa-Gunda 2000).

There are various reports that *S. birrea* was used extensively during colonial times for manufacturing tomato boxes and toilet seats (Palmer and Pitman 1961, Shone 1979). Other uses for the wood include furniture, panelling, flooring, laminated products, box shooks and manufactured articles such as shoe heels (Immelman *et al.* 1973).

Use of other marula products

The shells of marula nuts are often used as kindling and are a good source of fuel (Lombard *et al.* 2000). Some women report that the hot nuts provide an effective heat source to use in coal irons (Lombard *et al.* 2000). Dried nuts may also be used to make necklaces that traditionally symbolise love (F. Chiloane pers. comm.).

Wood from male trees is sometimes used for firewood. Indeed, extension officers have been reported to encourage the use of male trees for this purpose, in spite of customary laws that prevent felling (Shackleton 1993). Quantitative work has indicated that the use of marula for fuelwood is relatively high in some areas. For example, Cunningham *et al.* (unpubl.) found that 97 % of households in Sihangwane, Northern Kwazulu-Natal were using marula for fuelwood, as were 65 % in Zimbabwe. In the case of the latter, the wood was mainly used for firing bricks. By contrast, none of the people interviewed on Inhaca Island were burning marula. In some parts of southern Africa removal of male trees has been so severe that female trees have ceased to be productive and so are also felled (R. Leakey pers. comm.).

The bark has medicinal properties and is used widely in treating dysentery and diarrhoea, rheumatism, gangrenous rectitis, insect bites, burns and a variety of other ailments (Dalziel 1948, Watt and Breyer-Brandwijk 1962, Khan and Nkanya 1990, Kokwaro 1993, Hutchings *et al.* 1996, Morris 1996, Lombard *et al.* 2000). In the Zomba district of Malawi an infusion of the bark is used for treating coughs and throat infections (Morris 1996). Medicinal uses of the root are also numerous. Decoctions, infusions or steam from boiled roots is used to treat heavy menstruation, bilharzia, coughs, weakness, sore eyes, heart pains and as an antiemetic (Gelfand *et al.* 1985). Essence from the leaves provides a remedy for abscesses, spider bites and burns. The leaves are also used as a sedative (Descheemaeker 1979). Both bark and leaves are said to have antiseptic and astringent properties (Jenkins 1987, Khan and Nkanya 1990). Noristan did preliminary tests on crude extracts of marula bark and found weak pharmacological activity in respect to hyper-tension, anti-inflammation and pain killing (von Teichman 1983). The use of bark as a malaria prophylactic or cure has been widely reported, although there is, as yet, no pharmacological evidence to support its efficacy in malaria treatment (Watt and Breyer-Brandwijk 1962, Morris 1996, van Wyk and Gericke 2000).

As well as medicinal uses, there are reports of the bark being used as an insecticide in Tanzania (Khan and Nkanya 1990). Venda women are said to use ground bark mixed with soft porridge to wean and strengthen their babies (E. Mabogo pers. comm.).

The frequency of use and amounts of bark and leaves used for medicinal purposes appears to be relatively low. Cunningham's *et al.* (unpubl.) survey revealed that only a relatively small percentage of households use marula products for medicinal purposes (between 2 % and 48 %). However, this is an area where almost no quantitative data exists.

The gum secreted by *S. birrea* is rich in tannin and is used to make ink by dissolving it in water and adding soot (Dalziel 1948, Watt and Breyer-Brandwijk 1962, FAO 1995, ANU 1999). The San of Namibia and Botswana use marula gum as a carrier for a poison made from crushed *Polyclada* beetle larvae. This is applied to the tips of their hunting arrows (ANU 1999). In Northern KwaZulu-Natal the bark of *S. birrea* is sometimes used for dying ilala palm leaves prior to weaving (van Wyk and Gericke 2000) or fish nets (Pooley 1980). The colours obtained are generally shades of mauve, pink, brown or red (van Wyk and Gericke 2000). Use of *S. birrea* bark for dye has also been reported from Madagascar (Perrier de la Bathie 1946). In West Africa *S. birrea* ashes are used with those of other species to dehair goat skin before tanning (Dalziel 1948).

Sclerocarya birrea is one of the primary hosts for the parasitic mistletoes that produce "woodroses". Woodroses are flower-like, woody outgrowths produced in response to the parasite. They are harvested and sold as curios providing income to collectors (Dzerefos 1996).

The species is also host to a variety of butterflies and moths which produce large, edible saturniid caterpillars (*amaCimbi* in Zulu) (Pooley 1980, 1993). These caterpillars are collected, their skins spilt and the insides squeezed into a pot. The contents are then roasted and eaten. The cerambycid wood-boring beetle larvae (*Izi Mpunge* in Zulu) that occur under the bark of *S. birrea* trees are also commonly consumed (Dalziel 1948, Pooley 1980, 1993, Cunningham 1985). They are found by tapping the tree until a hollow sound indicates a hole, which is then investigated and the larvae extracted (Pooley 1980). These larvae are cooked in their own fat.

The fruits and leaves provide nutritious fodder for livestock especially during the winter months (Holtzhausen 1993). The fruits are used by the Zulus as an insecticide particularly for destroying ticks (SEPASAL 2001).

CULTURAL AND RITUAL IMPORTANCE

Beliefs and biological factors: fecundity, symbolism and ancestor spirits

The first section of this review highlights some of the biological features of *S. birrea* in which specific cultural practices are rooted The cultural importance of *S. birrea* is easy to understand. As has been clearly illustrated in the preceding section, few African tree species have as many uses or are such productive bearers of multi-purpose fruits. Quite literally, *S. birrea* trees are valued from the seedling stage (as a palatable browse for livestock) to rotten stumps (a source of edible cerambycid larvae). Amongst these many uses of all parts of the tree, three factors, however, provide the basis for the main cultural beliefs linked to *S. birrea.*

Firstly, and most important, the high fruit production of mature female trees. The implications of this from a cognitive anthropological perspective are discussed later in this section.

Secondly, the dioecy of *S. birrea*. Amongst VhaVenda traditionalists in South Africa, for example, powdered bark from male marula trees is used to "select" a male child and bark from a female tree for a girl (Shone 1979, Mabogo 1990).

Thirdly, the pink colour of the inner bark and red phloem, coupled to the dioecy of this species, add to the symbolic significance of *S. birrea* from a traditional African worldview. In many societies, red is the colour of blood and is frequently related to pregnancy and menstruation (Berglund 1976, Knight 1991). It is not surprising therefore, that such a favoured fruit and kernel, should find a place in traditional fertility rituals and first fruits ceremonies in southern Africa, particularly in landscapes with sandy, low arable potential soils where seasonal food scarcity is common. From a traditional African worldview, there are strong links between the fecundity and productivity of these female trees, of farmed fields and of women. Gertsner (1939), suggested that the Zulu name for *S. birrea, umganu,* was probably derived from the word *gana*, which means "to marry or become betrothed" (Doke and Vilakazi 1964). Although active ingredients are found in *S. birrea* bark and leaves which support some traditional medical uses, such as in treating diarrhoea (Hutchings *et al*. 1996), the psychosomatic role of symbolism and ritual practice in health practices should not be underestimated. Symbolic associations with *S. birrea* are a good example of this. Gerstner (1939), for example, recorded the bark as being used "as a blood cleansing emetic before marriage". Amongst VhaVenda people an infusion of *S. birrea* and *Combretum kraussii* bark is used to "support pregnancy [and] for treating barrenness and illnesses related to fertility" (Mabogo 1990). In Zimbabwe, an infusion of *S. birrea* roots are drunk to treat heavy menstruation (menorrhagia) (Gelfand *et al*. 1985).

Sclerocarya birrea herbal preparations are also widely used in southern Africa for their protective function and in purification rituals (Gelfand *et al.* 1985, Shone, 1979). Amongst the Ndebele community in Zimbabwe, for example, an infusion of roots and leaves is traditionally used to wash the body of a person to prevent a malevolent spirit from possessing a member of the family (Gelfand *et al*. 1985). A similar protective use was recorded by Bryant (1909) nearly a century ago, where the traditional healer, prior to treating an infectious disease (phagedaenic rectitis) "commences by fortifying himself against the danger [of infection] in that he bathes his body beforehand in a decoction of *umGanu* (*Sclerocarya caffra*) bark". Shone (1979) also records a "concoction" of *S. birrea* bark as "taken internally during purification rites to remove defilement from food eaten in the house of relatives where there has been a death without the performance of the necessary purification rites".

Although the protective function of an active ingredient may be involved (as Bryant (1909) suggested on the basis of the reported use of *S. birrea* as an ascaricide and which has been cited many times since then but not substantiated), the religious symbolic function of this ritual is more likely to account for its protective and purification uses. Apart from the use of *S. birrea* in purification and protection, the common factors are either the red/pink symbolism of the bark /roots or, more likely, the ritual connection between a herbal medicine from *S. birrea* and ancestor spirits (who play a protective role). This link to ancestral spirits is also shown in Zimbabwe, where *S. birrea* roots are mixed with *Tapinanthus* twigs to make an infusion which is "taken by mouth" (and probably blown out) to call the ancestor spirits (Gelfand *et al.* 1985). A *S. birrea* nut is also used as one of the Tsonga divination "dice" apparently to represent the plant kingdom or herbal medicines (Watt and Breyer-Brandwijk 1962, Shone 1979). The strongest links between *S. birrea* and ancestor spirits however, are demonstrated through rituals associated with brewing marula beer, through first fruits ceremonies and traditional religious offerings made at *S. birrea* trees which are commonly used as family land shrines.

Community, ceremony and marula beer

As a result of religious and socio-economic change, first fruits ceremonies celebrated through traditional African religion are no longer common in southern Africa. Formerly, they were widespread and first fruits ceremonies linked to *S. birrea* have been recorded in Mozambique, South Africa and Zimbabwe (Junod 1938, Watt and Breyer-Brandwijk 1962, Cunningham *et al.* unpublished). In KwaZulu-Natal (South Africa), for example, a specific song, the i*ngoma* or *ingoma yenkosi*, was a unifying event sung at a national occasion where ancestor spirits (*amadlozi*) were present. This was described in detail by Krige (1936). Although the national first fruits ceremony no longer occurs

(Berglund 1976), local first fruits ceremonies associated with *S. birrea* are still conducted in more remote parts of southern Africa.

The four stages of the marula first fruits ceremony (*ubukanyi*), which is named after the tree, was described in detail by Junod (1938) on the basis of work in Mozambique and South Africa from 1895 to the early 1900's. Today, marula first fruits ceremonies are still well known in many parts of southern Africa, are not necessarily practiced. In the Ingwavuma district, KwaZulu-Natal (South Africa), for example, first fruits ceremonies are seldom held, despite it being an area where many traditional religious practices continue to be followed. In a survey conducted in Mberengwa area of western Zimbabwe in 1990, however, nearly 30 % of respondents participated in first fruit ceremonies. These usually involved making *S. birrea* fruit beer by a special group of elders in the area, pouring some of it on the ground and communing with the ancestral spirits. On Inhaca Island, Mozambique the biggest and first ceremony is celebrated within the Nhaca family; the traditional owner of the island. Following from this, most families on the island make their own ceremony where only the old people participate (Cunningham *et al.* unpubl.).

In common with other important traditional religious events where the ancestral shades are present, the marula first fruits ceremony may involve the ritual slaughter of a goat or, in an event described to one of us (Cunningham pers. obs) in 1983, a black bull. This process is known in Zulu as *umsebenzi* (literally "work", but referring specifically to the ritual slaughter for the ancestors (*ukuhlablea amadlozi*) (see Berglund, 1976). This takes place at a specifically selected *S. birrea* tree, where an offering of marula beer in a clay pot is made to the ancestors at a ceremony where the local traditional leadership, spirit mediums (*izangoma*) and traditionalists in the community are involved.

Far more widespread, however, are firstly, the presentation of marula beer to traditional leadership and secondly, offerings to ancestor spirits made at specific *S. birrea* trees by individual families (rather than the larger community as described above for first fruits ceremonies). The presentation of the first brewed marula beer to traditional leadership still takes place annually in several rural areas of southern Africa (Shone 1979, Cunningham 1985, Mabogo 1990). In areas where this occurs, household consumption of marula beer is not supposed to take place until the first beer has been presented to traditional leadership (either local headmen or the chief).

Less obvious, but very sincere, are the offerings to ancestor spirits made at specific *S. birrea* trees which are the land shrines of individual families. These are evident in the form of the horns of ritually slaughtered cattle or goats which are placed in the fork or branches of a specific *S. birrea* tree usually hear the homestead, and in containers (glass bottles, beer pots) placed at the base of the tree. On some occasions (observed many times during fieldwork in the Ingwavuma district, South Africa (1980-

1990) by Cunningham), a white cloth known as a *palo* is bound around the base of the tree as a sign that the tree is the altar of the ancestors (Junod 1938). This practice and the colour of the cloth are highly significant. The white cloth symbolizes the ancestor spirits, cleanliness and purity. Ritual offerings contained in bottles have also been observed placed at the bases of selected *S. birrea* trees in farmed fields (Mkuze district, South Africa, 1990) rather than near the homestead. Whether these relate to requests to the ancestor spirits to positively influence the productivity of the field, someone in the family or some other reason is uncertain.

The social function of marula beer

Out of all *S. birrea* products, it is marula beer, which has the most significant role at the confluence between the local community, the ancestor spirits and *S. birrea* trees in the landscape. Two reasons are likely to account for the social significance of marula beer as a "social glue" in maintaining community cohesiveness in areas of southern Africa. Firstly, because grain crop surpluses are low and infrequent on the low arable potential, drought prone soils where *S. birrea* occurs and secondly, the superabundance of fruit which can be fermented to make an alternative, very tasty beer (with the various symbolic implications of this, as described above).

This social function of marula beer is similar to, but far more seasonal than that of traditional beers made from *Sorghum, Pennisetum, Eleusine*, or more recently, maize or commercially brewed beers. Beer from grain crops have an important and more widespread social role at many significant points in life: at weddings, in offerings to ancestors, at funerals, conflict resolution rituals and after communal work parties, for example in farming or when a hut is moved to a new site (Krige 1936, Cunningham and Gwala 1986). In rural Zimbabwe, for example, *chisi* (plural: zv*isi)* days when people rest from hunting or agricultural work in their fields are still widely observed, and beer drinking and offerings of beer to ancestors, are a significant aspect of these days (Lan 1985). Marula juice was similarly used as an offering to ancestors, in purification rituals and in communal celebrations (Junod 1938). Although it is possible to store marula beer in sealed pots underground, storage is uncommon. As a result, recreational or ceremonial brewing and consumption of marula beer is highly seasonal. This limits its wider ceremonial use during the year far more than with grain brewed beer, as grain can be stored for longer periods. The seasonal peak in marula beer consumption is certainly noticeable, however, in terms of brewing and consumption, but very significantly not in terms of marula beer sale.

Although marula beer brewing is done by women from extended families, it can also be a communal activity (Rodin 1985). Whether this brewing is done individually or communally, the first of the fermented beer comes under wider local political control, as described briefly in the previous section.

The customary rule requiring the first of the marula beer to be given to the local traditional leadership is one of the ways in which local political control is reinforced (Shone 1979).

Although this differs in some ways from a similar process which takes place amongst the Tembe-Thonga communities of southern Mozambique and the Ingwavuma district, KwaZulu-Natal (South Africa), the customary rule that no general beer-drinking is allowed until the presentation of the first brewed marula beer has taken place is a common component. What differs is that in the Ingwavuma district, marula beer was taken to the homestead of the local headman or traditional leader, rather than being left under a tree. Whether the "testing" described by Shone (1979) is for the "best" tasting beer - or whether to test for *idliso* (poisonous medicines which are placed by jealous rivals in food or beer) is debatable. In many cases the person presenting the beer is required to taste it on presentation. Historically, the processes of beer brewing and distribution of the first brewed beer involved large numbers of people and extended far more widely than they do today as described by Junod (1927).

The popularity of marula beer was evident during a study done on the palm wine trade in the Ingwavuma district in the early 1980's, which monitored sale of palm wine over an 21 month period (Cunningham 1990). Although regional palm wine sales were high (over 976 000 litres/yr), they plummeted during the marula fruiting season when an alternative (and far better tasting) alcoholic beverage was available. For example, at one of the main sale points (esiCabazini) which sold over 288 000 litres of palm wine/yr, monthly palm wine sales dropped from an average of around 37 750 litres/month during the four months preceding the marula brewing season (October - January) to about 20 000 litres/month during the season when marula beer was available (February - April). Unlike palm wine, however, marula beer was not sold in this area, but was brewed and consumed communally. A similar customary prohibition on sale applies in Zimbabwe to grain brewed beer used on *chisi* days as offerings to ancestors (Lan 1985) and until recently, has applied to marula beer in other parts of southern Africa. Mabogo (1990), for example, records that "*mukumbi* has recently entered the markets as most people do not have time to collect fruit and make their own". We suggest that this move towards commercialisation of marula beer is more a symptom of social, religious and political change than purely a lack of time, and illustrates some of the complex social and cultural factors that need to be taken into account in decisions on whether to commercialise a product or not.

POTENTIAL ECOLOGICAL IMPACTS OF USE

The many and varied uses of *S. birrea* complicates identification and estimation of potential impacts of harvesting because of potential synergistic effects. Since (i) marula fruits have been harvested by humans for centuries, and (ii) there has been no study of impacts resulting from increased human population densities, or commercialisation, it is only possible to identify potential areas for concern that require systematic and ongoing assessment in areas of high harvesting rates.

Harvesting of fruits

Lombard *et al*. (2000) stated that "harvesting of fruit from marula does not present any direct environmental risk". This may be the case, but needs further examination since fruit collection for human use could potentially impact on the regeneration rate of the species. Data for other important fruit species indicate that both situations are possible. For example, in his study on the impact of seed harvesting on populations of the tagua palm (*Phytelephus seemannii*) in Columbia, Bernal (1998) found that over 80% of the seed could be harvested without negatively effecting the palm populations. These tagua ("vegetable ivory") palm fruits have a higher economic value than marula fruits and are easier to find - yet historical, high intensity collecting appeared to have had no long term effect. On the other hand, research on other species, also with an apparent abundance of fruits, have indicated declines in recruitment and altered size structure profiles over the long-term in the face of increased harvesting (e.g. Boot & Gullison 1995, Peters 1999).

The fact that *S. birrea* germinates readily and can also be propagated via truncheons means that it should be possible to readily replace stocks if fruit harvesting reduces recruitment in the long term, although care should be taken to ensure the maintenance of genetic diversity by using materials of very different origins. However, it is necessary that an 'early-warning' system is in place to detect such shifts and implement appropriate interventions before fruit supplies are reduced, with negative impacts on local rural livelihoods and incomes. Thus, in areas where increasing commercialisation is occurring or envisaged, it is necessary to (i) implement a simple and replicable monitoring system of plant densities, recruitment and size profile, and (ii) a rational harvesting strategy that ensures an acceptable proportion of fruits remain unharvested each year as a means of promoting recruitment. Such unharvested fruits are also available for other vertebrates and invertebrate species that make use of marula fruits.

Harvesting of other components

The real impacts of bark harvesting for medicines, and trunks and branches for carving, will vary according to the frequency, intensity and extent of harvesting, at both the level of an individual tree, and each population. Marula is a renewable resource, and consequently it is possible that some proportion of the population, however large or small, can be harvested on a sustainable basis. Whether or not this can be achieved in practice depends upon a multitude of factors, including social, economic as well as ecological. In situations where harvesting is unsustainable at the local scale, there will be a decline in the size structure and density of trees over a period of time. This will in turn impact on other species that make use of *S. birrea*. However, the main factors that will have a negative impact on marula populations are: (i) the felling of the trees (e.g. for timber as occurred commercially in South Africa (Shone, 1979)) and, (2) high mortality of seedlings (either due to fire or through frequent, intensive browsing of the seedlings by livestock and wildlife).

CONCLUSION

There is no doubt that the marula is important to rural communities for a wide range of reasons. It is essential that its role in the lives of millions of people in southern Africa is not underestimated, nor jeopardised by competing commercial pressures. As a wide-ranging and drought resistant species, the marula is particularly important in times of hardship, and it is at these times that its continued existence within communal lands can be crucial for human survival. While it is anticipated that commercialisation of species such as marula will bring financial benefits to communities, this must not be to the detriment of the subsistence sector, or sustainability of the resource itself. Against this background, issues relating to commercialisation are examined in Part 2 of this review in the next edition of the journal.

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Table 1: Abundance of *S. birrea* in protected areas across a rainfall gradient (MAR) in the central lowveld (South Africa).

Locality	**MAR (mm)**	**Density**		**Basal area**		**Biomass**	
		Stems/ha	%	m^2/ha	%	t/ha	%
Arid	500	16.8	0.3	1.27	12.8	4.67	20.3
Semi-arid	670	107.5	1.9	1.35	15.6	6.22	30.7
Mesic	> 850	37.7	0.2	1.22	8.7	5.22	12.6

* Note: stems/ha refers to stems, not individuals. A single tree may have > 1 stem, especially small individuals (< 1 m tall).