55. Frankincense and Myrrh – imperilled divine symbols of religion’s duty to conserve biodiversity

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Introduction

Frankincense and myrrh (Figure 1) are aromatic resins that have had spiritual significance since ancient times. Like so many other species, the scrubby trees and shrubs in Northeast Africa and the adjacent Middle East, from which these are obtained, are suffering from severe degradation of their dryland habitats as well as unsustainable overharvesting. Because of the respected, indeed sacred status of the plants in many cultures (Groom 1981), they are ideal subjects for eliciting concern not only for their welfare, but for the survival of all wild creatures. While this review deals primarily with Christian religious–biodiversity relationships, it needs to be understood that numerous religions and spiritual faiths have critical roles to play in the conservation of nature (Azad 2012; Bhagwat, Dudley, and Harrop 2011; Negi 2005; Tomalin 2009; Troster 2008).

History

Although linked with many belief systems, today frankincense and myrrh are particularly associated with Christmas. Most people are acquainted with the story of the Magi (commonly known as Wise Men and Kings) who delivered gold, frankincense and myrrh, luxuries in antiquity, to honour the baby Jesus (Figure 2). In fact, these were standard gifts for potentates in the ancient world: gold as a precious metal; frankincense as a perfume and incense; and myrrh as an anointing oil. In those early times, frankincense and myrrh rivalled gold in value.

In the classical period, frankincense, myrrh and allied resins were precious commodities in scarce supply. They have been burned in religious ceremonies for perhaps 5000 years, tracing back to major pre-Christian civilisations such as Babylonia and Assyria. Frankincense and myrrh became staples of the trade in incense, which was essential for temple rituals throughout the Mediterranean and Southwest Asia. Indeed, the usage far exceeded consumption in modern times. Trade routes were established to bring aromatic resins from their sources to chief markets, including Egypt, Greece, Mesopotamia, Persia and Rome. The ‘Incense Trade Route’ or ‘Incense Road’ of Antiquity included land and sea trading pathways joining the Mediterranean world with eastern and southern sources. Frankincense, myrrh and other resins were, in fact, the basis of what is believed to be the oldest global supply chain. The frankincense and myrrh trade was centred in Arabia, which became extremely wealthy as a result of exporting not just resins but also spices from India to the great civilisations of the times. Frankincense was marketed from Arabia as long ago as 3000 BC, first to Egypt and later to the Parthian and Roman Empires. Curiously, in the early years after
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and when hardened becomes a barrier that stops pests and prevents loss of water (Langenheim 2003). The resins have appreciable economic and medicinal value (Su et al. 2015), and have been employed culturally for millennia, both for religious and social purposes (Ben-Yehoshua, Borowitz, and Hanuš 2011). Acquiring the resin involves tapping or cutting the bark to release sap, which hardens and is then collected. There is some controversy regarding whether the most important species today are the same as those that were employed in ancient times (Tucker 1986).

Psychoactivity

Frankincense and myrrh are occasionally said to have ‘narcotic’ properties, a contention that is usually vigorously denied because narcotics are viewed very pejoratively and therefore their use in religion seems unacceptable. Nevertheless, as will be documented later, there is scientific evidence consistent with induction of mild psychoactivity (such as sedation and pain relief) by both substances. As will be pointed out, the aromas (which combine taste and smell) of frankincense and myrrh seem to be psychoactive in a limited sense, perhaps altering human psychology in ways that complement spiritual experience. This is reminiscent of the usage in many spiritual traditions of much more powerful hallucinogens or psychedelics (e.g. peyote by the Native American Church). A more apt comparison, perhaps, is the use of Sweetgrass (Hierochloe species, especially H. odorata) by many native North American tribes, who employ smouldering preparations in prayer, smudging

the rise of Christianity, incense was forbidden because of its association with pagan worship, and for centuries thereafter frankincense and myrrh became obsolescent in Europe. Later, however, their usage in some denominations resumed.

Although frankincense and myrrh have always been primarily employed as spiritual incenses and fragrances, they have also been significant medicinally. They have been employed to treat inflammatory conditions, some cancers, wounds and a very extensive range of other maladies, in the traditional medicines of Greece, India, Rome and elsewhere (Morikawa, Matsuda, and Yoshikawa 2017). Frankincense and myrrh later became staples of traditional Chinese medicine, where they have been used for at least 2000 years, and indeed China today is the world’s largest consumer of both resins. As described later, although their use in modern Western medicine is quite limited, frankincense and myrrh are considered to have promising medical potential.

The plants

Frankincense, myrrh and several similar plant extracts mentioned in this article are natural resins prepared from certain species of the Burseraceae family. This group is known as the Torchwood family, because the resinous wood burns vigorously, but it is also well known as the Frankincense and Myrrh family after its most famous representatives. The resinous sap produced by species in the family discourages herbivores by bad taste and toxicity, acts as an antiseptic cover for wounded areas, and when hardened becomes a barrier that stops pests and prevents loss of water (Langenheim 2003). The resins have appreciable economic and medicinal value (Su et al. 2015), and have been employed culturally for millennia, both for religious and social purposes (Ben-Yehoshua, Borowitz, and Hanuš 2011). Acquiring the resin involves tapping or cutting the bark to release sap, which hardens and is then collected. There is some controversy regarding whether the most important species today are the same as those that were employed in ancient times (Tucker 1986).

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and sacred purification ceremonies. ‘Entheogens’ are substances, usually derived from plants, employed sacramentally in a shamanic or spiritual context to induce altered consciousness. (See Brown and Lupu 2014 for the ancient use of entheogens in Christianity.) It is unwise to associate frankincense and myrrh with conventional narcotic substances, but it may well be the case that they do positively affect religious experiences, like music, art and costumes traditionally associated with sacred rituals.

**Frankincense**

Frankincense, also known as olibanum, is an aromatic resin commercially produced by several deciduous species of *Boswellia*. The curious word ‘frankincense’ may have originated from Old French, *franc encens*, meaning ‘pure incense’, and the word ‘olibanum’ from Arabic *luban*, meaning ‘white’, a reference to the clarity of the resin droplets. Frankincense has been used as an incense since ancient times, when the trade was maintained as a monopoly by discouraging competitors through the rumour that winged serpents protected the source trees which could only be tapped by an elite tribe. Indeed, frankincense became the most lucrative commodity in the ancient world, and to this day is the most popular of the aromatic gum resins used as incense in religious ceremonies. *Boswellia* includes about 20 species of shrubs and short trees found from tropical west Africa to the arid Horn of Africa, south to Tanzania and Madagascar, to the southern edge of the Arabian Peninsula and north to India. Resin from many of the species is harvested for perfume, incense, cosmetics, aromatherapy, flavouring, sacrament and medicinal purposes. In dry weather, droplets of milky sap can ooze from species of *Boswellia* and dry on the plants (Figure 3) or accumulate as translucent amber-coloured drops (‘tears’) on the ground. While these can simply be gathered, the bark is commonly slit to encourage yield of sap, and the dried resin is collected two or three weeks later (Figure 4). Frankincense yield per tree per season can vary between 40 and 3000 g, depending on tree size, tree health and site conditions (Tolera et al. 2013b).

Frankincense is extremely fragrant, particularly when burned, producing a sweet, citrusy scent. As in ancient times, frankincense is used at present mainly to manufacture incense, particularly for the Roman Catholic (Figure 5b) and Greek Orthodox Churches. In antiquity, people often had personal frankincense burners for use in rituals in their residences, and today artistic frankincense burners are marketed for general incense use (Figure 5a). Frankincense has been said to be a ‘narcotic’ (Dolara et al. 1996), which exaggerates its effects. At least, it has been shown to have psychoactive components which ‘may provide a biological basis for deeply rooted cultural and religious traditions’ (Moussaeiff et al. 2008). Note the later discussion of myrrh as also having similar effects.

Distillation of frankincense resin typically yields about 6% essential oil (i.e. volatile terpenoids), although higher amounts can be obtained from better quality material (Shackley 2007). This liquid is used for perfume and aromatherapy, and it is also employed in cosmetics, hair-care products and soaps. Gum extracted from the resin occasionally serves as a chewing gum, which is sometimes considered to be medicinal.

Frankincense is antibiotic against microorganisms, including bacteria and fungi, and so its antiseptic properties have been useful in many herbal medicine applications over the millennia, and today also in toothpastes and mouthwashes. Ancient civilisations of the Middle East, India and China used the resin in various medicinal preparations. Employed as an incense or fumigant, frankincense may have been valuable in repelling mosquitoes from transmitting diseases such as dengue fever, malaria and West Nile Virus. In modern times, frankincense is also employed in several ointments, especially to treat arthritis and other inflammatory conditions, and its chemical composition (Badria 2015) and medical potential have been studied (Al-Yasiry and Kicgorowska 2016; Bansal et al. 2013; Moussaeiff and Mechoulam 2009).

**Figure 3. Boswellia sacra** (Frankincense Tree) showing sap that has oozed from cuts in the bark and hardened into resin. Photo by Mauro Raffaelli (CC BY SA 3.0).
Figure 4. ‘Gathering frankincense in Arabia’, a woodcut from: Paré, A. 1579. Les oeuvres. Gabriel Buon, Paris. The crude drawing of the tree makes its identification uncertain, but this very early illustration captures the spirit of resin collection. Source of photo: The National Library of Medicine, https://collections.nlm.nih.gov/catalog.nlm:nlmuid-101434563-img.

Figure 5. Use of frankincense as incense. (a) Frankincense burners. Photo by Mike Rosenberg (CC BY 2.0). (b) Use of swing censers by altar servers to produce clouds of smoke, a tradition at Mass and other Catholic liturgical services. The Catholic Church is thought to be the principal consumer of ceremonial frankincense. Photo by Raimond Spekking (CC BY SA 4.0).
However, there are numerous advertisements for products containing frankincense that make bogus or exaggerated medical claims (Ernst 2008). Although sometimes used as a spice to flavour candies and baked goods, and even consumed in pharmacological preparations, internal use is regarded as slightly hazardous.

The three most important species for the frankincense trade are discussed next. *Boswellia frereana*, mainly from Somalia, is a less significant source and is not discussed in detail here. In Western nations it is called ‘Coptic Frankincense’ in recognition of its use by the Coptic Church of Egypt.

**1) Boswellia sacra (Frankincense Tree, Sacred Frankincense)**

The best known frankincense species is *B. sacra* (Figures 6 and 7). This is also known as *B. carterii*, although some claim the latter name designates a different species (for example Woolley et al. 2012). It occurs in drylands from Somalia to the Gulf of Aden in Yemen and in Oman in southern Arabia. Most of the supply comes from Somalia, Oman and Yemen. The largest area of native occurrence of this species is in northern Somalia.

![Figure 6. Boswellia sacra (Frankincense Tree). Old trees in Oman. (a) Photo by Mauro Raffaelli (CC BY SA 3.0). (b) Photo by Francesco Bandarin (CC BY SA 3.0).](image)
India. The extracted frankincense from the tree has been used for millennia in traditional, especially Ayurvedic medicine in the region, and a considerable amount of medicinal research has been conducted for this species (Engels 2010). An article on *B. serrata* published by Rijkers et al. (2006) raised alarm that frankincense trees were becoming endangered. Subsequently considerable sustainability research has been carried out on this species.

**Myrrh**

After frankincense, myrrh is the second most important commercial source of aromatic incense resin. The word ‘myrrh’ is based on the ancient Acadian *murru*, from the Arabic *mur* and the Hebrew *mar*, meaning ‘bitter’. The symbolic bitterness associated with myrrh traces to its use in the materials employed for Christ’s embalmment and as a constituent of the final wine drink offered to him on the Cross. At the time of the Crucifixion, it was believed that myrrh had narcotic properties, and it was offered to prisoners about to be put to death to lessen their anxiety (Moussaieff and Mechoulam 2009).

*Sweet Cicely* (*Myrrhis odorata*) is an old-fashioned culinary herb which is poorly known today. It is sometimes referred to as Myrrh (or British Myrrh), perhaps because it is also aromatic, and this has led to some confusion with the *Commiphora* species discussed in this review.
Myrrh is obtained from species of Commiphora, a genus with about 200 species, occurring mostly in drier areas of Africa, but ranging into Arabia and the Indian subcontinent (Mahr 2012). The species discussed here are deciduous, and for much of the year (the dry season) are leafless. Myrrh resin is extracted in much the same way as frankincense. The viscous pale-yellow sap hardens into reddish-brown tear-shaped masses, which are very fragrant, bitter, and acrid in taste. When burned, myrrh produces a piney odor.

Like frankincense, myrrh has a long history of use as incense in religious. Its ancient use as a holy incense continues today in some Christian traditions, and by those who simply like to employ incense. Myrrh is also used as a fragrance in cosmetics, soaps and perfumes.

Myrrh was employed as an embalming agent for the ancient Egyptian pharaohs, and indeed its smell can sometimes still be noticed when burial tombs are excavated. Myrrh continued to be used to protect dead bodies from decay and deterioration until the fifteenth century.

Myrrh was employed to flavour wine in antiquity, and to this day is sometimes a constituent of alcoholic and non-alcoholic beverages. To a very minor extent, it is also used as a flavouring agent in candy, baked goods, chewing gum, gelatins, frozen desserts, puddings and meat products (Engels and Brinckmann 2012). ‘Maidi’, a type of frankincense from B. frereana, is popular in the Arab world as a naturally scented, white chewing gum, which is not bitter like the gum of B. sacra.

Myrrh does have medicinal properties, and an extensive record of usage in various cultures for medical purposes (Engels and Brinckmann 2012; Shen et al. 2012). It is occasionally present in antiseptic, disinfectant or healing preparations to treat skin conditions such as bruises and acne, in liniments, toothpastes, mouthwashes, cough mixtures, and treatments for digestive disorders. It has often been used to treat gut parasites, notably schistosomiasis, a disease caused by flatworms which affects over 250 million people in tropical and subtropical regions. However, it has been judged to have limited therapeutic value for this condition (Abdul-Ghani et al. 2010; Osman et al. 2010). The use of myrrh in attacking cancer cells is under exploration.

The three most important species for the myrrh trade are discussed next.

(1) Commiphora myrrha (Myrrh)

The most notable source of myrrh is C. myrrha (also known as C. molmol). This is a shrub or small tree growing up to 4.6 m or 15 feet, covered with spines and peeling bark (Figure 10). It occurs on shallow soils, often over limestone, in open bushlands. The species is native to the Horn area of eastern Africa (including Kenya, Ethiopia
and Somalia) and adjacent Arabia (including Oman, Yemen and southwestern Saudi Arabia). Most of the supply of myrrh comes from Somalia and Ethiopia.

**(2) Commiphora wightii (Guggal, Mukul Myrrh)**

Some species of *Commiphora* in India are in considerable danger as a result of overharvesting for their resin for traditional (Ayurvedic) medicine, the dominant medical system of the country (Figure 11b). Notable of these is *C. wightii* (also called *C. mukul*; Figure 11a) of the Indian states of Rajasthan and Gujrat and adjoining regions of Pakistan where it has been rated as ‘Critically Endangered’ (Ved et al. 2015). This is a small tree or shrub growing to 4 m (13 feet) in height, but usually no more than 2 m (6.6 feet). The resin is variously known as Indian bedelium, gugal, guggul, gugul and Mukul myrrh, It is extensively employed medicinally (Atal, Gupta, and Afaq 1975; Chaudhary 2012; Sarup, Bala, and Kamboj 2015) and has potential for expanded use (Bhatia et al. 2015). The tree also grows in northern Africa, and is cultivated (Kumar, Mishra, and Sharma 2012), so it is not in imminent danger of extinction. However, conservation attempts are underway to maintain it as a significant commercial source of resin (Harish et al. 2014; Kulhari et al. 2012, 2014; Kulloli and Kumar 2014; Soni 2010; Soni and Swarnkar 2006).

![Figure 10. Commiphora myrrha (Myrrh). (a) Somalian worker collecting resin. Photo by Somalia Ministry of Information and National Guidance (CC BY SA 2.0). (b) Spiny branches. Source: Köhler (1883–1898).](image)

![Figure 11. Myrrh in India. (a) Commiphora wightii (Guggal). Its resin is a staple of traditional Indian (Ayurvedic) medicine. Photo by Geethaka 99 (CC BY SA 4.0). (b) An Ayurvedic pharmacy in India. Photo by Ken Wieland (CC BY SA 2.0).](image)
(3) **Commiphora gileadensis (Balm of Gilead)**

Like frankincense and myrrh, Balm of Gilead (sometimes called Balm of Mecca) is linked to the Bible: ‘Is there no balm in Gilead; is there no physician there? Why then is not the health of the daughter of my people recovered’ (Jeremiah 8:22). Gilead was a mountainous region situated in modern Jordan. The identity of the plant used at the time has been debated. Balm of Gilead is now usually interpreted as *C. gileadensis* (also called *C. opobalsamum*), a shrub or small tree (Figure 12) growing up to 4.6 m (15 feet), found in the Arabian Peninsula, Egypt, Ethiopia, Somalia and Sudan. In ancient times, Judea was the major commercial source. In antiquity, balm of Gilead was harvested from the Dead Sea region for about 1500 years, making ancient Judaea wealthy. The Bible (1 Kings 10) relates that the

![Figure 12. *Commiphora gileadensis* (Balm of Gilead). (a) Drawing of shrub from Engler (1910). (b) Painting of leafy branch from: Petronella, J.M. Pas. 1881. University of Amsterdam https://dpc.uba.uva.nl/.

![Figure 13. 'The Visit of the Queen of Sheba to King Solomon'. Note gifts to the king at bottom left. Painted by Edward Poynter in 1890, housed in and photographed by the Art Gallery of New South Wales (public domain photo).](image-url)
Queen of Sheba gave balm of Gilead to King Solomon of Israel as a gift (Figure 13), a visit also recorded in the Koran (Highet 2006) that would have occurred about 950 BC. (Information about the Queen and her visit is problematical; Groom 1981.)

In antiquity, balm of Gilead was in considerable demand for an extremely wide range of medicinal uses, although the supply has always been limited. In modern times it is being examined for its medicinal potential (Iluz et al. 2010), and is included in some extremely expensive perfumes. Occasionally it is cultivated as an ornamental (Eslamieh 2011).

Economics

In ancient times, the harvest of frankincense and myrrh was much larger than today. Because of instability in the areas of production and export, it is not possible to obtain reliable statistics on quantities harvested or exported in modern times, and frequently collective statistics for several gum crops are all that is available. It has been estimated that about 2,500 tonnes of frankincense and myrrh collectively are currently traded annually (Laggan 2011). It has also been estimated that Ethiopia exported 14,978 tons of resins (mainly frankincense, myrrh and gum Arabic) over the period 2003–2007 with a total value of US$21.53 million (Tilahun et al. 2011b). Shackley (2007) stated for the trade in frankincense ‘a figure of 5,000 tonnes/year is probably about right, although it is probable that ten times this amount is harvested locally and used domestically throughout the Middle East.’

Somalia, Sudan and Ethiopia are the largest producers of frankincense. Ethiopia is generally regarded as the largest producer. Lemenih and Kassa (2011) stated that 3384 tons of frankincense were exported in Ethiopia in 2007/08, but local use was about 10,000 tons. The market value of frankincense varies from about US$5.00 to $70.00 per kg (Mertens, Buettner, and Kirchhoff 2009). Shackley (2007) estimated that 50% of the frankincense harvest today goes towards the perfume, aromatic and medicinal trades, which is a reflection of the decreasing use for incense, the primary usage in the past and still the most important product.

Reliable global production figures for myrrh are unavailable, but exports are likely, as with frankincense, only a few thousand tonnes, at most. Somalia, Ethiopia and Kenya have been traditional exporters, with most consumption in China and Saudi Arabia. The market price of good quality myrrh is usually somewhat greater than for frankincense, but at present most available material is rather inferior (Engels and Brinckmann 2012).

Gum or resin collection in northeastern Africa and the adjacent Middle East is economically significant as a source of income for poor people in rural areas. It has been estimated that Ethiopian frankincense woodlands could generate US$58.00 per ha per year, employing 30,000 seasonal employees (Tilahun et al. 2011a). Men are usually involved in tapping and harvest, while predominantly women process (sort, grade) the material for export.

Frankincense, myrrh and related resins are employed in several industries, including food and beverages, perfumery, cosmetics, pharmacology and insecticides (Lemenih and Teketay 2003). China has become the world’s largest consumer and importer of frankincense and myrrh, for use in traditional medicines (Shen and Lou 2008).

The frankincense and myrrh ecological crisis

In recent times, about 90% of the world’s myrrh has come from Somalia, and much of the frankincense from Yemen. Unfortunately, these and other source countries in the Horn of Africa, the native area of the trees, are plagued with poverty, corruption, civil strife and war. Desperate for income, expanding populations in the region have been forced to overharvest the wild trees, weakening them. However, these plants are adapted to utilisation of scarce water resources, and their survival is key to combating desertification.

Many arid and semi-arid lands have been employed for thousands of years by nomadic pastoralists, and are simply inappropriate for permanent crops, sometimes because of unsuitable soils but usually because of the absence of sufficient water. It is essential to respect the natural limitation of such lands, and the species producing frankincense and myrrh can play very important economic roles in these situations (Hassan et al. 2011). Regrettably, the lands of northeastern Africa are in very perilous ecological condition, not only because of desertification, but also due to climate change, farmland expansion, overgrazing, fires set by people, and harvesting of the meager natural woodlands (Fenner 1982). Compounding the difficulties, natural herbivores are making survival difficult for frankincense and myrrh plants: elephants are fond of some Commiphora species, and sometimes severely damage trees in South Africa; and beetle attacks cause significant damage to Boswellia papyrifera in Ethiopia (Groenendijk et al. 2012).
The religious and ethical dimensions

Religions are central to basic beliefs and ethics that influence people’s behaviour and should be considered more seriously in biodiversity discourse… a greater involvement of religious communities in the conservation discourse, and a greater inclusion of conservation issues in religious ethics, could be beneficial for biodiversity… Amongst the various religions the Roman Catholic and Orthodox Churches have the greatest potential to support biodiversity conservation, as they are the dominant religions in areas important for global biodiversity.

– Mikusiński, Possingham, and Blicharska (2014)

Unfairly, frankincense, myrrh and related resins are collected by very poor people for meager financial rewards (Lemenih, Feleke, and Tadesse 2007) while high profits are earned by middlemen and retailers of the products. It is also unseemly that these very scarce resins are being employed for expensive perfumes and in many medicinal compounds for which their validity is doubtful. Perhaps the most contentious usage of frankincense and myrrh is in customary religious ceremonies – understandable because of their sacred significance, but debatably appropriate since their present utilisation endangers the survival of part of the natural world created by God. As noted in the textbox quotation by Mikusiński, Possingham, and Blicharska (2014), the Catholic and Orthodox Churches are in a particularly strategic position to play an important role on behalf of biodiversity. Since they are the principal consumers of frankincense and myrrh, they have a special responsibility to promote an environmentally responsible, sustainable industry associated with the production of these commodities. St. Francis of Assisi (Figure 14) epitomises an admirable respect for nature by a Christian luminary. St. Francis’s namesake, Pope Francis, issued an extensive and eloquent statement on the need for mankind to respect biodiversity (see textbox and Francis 2015).

The earth’s resources are… being plundered because of short-sighted approaches to the economy, commerce and production. The loss of forests and woodlands entails the loss of species which may constitute extremely important resources in the future, not only for food but also for curing disease and other uses. Different species contain genes which could be key resources in years ahead for meeting human needs and regulating environmental problems… It is not enough, however, to think of different species merely as potential ‘resources’ to be exploited, while overlooking the fact that they have value in themselves. Each year sees the disappearance of thousands of plant and animal species which we will never know, which our children will never see, because they have been lost for ever. The great majority become extinct for reasons related to human activity. Because of us, thousands of species will no longer give glory to God by their very existence, nor convey their message to us. We have no such right.

– Pope Francis (2015)

There are attempts underway by fair-trade and rural-poverty development agencies to address the problems posed by current excessive resin harvesting in Africa, but political instability in the region is making progress very difficult. It has been estimated that 60% of myrrh exported from Ethiopia is channelled through illegal markets (Gizaw et al. 2014). Shackley (2007) stated, with respect to frankincense, ‘Estimating the world’s annual production is difficult since much resin is harvested and

Figure 14. St Francis of Assisi, born in Italy about 1181 or 1182, and noted for preaching that it is the duty of mankind to protect nature since it was created by God. He is regarded as the patron saint of animals, and in 1979 Pope John Paul II declared him to be the patron saint of ecologists. Painting (public domain) by Albert Chevallier Tayler in 1898.
exported illegally to avoid taxation, with the trade being increasingly dominated by powerful cartels in the United Arab Emirates.’

Consumers need to address the difficult issue of whether their purchase of frankincense and myrrh products is, on balance, ethical.

**What needs to be done**

Finding paths for ecologically and socially sustainable development in post-conflict regions of Africa poses a tremendous challenge... we conclude that trade would not be hampered by environmental conservation. The harvesters would benefit from more vigilance of the trade mechanism with effective social and environmental policy... Furthermore, plant products have important renewable characteristics that deserve attention in development planning in such highly impoverished areas. Minimal infrastructure is needed for developing such an economic base and such a sector can very quickly help to bring in capital for other sectors of the economy to develop while creating incentives for environmental conservation.

– DeCarlo and Ali (2014)

**Is cultivation a solution? Perhaps!**

An important issue for natural habitats is whether using the lands for conventional crops produces superior profits by comparison with maintaining them in their original state and simply harvesting their bounty in a sustainable way. Unfortunately for natural biodiversity, wild resources such as honey, firewood and fodder often cannot compete with the value of crops grown on the same land. In areas of poverty, this is a critical consideration, as poor people are strongly motivated to maximise limited income, even at the cost of destruction of natural habitats and endangering biodiversity. Drylands, such as occupied by frankincense and myrrh species, are of special concern, since by definition water is limited by natural conditions, and given that fresh water is becoming scarcer, the conversion of natural drylands to croplands is problematical. Moreover, drylands are naturally very low in productivity, and slow-growing vegetation usually cannot be forced to be more productive without ecological damage to natural ecosystems.

There is good reason to believe that harvesting of natural Frankincense and Myrrh woodlands is often at least as profitable as using the same lands agriculturally (Dejene, Lemenih, and Bongers 2013; Tilahun et al. 2007), and so such ecosystems should be protected not just for ecological ideals but also for economic purposes. In some areas, collecting resin is a more profitable use of land than crop production, and accounts for most of the income of households (Tolera et al. 2013b).

There is an unmet demand for frankincense and myrrh, and it may be that it simply is not possible to supply the marketplace with wildcrafted material. (‘Wildcrafting’ refers to the gathering of uncultivated plant and fungal resources, mostly from natural habitats.) When demand for a wild crop exceeds the supply to the point of endangering its survival, it is time to consider replacement or supplementation of wild collection with domestication and cultivation of the species. Most major crops are grown in areas where they are not native, but Frankincense, Myrrh, and related resin plants are finely tuned to the special, very stressful conditions of their particular dryland habitats, making it very difficult...
Believe it or not

- In ancient Egypt it was thought that frankincense was the sweat of gods, fallen to earth (Highet 2006). The classical Egyptians also believed that the legendary Phoenix Bird constructed its nest from frankincense twigs and fed on the plant’s coagulated resin drops.
- It has been claimed that the emperor Nero (54–68 AD) burned the entire supply of frankincense available in Rome at the funeral of his favourite mistress (or wife) Poppaea (Sellar and Watt 1996).
- In the Middle Ages, balm of Gilead was sold by weight at twice the price of gold – the highest price ever achieved for an agricultural commodity (Ben-Yehoshua, Borowitz, and Hanuš 2011).
- There have been occasional health scares about the use of frankincense-based incense in religious rituals, and warnings not to inhale too much smoke. Within the Anglican Communion in the U.K., the faction opposed to the introduction of the ‘Catholic’ use of incense has sometimes complained that this injects too many pollutants into poorly ventilated churches, causing coughing. In response, the more Catholic-friendly faction has characterised the coughing as a sham ‘Protestant cough’ (Shackley 2007).
- Frankincense was charred and ground into a power to prepare an important component of kohl, a

Is habitat management the answer? Yes!

Frankincense and myrrh are currently wild resources commonly placed in the category ‘Non Timber Forest Products’, although their ‘forests’ are more properly called woodlands or savannahs. They, along with their ecosystems, can only be maintained by sustainable harvesting (Lemenih and Kassa 2011; Eshete, Sterck, and Bongers 2012), which in fact has been practised for perhaps 5,000 years, until recently. It is essential that conservation strategies oriented to local conditions be formulated (Attore et al. 2011).

Figure 16. Heavy eyeliner worn by classical Egyptians. As noted in the text, frankincense was a key ingredient of kohl, a preparation employed to blacken eyelids and eyebrows. (a) Painting of the young pharaoh Tutankhamun (died ca. 1323 BC) on a lid for a canopic container (to store viscera during mummification) in the Cairo Museum of Egypt. Photo by D. Denisenkov (CC BY-SA 2.0). (b) Bust of queen Nefertiti (stepmother of Tutankhamun; died 1331 BC) in the Neues Museum, Berlin. Photo by Arkadiy Etumyan (CC BY-SA 3.0).
heavy, black eyeliner Egyptian women (Figure 16b) and sometimes men (Figure 16a) wore in a fashion that would be considered highly exaggerated today. Eyelids were heavily smeared, thick lines rimmed the eyes, and often kohl was used to outline the eyebrows and enhance facial tattoos. The poor, who could not afford frankincense, sometimes employed fire soot.

Acknowledgements

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Disclosure statement

No potential conflict of interest was reported by the author.

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