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## The viability of propagules of alien plant species sold for traditional medicine in South Africa

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### ABSTRACT

Invasive alien species are routinely moved around the world as horticultural specimens. An additional route through the traditional medicine trade may exist, especially where cultures from different continents coalesce. South African traditional medicine, for example, has a long history of association with its Indian Ayurvedic equivalent via migration of people from the sub-continent as either slaves or indentured labour. This study investigated the occurrence and viability of alien species in South African traditional medicine markets and shops. Forty-two species of alien plants were found, of which 26 species were propagules and 22 were viable. Seven of the viable species are listed as invasive in South Africa. However, all but one of the 22 species that were tested and identified are known to be invasive somewhere in the world. Most of the viable alien species were sold as seeds, seedpods or nuts (64%,  $n = 14$  of 22 species) from Indian-owned shops, while mainly tubers, stems and rhizomes were found in African-run markets. Alien plant species moving within this trade route have circumvented all dispersal barriers and may have exerted propagule pressure over at least a century, and should therefore be considered as candidates for monitoring.

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### 1. Introduction

This paper investigates the viability of plant parts sold as traditional medicine, as propagules of potentially invasive alien taxa. Many invasive alien plants are regarded as conflict of interest species (Beinart and Wotshela, 2011) that simultaneously create problems and benefits for different members of human communities or natural ecosystems. Exotic medicinal plants fit this description, with some claims that such plants “will ultimately enhance the regions' biodiversity” (S. Semanya et al., 2012), and provide livelihood and health benefits, while at the same time being the subject of government clearing operations. Invasive alien plant species (IAS) cost South Africa at least R6.5 billion per year, which if unmanaged will multiply by a factor of six (Van Wilgen et al., 2008; De Lange and Van Wilgen, 2010). The National Resource Management Programme of the Department of Environmental Affairs [formerly known as Working for Water (WfW)], however, manages IAS in South Africa through an extensive clearing programme that is combined with the biological control of 48 plant species (Moran et al., 2013). The NRMP also funds a unit of the South African National Biodiversity Institute's Invasive Species Programme (SANBI ISP), which

provides post-border risk assessments of IAS with a view to eradicating appropriate target species, or to feedback information to NRMP, for longer-term management of prospective weeds (Wilson et al., 2013). This study thus informs the potential of traditional medicine to serve as a source of IAS.

In some developing countries knowledge of IAS may be poor, especially concerning naturalized species (Pyšek et al., 2008). South Africa is somewhat of an exception to this as many publications on the topic have appeared in recent years, (e.g. Rouget et al., 2015) accompanied by new legislation incorporated in the National Environmental Biodiversity Act of 2014 (NEMBA, 2014), which lists 379 terrestrial and freshwater species of invasive plants. The SANBI SUSPECT (Species Under Surveillance – Possible Eradication or Containment Targets) list includes a further 112 species of concern, which are being considered for eradication or management by WfW (Wilson et al., 2013).

Both indigenous and alien plants are used and sold as traditional medicines (*umuthi*) in South Africa. Because the routine focus of ethnomedicinal studies has been on indigenous flora, including the impact of trade, comparatively little has been published about the alien taxa employed compared to their indigenous counterparts (Dold and Cocks, 2000; Thring and Weitz, 2006; S. Semanya et al., 2012; S.S. Semanya et al., 2012). These few studies revealed, however, a small number species in common between widely separated consumers and also the widespread use of certain species like *Ricinus communis* (L.)

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var. *communis*. What has not been examined, however, is the viability of the plant parts sold in outlets catering to consumers of traditional medicine.

Ethnomedicinal surveys in Johannesburg documented alien taxa being sold in outlets, known as *umuthi* shops and markets, between 1992 and 2001 (Williams et al., 2000; Williams et al., 2001; Williams, 2007). These taxa included *Acorus calamus* L., *Cinnamomum camphora* (L.) J. Presl., *Eucalyptus* spp., *Hedychium gardnerianum* Ker Gawl. and *Opuntia* spp. In addition, notable numbers of mostly unidentified seeds were also being sold that were frequently imported from India (e.g. *Helicteres isora* Linn. and *R. communis*) and sold in Indian-owned *umuthi* shops (Williams et al., 2000), suggesting that the traditional medicine trade could be a source of new alien introductions, or at least a mechanism for the redistribution of exotic plants in South Africa – but the contribution of traditional medicines to the spread of alien weeds has largely been overlooked.

The South African traditional medicine trade is an extensive, largely unregulated system, which is alleged to cater for a major proportion of the population's primary healthcare needs (Mander et al., 2007). Although this assertion is largely untested, we do know that more than 130,000 traders or harvesters sell over 70,000 t of plant matter per year (Mander et al., 2007). This material is traded in semi-formal markets, of which the two largest are situated in Johannesburg and Durban, and in more formal *umuthi* shops in those cities and others, some of which are owned by Indian proprietors. Much of South Africa's Indian population are descendants of indentured labourers, brought from the Indian subcontinent in the 19th Century to work the sugar cane fields of the Natal Province (now KwaZulu-Natal) (Flint, 2008). These immigrants brought with them their own indigenous medicine systems, some of which has subsequently been incorporated into South African traditional medicine practises (Flint, 2006; Williams, 2007; Flint, 2008).

From surveys conducted in 1992 and 1995, Indian traders (especially Tamil-speaking) were found to be a notable component of the South African traditional medicine trade (Williams et al., 1997); and, while not currently as dominant in the trade as they once were, they continue to be an important conduit for commerce in plant medicines in urban areas, especially with regard to importation of non-indigenous material. Tamils use the Ayurvedic and Siddha medical systems (Soundrapandi, 2006), and for the early immigrants access to indigenous Indian foods and medicines in South Africa was initially restricted. In the absence of traditional remedies in South Africa, the Tamils discovered substitute plants in the KwaZulu-Natal flora and subsequently acquired knowledge of Zulu healing plants and practises. This knowledge also led to a few Tamils opening the first *umuthi* shops in South Africa (probably around Newcastle) in the latter half of the 1800s, following which shops were opened up on the Witwatersrand in the 1900s (S. Dorasamy, pers. comm., 2008).

Some Indian traders continue to maintain familial and trade links to the Indian State of Tamil Nadu. For example, one Johannesburg trader reported that his company imports seeds of at least 20 different species for medicine and/or food, usually from Tamil Nadu (Wojtasik, 2013). This, along with the other alien plants species known to be in the *umuthi* trade (Cunningham, 1988; Dold and Cocks, 2000; Williams et al., 2000; Williams et al., 2001; Von Ahlefeldt et al., 2003; Williams, 2003; Thring and Weitz, 2006; Williams, 2007; S. Semanya et al., 2012; S.S. Semanya et al., 2012; Wojtasik, 2013), suggests that the traditional medicine trade presents a route into South Africa for alien species and a potential mechanism for their spread within the country.

The first step towards acknowledging and managing a risk should be a quantification of its extent. Leung et al. (2012) developed a framework, dubbed 'TEASI', to assess risks posed by IAS at each phase of invasion, which they characterized as having five stages in the Transport, Establishment, Abundance, Spread and Impact of IAS (TEASI). Trading in an alien plant immediately promotes any species through the first four stages of TEASI, vaulting them over the initial obstacles to invasion listed by Richardson et al. (2000). Relatively rapid importation

overcomes major geographical barriers, while storage as a foodstuff may ameliorate biotic and abiotic environmental obstacles at the site of introduction by protecting potential propagules from predation and climate. Reproduction barriers will be overcome by repeated introductions of seeds and vegetative reproductive parts especially if viable propagules are part of the merchandise. By distributing such merchandise between *umuthi* shops and markets, local and regional dispersal barriers will be surpassed. Finally, any remaining environmental barriers in human-modified or alien-dominated vegetation will be circumvented if traditional medicine consumers or vendors decide to propagate a plant themselves, rather than repurchase it in the future.

Some plants travel and propagate more easily than others, and may have additional traits which make them more likely to transform into an invader in a new habitat. Nevertheless these traits, although important, are often not generalized characters since they are to a large extent stage- and habitat-specific (Pyšek and Richardson, 2007), making prediction of invasiveness difficult (Williamson and Fitter, 1996a, 1996b). However, a history of invasiveness elsewhere, and association with, in particular, large numbers of humans where disturbance will be greater, are probably the two best predictors on the invasive potential of a species (Thuiller et al., 2006). Again, species used as medicine are likely to possess both of these traits because they are moved and traded over relatively long distances, as exemplified by the castor oil plant *R. communis*, which is now cosmopolitan, having originated in East Africa and the Mediterranean region (Govaerts, 2014).

The parallels between horticultural plants and traditional medicine products are apparent. Traits such as ease of cultivation along with rapid growth and reproduction, all of which make ornamental plants "good garden subjects", contribute to the invasion success of introduced species (Dehnen-Schmutz et al., 2007a). A low unit price, indicating popularity and simple propagation along with the length of time each species has been present in a market, increases the probability of invasion (Dehnen-Schmutz et al., 2007b). Therefore repeated introduction through local markets will increase the likelihood of establishment, as a pre-cursor to invasion, if the plant is sold as a viable propagule of some sort.

Mean residence time in the country of introduction is probably the most important characteristic in predicting the likelihood, or not, of invasion (Dehnen-Schmutz, 2011). Groves et al. (2003) and Groves (2006) defines 'sleeper weeds' as those species that have been in a country for more than 50 years, and have in that time substantially increased their population size. Richardson (2001) states that 1825–1860 covers the main period of most alien plant introductions into South Africa. The date of introduction of plants associated with Ayurvedic medicine is largely unknown. However, more than 150,000 Indians arrived in South Africa as indentured labours from 1860 to 1911, which although later than Richardson's dates, falls well within the 50-year sleeper weed stipulation. Sleeper weeds have a long lag phase, which can be used to management advantage to assess their invasive potential before they explode into full invasion (Hulme, 2012). Because such sleepers have a low conversion rate to invasiveness, they are suitable subjects for management by the 'scenario planning' proposed by Hulme (2012), in which uncertainties about a particular weed system are analysed with a view to designing alternative management strategies specific to particular species. Any information on the viability of plants being imported into the traditional medicine trade will go some way towards reducing unknowns about those species, and lead to consideration for incorporation in the SANBI Invasive Species Programme for South Africa (Wilson et al., 2013), or a watch list as proposed by Faulkner et al. (2014).

Unlike the horticultural plant trade, which operates under the expectation of viability of its products, plant viability in the traditional medicine trade is unknown as the products are not necessarily sold as viable propagules. Nevertheless seeds, and to some extent tubers, have evolved as long-distance dispersal mechanisms and would be expected to take intercontinental redistribution in their stride.

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