ALIENS IN THE NURSERY:

ASSESSING THE AWARENESS AND ATTITUDES OF CAPE TOWN NURSERY MANAGERS IN REGARD TO INVASIVE SPECIES REGULATIONS

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PLAGIARISM DECLARATION

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ABSTRACT

The horticultural industry is recognised as one of the major pathways for the introduction and spread of invasive alien plants (IAPs). In recognition of this, the South African government has recently enacted a new set of Alien and Invasive Species regulations, under the National Environmental Management Biodiversity Act (NEMBA), that are intended, in part, to improve controls on the horticultural industry's role in the spread of IAPs. In order to assess, and possibly enhance, the likely effectiveness of NEMBA, it is critical to build an understanding of stakeholders' awareness and attitudes towards the control of IAPs and associated regulatory policies. A two-pronged approach – involving nursery manager interviews (n=30) and plant stock audit assessments (n=41) – was used to gauge the awareness, compliance and attitudes of Cape Town nursery managers towards the NEMBA regulations. Results showed that less than ten percent of the city's audited nurseries were compliant with the NEMBA regulations, and that over fifty percent were stocking IAPs that have been regulated for at least thirteen years under a previous set of regulations (the Conservation of Agricultural Resources Act, CARA). This is despite high levels of awareness about the CARA regulations reported in the interviews, reported enthusiasm for compliance, apparent concern for the environment, evidence that managers understand the problems that IAPs cause, extensive reported support for the control of IAPs, and a reportedly strong sense of duty to protect the environment. The vast majority (73.5%) of IAP species found in nurseries were NEMBA category 1b invaders such as *Nerium oleander, Lantana montevidensis* and *Canna indica*. These are species that are widespread and well-established invaders that require control. This study suggests that a range of factors are likely to negatively influence compliance including a perceived lack of enforcement, weak communication from government, issues related to the clarity of the regulations, the lack of inclusion of the industry in the regulatory process, and a lack of awareness, with at least half of the managers reporting that they had not heard about the enactment of NEMBA. Any attempt to improve the impact of the new regulations will need to adequately address each of these factors. The results of the study suggest that enhancing the impact of NEMBA will require improving aspects of the legislation itself, and supplementing the current top-down approach to regulation with an inclusive partner-centred approach.

INTRODUCTION

Biological invasions pose one of the most serious threats to the integrity of ecosystems and biodiversity worldwide (Richardson et al, 2003; Gagliardi and Brand, 2007; Andreu et al, 2009). Negative environmental impacts of invasive alien plants (IAPs) include competitive exclusion of native species (Blossey and Notzold, 1995), increased fire frequency or intensity (Brooks et al, 2004) and changed hydrological cycles (Gorgens and van Wilgen, 2004). IAPs also adversely affect ecological processes that influence human health and economic development (McNeely, 2001) and, in South Africa, were initially largely regarded as a threat to agriculture (Richardson et al, 2003). Humans suffer the consequences of IAPs, but they are also primarily responsible for initiating the invasion process. Indeed, the first step in the progression of an invasion involves the human-mediated introduction of a species into an area outside of its native-range. Some of these new species will become invasive if the conditions are favourable (Richardson and Pyšek, 2006).

South Africa has a long history of human-mediated plant species introductions (Irlich et al, 2014), with records of such introductions dating back to 1652, when Dutch horticulturalist Hendrick Boom set up a garden in Cape Town for the Dutch East India Company (Pooley, 2009). Since then, alongside rampant globalisation, particularly of trade over the last century, biological invasions and associated impacts have escalated rapidly (Richardson et al, 2003). The human-mediated pathways by which invasive alien species arrive and spread within a region have attracted growing attention in the international and South African literature (Richardson et al, 2003; Le Maitre, Richardson and Chapman, 2004; Humair, Siegrist and Kueffer, 2014). This growing body of literature has demonstrated that the drivers behind biological invasions have important social and economic components that should be factored in when developing IAP management interventions. Traditionally, research on the problem of biological invasions has largely been addressed from a narrow ecological perspective (García-Llorente et al, 2008; Sharp, Larson and Green, 2011; Vanderhoeven et al, 2011). However, Richardson et al (2003) have argued that there is little point in exclusively focussing research efforts on improving our understanding of the ecological mechanisms of invasion, when our knowledge of the socio-economic mechanisms underlying the arrival and spread of IAPs is lacking. To be effective, management interventions aimed at preventing the introduction and spread of IAPs require a thorough understanding of IAP dispersal pathways, and the underlying social, economic and biological drivers of invasion.

The horticultural industry is recognised as one of the major pathways for the introduction and spread of IAPs around the world (Reichard and White, 2001; Mack, 2005; Dehnen-Schmutz

et al, 2007; Drew, Anderson and Andow, 2010; van Wilgen et al, 2012; Wilson et al, 2013). Due to reduced trade barriers, strong market demand and improved propagation techniques, the industry is growing fast, and is increasingly important for commercial trade within emerging economies (Humair, Siegrist and Kueffer, 2014). In South Africa, the horticultural industry represents a particularly important pathway for the introduction of IAPs. The escape of ornamental plants from cultivation and gardens is regarded as having caused some of the most extensive problems with regard to biological invasions in the country (Richardson et al, 2003). A prominent example is *Lantana camara,* a species that was introduced in the mid-1800s for horticultural purposes and is now ranked as South Africa's worst IAP in terms of its impacts on biodiversity (Le Maitre et al, 2004).

The horticultural industry facilitates plant invasions in two distinct ways: through an increase of propagule pressure, and through the selection and breeding of traits that are associated with enhanced establishment success (Dehnen-Schmutz et al, 2007). Propagule pressure is a measure of the number of introductions and the number of individuals in a propagule in each introduction and is an important predictor of invasion success. High propagule pressure can buffer introduced species from stochastic effects, thereby enhancing the likelihood of invasion. Thus, the more often a plant is available at plant nurseries, the greater the chance that it will be widely used in plantings, and the risk of invasion increases (Dehnen-Schmutz et al, 2007). Indeed, Dehnen-Schmutz and Touza (2008) found that the market availability of ornamental plants and the marketed prices of those plants directly influence invasion success. The other important way in which the horticultural industry contributes to the risk of invasion is through the selective breeding of traits that make for good and robust garden plants and that, therefore, also increase the chance that they will become successful invasive plants (Richardson et al, 2003; Dehnen-Schmutz and Touza, 2008). Ultimately, both invasion risk factors are driven by consumer demand for plants that are widely available, attractive, robust, cheap, and possess traits such as ease of propagation, as well as disease- and pest-resistance (Dehnen-Schmutz and Touza, 2008; Humair, Siegrist and Kueffer, 2014).

In Cape Town, the problem of invasions is compounded by the fact that the city is one of South Africa's fastest growing metropolitan areas (Alston and Richardson, 2006; South African Cities' Network, 2011; Goodness and Anderson, 2013). With over 3250 indigenous plant species occurring within the bounds of the Metropolitan area, Cape Town is widely regarded as a local hotspot of biodiversity within the Cape Floristic Region (CFR) which is itself recognised as a global biodiversity hotspot. Indeed, the Cape Flats region of the city contains the largest concentration of endangered and critically endangered indigenous plant species in the world (Holmes et al, 2012; Goodness and Anderson, 2013). These remnant

natural areas are increasingly encroached upon by urban development, expanding the extent of the urban-wildland interface, and bringing gardens and exotic ornamentals into closer contact with ever declining remnant patches of indigenous vegetation. Proximity to human habitation and the disturbance associated with spreading human settlements are important determinants of invasion (Alston and Richardson et al, 2006), making Cape Town's increasingly fragmented natural areas especially vulnerable to the escape and spread of ornamental exotics from suburban gardens.

South Africa's national government has identified the control of IAPs as a primary concern and, by 2006, had already enacted eleven national and provincial laws aimed at regulating the problems associated with IAPs (Paterson, 2006). Chief among these laws, until recently, was the Conservation of Agricultural Resources Act 1983 (CARA, Act No. 43 of 1983). In its original form, CARA listed 46 weeds (invaders of cultivated or waste lands) and 35 invasive exotic species (invaders of natural or semi-natural habitats), and was specifically enacted to manage the impact of IAPs on the agricultural sector (Montgomery, 2003). In 2001, the Act was amended to facilitate the regulation of IAP impacts on biodiversity conservation, and a new single list of 198 IAPs was developed. The amendments officially made it illegal to commercially sell or propagate any of the listed plants (Wilson et al, 2013). Despite the fact that CARA was promulgated over three decades ago, IAPs continue to spread across South Africa, costing the country an estimated R6.5 billion every year (de Lange and van Wilgen, 2010; Wilson et al, 2013). By 2011, however, there had not been a single successful conviction under this legislation (Badenhorst, 2011).

Paterson (2006) cites a number of potential reasons for the inefficacy of the CARA IAP regulations: a lack of public awareness about the problems caused by IAPs (despite awareness-raising campaigns); the narrow primary focus of the legislation on the agricultural sector; a lack of enforcement; reliance on a 'command and control' approach where government seeks to change and regulate behaviour using financial penalties; the absence of specific regionally relevant measures; a lack of provision for monitoring; and a lack of adequate fines or sanctions for non-compliance.

In 2004, in an attempt to transform biodiversity conservation legislation and develop a more coherent legislative framework to regulate IAPs, the South African government enacted the National Environmental Management: Biodiversity Act 2004 (Act No.10 of 2004), NEMBA (Wilson et al, 2013). Chapter five of the Biodiversity Act deals directly with invasive alien species. These invasive alien species regulations took ten years to reach completion, and were finally promulgated on 1 October 2014. The regulations list 379 IAPs which must be controlled and may not be imported, propagated, moved, or sold. These listed invasive

species constitute only 32% of all the total known IAPs in South Africa (Invasive Species South Africa, 2014). Of the 181 plant species that were added to those listed in CARA, 120 are ornamentals (Invasive Species South Africa, 2014). The NEMBA regulations list four categories of IAPs which require control. Category 1a includes emerging IAPs that require immediate compulsory control or eradication; Category 1b includes the most widespread and problematic species which require control and landowners must adhere to any associated management plans; Category 2 includes species which require permits for cultivation; and Category 3 includes species which require control within riparian areas.

It remains to be seen whether NEMBA will prove to be more effective than CARA in helping control the spread of IAPs. Some of the weaknesses in the CARA regulations have been addressed. For instance, NEMBA now provides region-specific regulations, where the status of certain species varies between provinces and may vary depending on the characteristics of the area. For example, some species may not be introduced into wetlands. In addition, provision is made for monitoring compliance with the regulations, and the new sanctions for non-compliance are far more severe (fines of up to R10 million or imprisonment of up to 10 years) and may serve as a more substantial deterrent. However, aspects of this new legislation continue to include at least two features that Paterson (2006) has identified as contributing to the limited impact of CARA. The NEMBA provision for monitoring compliance only requires that the Minister issue guidelines to develop monitoring plans *within a year* of the promulgation of the legislation. Thus, the impact of the new regulations is potentially weakened by perpetuating the current impression associated with CARA that there is a low likelihood of incurring sanctions. Another concern is the continued reliance on a 'command and control' approach that rests largely on the issuing of regulations that seek to control human behaviour by proscribing a set of activities

The 'command and control' assumption that effective and sustainable change in human behaviour can be achieved through legislation, regulation and sanctions alone or even primarily is increasingly regarded as problematic, even where there is effective monitoring and enforcement (Stern, 2000a; Dobson, 2007). The literature on motivation has long drawn a distinction between intrinsic and extrinsic motivation (Deci, 1972; Deci and Ryan, 1985), suggesting that sustainable and effective behaviour change that does not require constant enforcement is best achieved through promoting the intrinsic adoption of appropriate values rather than through extrinsic incentivisation of behaviour change through either the 'carrot' or the 'stick' (Dobson, 2007; Grant, 2008, Crompton et al, 2014). Change in behaviour based on a change in intrinsic values is generally associated with strategies that rely on education, communication, and involvement in order to build shared commitment to longer term objectives (Stern, 2000a; Dobson, 2007). Although it often entails more effort initially, the

suggestion is that attention to intrinsic values will pay off in the longer-term. In fact, in many areas, it may be the determinant of success (Dobson, 2007). In terms of this theory, informed cooperation and a more partnership-orientated approach is a necessary condition for effective change where reliance on extrinsic motivators will not produce or sustain appropriate behaviour. Although legislation and regulation have long been the key mechanisms applied by governments, recent literature suggests that these approaches should be supplemented by other mechanisms designed to secure cooperation based, as far as possible, on intrinsic commitment. This is particularly important in cases where reliance on external incentives and sanctions is not viable, sustainable, or will not lead to the desired or appropriate behaviour and effective results (Dobson, 2007).

Dobson (2007) argues that regulating behaviour through fiscal penalties does not produce lasting solutions to environmental problems and, at best, makes a superficial impression on human habits and practices. Instead, in order to secure more long-lasting behavioural changes, it may be necessary to target the underlying factors that direct behaviour such as beliefs, attitudes, and the situational pressures and personal capabilities that influence them (Stern, 2000a; Stern, 2000b; Ajzen, 2002; Dobson, 2007). In practice, international and local experience has shown that legislative tools that rely on financial incentives for directing behaviour have proven to have a limited impact on effectively preventing the spread of IAPs (Paterson, 2006; Humair, Siegrist and Kueffer, 2014), and fall short in their objectives of encouraging support for pro-environmental behaviour (Dobson, 2007). Reaser (2001) draws on psychology to provide an explanation for the shortcomings associated with traditional invasive alien species management systems. He argues that because invasive alien species are a by-product of human belief systems, effective control and management needs to be built on a thorough understanding of the underlying processes that direct and motivate behaviour. The link between human belief systems, values, motivation, behaviour, and the IAP problem, suggests that, in order to evaluate the likely effectiveness of South Africa's existing IAP regulations, it is important to build an understanding of stakeholders' attitudes and perceptions towards the control of IAPs and associated regulatory policies.

In South Africa, since the early 2000s, questionnaire surveys have been used to gauge nursery managers' awareness, perceptions and attitudes towards the CARA regulations and draft versions of the NEMBA regulations on invasive alien plants (Nurseries Partnership Education Programme, 2003; 2010; Badenhorst, 2011). These studies have provided valuable insights into the general perceptions of nursery managers but have limitations as a source for Cape Town-specific longitudinal data. Two of the three studies were focused on KwaZulu Natal nurseries and the first Nursery Partnership study was compromised by data that was too limited and statistically flawed to be used to draw sound inferences. The results

of these three studies revealed reasonably high levels of awareness amongst nursery managers about both sets of regulations, a general concern about the problems that IAPs cause, and high levels of compliance in terms of not stocking CARA-listed IAPs (Nurseries Partnership Education Programme, 2003; , 2010; Badenhorst, 2011). Although there were encouragingly high levels of awareness about the relevant legislation and apparent concern for the environment, most nurseries were found to be non-compliant with draft versions of NEMBA (Nurseries Partnership Education Programme, 2010; Badenhorst, 2011). This is not surprising, given that, at the time these surveys were conducted, the NEMBA IAP regulations were still in draft. Of potential concern, however, particularly with regard to the likely future effectiveness of the new regulations, is that most nursery managers expressed deep frustration at the lack of enforcement and the lack of government support for compliance with CARA (Badenhorst, 2011).

Given the recent promulgation of the NEMBA IAP regulations, it is important to re-assess perceptions of nursery managers that are likely to influence their response to this new IAP-control initiative. The focus of the study on Cape Town is important given that the city's increasingly fragmented and highly biodiverse natural areas are highly vulnerable to the escape and spread of ornamental IAPs from suburban gardens. To this end, the purpose of the present study was to assess the likely influence of Cape Town nursery managers' attitudes and level of awareness on compliance with the NEMBA regulations on IAPs. Specifically, the aim was to use a two-pronged approach focussed on nursery manager interviews and an analysis of plant stock audit data in order to address the following questions: 1) what is the current situation with regard to the stocking of NEMBA-listed and CARA-listed IAPs in Cape Town nurseries; 2) what levels of awareness exist amongst nursery managers about IAPs and the NEMBA regulations; 3) what are the attitudes of nursery managers towards the regulations and the control of IAPs; and 4) what are the factors indicated by nursery managers that influence compliance?

It is hoped that this study will contribute to improved understanding of ways in which regulation of the spread of IAPs through nurseries in Cape Town can be strengthened.

METHODS

Study area

The study was conducted in the Cape Town Metropolitan Area, which covers an area of 2 455 km² and extends northwards from the Cape Peninsula to the West Coast suburb of Mamre, and eastwards to Somerset West (Stafford, 2014). The Cape Metropole is characterised by a diverse matrix of mountains, remnant lowland vegetation and urban development. In the heart of the City, lies the Table Mountain National Park, a UNESCO World Heritage Site; and on the lowlands, a number of smaller nature reserves serve as conservation areas (Goodness and Anderson, 2013). These remnant vegetation patches contain some of the world's most endangered and critically endangered indigenous plant species (Holmes et al, 2012; Goodness and Anderson, 2013). The apposition of Cape Town's pristine indigenous vegetation and encroaching urban development means that the nursery industry in the metropole is a potentially important factor in the spread of IAPs across the urban edge.

Sample selection

A database of nurseries in the Cape Town Metropolitan Area was compiled using listings in the Yellow Pages telephone directory, the South African Nursery Association (SANA) membership list, the results of a *Google* search (key search words: plant nurseries in Cape Town) and listings on gardening websites. A total of 68 nurseries were originally identified. These nurseries were then pursued for participation in the two strands of the study: the nursery manager interviews and the stock audit assessments.

Prior to initiating the data collection, the Department of Environmental Affairs (DEA) was contacted in order to ascertain whether any existing plant stock audit data was available to be used in the study. The researcher was notified that the DEA's Biosecurity Department planned to conduct an audit of nurseries within the Western Cape after the promulgation of the new NEMBA IAP regulations. At the end of the audit period, the DEA official had conducted stock inspections at 47 of the 68 listed nurseries and made this audit data set available to the researcher. Ten of the nurseries in the database were found to have closed down. As several managers of trade association affiliated nurseries refused the DEA official permission to enter the premises to conduct the audit, only eight of the 22 listed SANA-affiliated nurseries were audited.

In order to enable a comparison to be made between the audit data and the interviews, the researcher focused interview sampling effort on only those nurseries that had been included in the DEA audit. However, the numbers were further reduced as, during the process of

arranging interviews with nursery managers, it became clear that branch managers of chain retail outlets were not well-enough informed to engage with questions regarding the stocking of invasive alien plants. Plant stock decisions at these outlets are made for the entire chain at a national level by a single head horticulturist. Indeed, the audit data revealed that nurseries belonging to a single chain of outlets carry the identical plant stock. In many cases these branch managers have no horticultural experience. In order to avoid pseudo-replication and interviews with managers with inadequate knowledge of plant stock, chain stores were excluded from the study sample. Overall, six nurseries were excluded from the analysis of the audit data, bringing the sample size to 41 nurseries in total. The managers of these nurseries were then approached for interviews in order to enable a comparative analysis of the resulting data. The process of triangulation using multiple data sources (Everest, 2014) helped to validate research findings.

Interviews were arranged with nursery managers until saturation of the sample population was reached. The managers of 28 out of the 41 audited nurseries were interviewed. This represents a response rate of 68% which is close to the established survey research baseline of ~75% (Kelley et al, 2003). As Kelley et al (2003) indicate it is not always wise to define an inflexible acceptable baseline response rate because local factors may make it difficult to reach the target. In this regard, it is important to note that the study was conducted over spring which is the busiest time of year for nursery managers and a period when plant sales peak. As a result, nursery managers were often hesitant to commit to an interview. Of the eleven nursery managers who could not be interviewed, two refused to have anything to do with the study, and the nine remaining managers were too busy to schedule an interview time.

In order to boost the sample size, two additional nurseries that had not been audited, but had formed part of the questionnaire pilot study (see '*Questionnaire design*' section below), were included, bringing the final survey sample size to 30. These managers responded to the same questionnaire as the others because there had been no need to change the questionnaire on the basis of the pilot study.

Data collection

In the nursery manager interviews, data was collected using a formal questionnaire. The DEA official responsible for conducting the independent audit recorded stocks of IAPs sold at individual nurseries using the NEMBA Alien and Invasive Species Lists (2014) and the amended (2001) CARA Declared Weeds and Invader Plants list and included only species that are listed as invasive within the Western Cape. Listed species for which legal sterile cultivars and hybrids exist were only included in the inventories if they were positively

identified as non-sterile forms. Given the difficulties of identifying cacti based purely on morphological characteristics and that many nurseries do not label cacti correctly; the DEA official responsible for the audit grouped all allegedly invasive cacti under one non-species specific inventory entry. As a result, cacti were excluded from the analysis. The auditing of nurseries was completed in two phases (one week in early October and one week in early November 2014) after which all data, including photographs and IAP inventories, were made available to the researcher for analysis.

The process of arranging interviews with nursery managers involved careful consideration of the sensitive nature of the research. Gaining access to research sites is particularly difficult when the research requires disclosure of information that is potentially incriminating. In these instances, it is essential to gain the trust of participants (Okumus, Altinay, and Roper, 2007). Given that the present study deals with issues of compliance with regulations, and the likely suspicion with which nursery managers would view the research, care was taken to build trust and a level of understanding about the purpose of the research. Because notifying people about a research survey beforehand usually elicits greater cooperation (Winter, Prozesky and Esler, 2007), telephonic contact was made with managers to arrange interviews and to provide a brief background to the study. Nursery managers were given a clear understanding of the independence of the research from government, and an outline of the content of the interview and how it would be used, including assurances that strict confidentiality and anonymity would be preserved. It was explained that, although compliance with legislation would be explored, the study was designed specifically to investigate some of the challenges faced by nurseries in complying with regulations. Once permission for the interview was granted, a more comprehensive background to the study was given in the form of a covering letter explaining the details of the research and the researcher (Appendix 1).

Nursery managers were invited to participate in structured face-to-face interviews. This method of data-collection was chosen for the study because personal interviews tend to generate a higher response rate than postal questionnaires or telephone interviews (Kelley et al, 2003). Previous nursery manager survey-based studies have highlighted the many advantages of face-to-face interviews. Laros (1991) indicates that the presence of an interviewer reduces the number of non-responses and allows for the clarification of questions. An interviewer questioning managers face-to-face can phrase explanations to sensitive questions tactfully and can gain insights into the reasoning behind answers (Badenhorst, 2011). Face-to-face interviews also capture respondents' attitudes and perceptions more accurately (Winter, Prozesky and Esler, 2007).

Twenty one nursery managers agreed to participate in face-to-face interviews. Several nursery managers indicated that they were too busy to schedule a fixed interview time and suggested unscheduled telephone interviews. The busy nursery managers that had expressed interest in the study were repeatedly telephoned during periods when few customers would be present (usually early morning and mid-afternoon) until the manager was able to participate in an interview. Nine nursery managers participated in telephone interviews.

It is important to acknowledge that the mixed data collection methodology used in the nursery manager interview-strand of the study may have implications for the homogeneity of the data. However, telephone interviews and face-to-face interviews both allow for a two-way interaction between researcher and respondent. Many of the advantages of face-to-face interviews therefore apply to telephonic interviews. Indeed, respondents interviewed over the telephone seemed no less willing to answer questions and to add explanations for their perceptions and attitudes.

Questionnaire design

The aim of the questionnaire was to draw quantitative and qualitative responses to assess the levels of awareness, compliance and attitudes of Cape Town nursery managers towards the newly published NEMBA regulations on invasive alien plants.

The questionnaire was subjected to review by experts from the University of Cape Town's Biological Sciences Department, the Centre for Invasion Biology at Stellenbosch University, the South African National Biodiversity Institute and the Department of Environmental Affairs. It was also tested in two pilot interviews conducted with managers from nurseries that were not included in the audit sample. These pilot interviews were intended to enable the researcher to identify possible areas of the questionnaire that needed refinement, and to ensure that the questionnaire length and questions were appropriate, and clear enough to ensure that respondents would understand questions. Given that the pilot interviews did not reveal any problems with the interview schedule, and that the questionnaire did not need to be altered, these two interviews were incorporated in the nursery manager survey analysis. However, given that the two nurseries were not audited during the stock assessment study, statistical analyses involving comparisons between interview and audit data excluded the pilot interview data.

The final version of the questionnaire included both closed-ended and open-ended questions. Closed-ended questions formed the bulk of the questionnaire because they are quick to administer and are generally more amenable to coding and analysis (Kelley et al,

2003). In cases where certain issues needed to be probed in more depth, and where all possible replies were too numerous to pre-code, open-ended questions were used. The response format of the closed-ended questions involved five-point Likert scales (Likert, 1932) allowing respondents to indicate their level of agreement with statements (1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree). Other closed-ended questions involved 'yes/no' response formats and variations on the Likert scale.

Interview duration varied from 15 minutes to 2 hours depending on the amount of discussion the questionnaire generated, and the amount of time the manager was able to spend on the interview. Most managers were willing to spend not much longer than 30 minutes away from work. This generally allowed for 15 minutes of discussion on key topics beyond the formal structure of the questionnaire. The content of the questionnaire is summarised below (see Appendix 2 for the full questionnaire).

Section A: Background information on nursery managers

The purpose of this introductory section was to obtain basic background information on nursery managers' experience and to determine whether trade association membership and nursery size (measured in annual turnover) influence levels of awareness, compliance and attitudes towards the NEMBA regulations.

Section B: Awareness about IAPs and associated regulations

Basic awareness of the regulations and their content is an obviously necessary condition for compliance. However, as Bremner and Park (2007) note more broadly, the key explanatory variable for public support for the control of invasive alien species is awareness of the problems arising from their spread. Thus, the second set of questions was aimed at collecting data on nursery managers' awareness of the newly enacted NEMBA regulations, knowledge of the plants on the NEMBA lists, access to information from government on IAPs and associated legislation, and awareness about the importance of controlling the spread of IAPs. Many conservationists (de Poorter in McNeely, 2001; Le Maitre, Richardson and Chapman, 2004; Bremner and Park, 2007) argue that the public will support IAP control initiatives provided that they have been given sufficient information and understand the extent of the problem. The questions aimed at assessing awareness of the problems associated with the spread of IAPs were deliberately left open to avoid pre-empting the responses and to capture the manager's actual formulation of the problem in order to assess the variation in understanding. This set of questions provided the basis for qualitatively assessing the level of awareness of nursery managers and exploring its possible association with compliance.

Section C: Compliance

The aim of this set of questions was to provide a basis for comparing respondents' stated level compliance with NEMBA and CARA against the nurseries' actual compliance as revealed by the audit. A nursery was defined as non-compliant if it was found to be selling one or more listed IAPs during the audit process. This section of questions also allowed for the opportunity to assess nursery managers' role in educating the public and building customer awareness about IAPs.

Section D: Attitudes and factors that influence compliance

Nursery managers' attitudes towards the NEMBA regulations were investigated by asking their opinions about its likely efficacy in helping prevent the spread of IAPs, and about their enthusiasm for complying with the regulations. Another set of questions aimed to determine factors that negatively limit and positively incentivise compliance. Managers were asked, for example, about the relative influence of various factors on compliance, including the expense of compliance, a lack of saleable alternatives for listed plants, consumer demand for IAPs, industry competition, a lack of enforcement, or a lack of involvement in the formulation of regulations. Managers were also asked to identify factors that enhance their motivation for compliance, such as a sense of environmental stewardship or a fear of breaking the law. This section also allowed for the opportunity to assess the nature of the relationship between government and the nursery industry.

Data analysis

For open-ended questions, results were summarised by reading through respondents' answers, grouping major concepts and recording the number of respondents that mentioned each concept. Most of the open-ended and close-ended responses were analysed in the programme Statistical Package for the Social Sciences version 22.0 (SPSS) using measures of frequency.

In order to identify the underlying factors that influence whether a nursery is compliant or not, a Multiple Correspondence Analysis (MCA) was conducted. Potential underlying factors that were included in the analysis were; 1) Awareness of the recent promulgation of the NEMBA regulations (Q6); 2) Attitude towards the control of IAPs (Q17); 3) Belief in the ability of Government to enforce the regulations (Q30); 4) Perceived expense of compliance (Q31); and 5) Fear of breaking the law (Q36). Due to the limited sample size associated with the nursery manager interviews, five-point Likert scales were collapsed into three response levels so as to ensure sufficient data coverage in each category.

Two additional Multiple Correspondence Analyses were conducted to determine whether 1) trade association affiliated nurseries and non-trade association affiliated nurseries; and 2) small and large (defined by annual turnover) nurseries differ in terms of awareness, compliance and attitudes. All multivariate analyses excluded pilot interview data, and were computed using the R package FactoMineR (Husson et al, 2011).

RESULTS

Background information

Most of the nursery managers interviewed in the study have over ten years of working experience in the horticultural industry, but over half the respondents do not have an official horticultural qualification (Table 1). Just over a quarter of the nursery managers indicated that they belonged to one or more of three horticultural trade associations; the South African Nursery Association (SANA), the Garden Centre Association (GCA), and the South African Landscapers Institute (SALI). Analysis of the survey data revealed that only a sixth of the smaller nurseries, with an annual turnover of less than R1 million (the majority of nurseries participating in the study which were prepared to reveal turnover), were members of a trade association.

Table 1. Background information on nursery managers and nurseries. The percentage of respondents (n=30) selecting each response choice is provided.

Question	**Respondents selecting each choice (%)**					
Q1. Years of experience in the horticultural industry	**0-5 yrs**		**5-10 yrs**	**>10 yrs**		
	16.7		13.3	70.0		
Q2. Horticultural qualification	**Yes**		**No**			
	46.7		53.3			
Q3. Nursery's annual turnover	**>R10m**	**R5-10m**	**R2-4.9m**	**R1-1.9m**	**<R1m**	**Private**
	10.0	10.0	6.7	10.0	40.0	23.3
Q4. Trade association membership	**Yes**		**No**			
	26.7		73.3			
Q5. Name of trade association	**SANA**		**GCA**	**SALI**		
	62.5		75.0	25.0		

Results of the Multiple Correspondence Analysis (MCA) comparing differences between small (with a turnover of less than R1 million per annum) and large (with a turnover of more than R1 million per annum) nurseries (Figure 1) revealed that a total of 47.7% of the variability in the data is explained by dimension 1 (Eigen value = 25.7%) and dimension 2 (Eigen value = 22%). Q33 (enthusiasm for compliance) exerts the greatest influence on dimension 1 (eta^2 = 0.7) as compared to other variables, and separates small and large nurseries along the first dimension. Small nurseries are more enthusiastic about complying with the NEMBA regulations, while large nurseries are dispassionate or neutral. Q6 (awareness about NEMBA), which contributes the largest proportion of the loading on dimension 2 (eta^2 = 0.7), appears to be another important factor separating large and small nurseries. Large nurseries are more strongly associated with awareness about the existence of NEMBA, whereas small nurseries report ignorance more often.

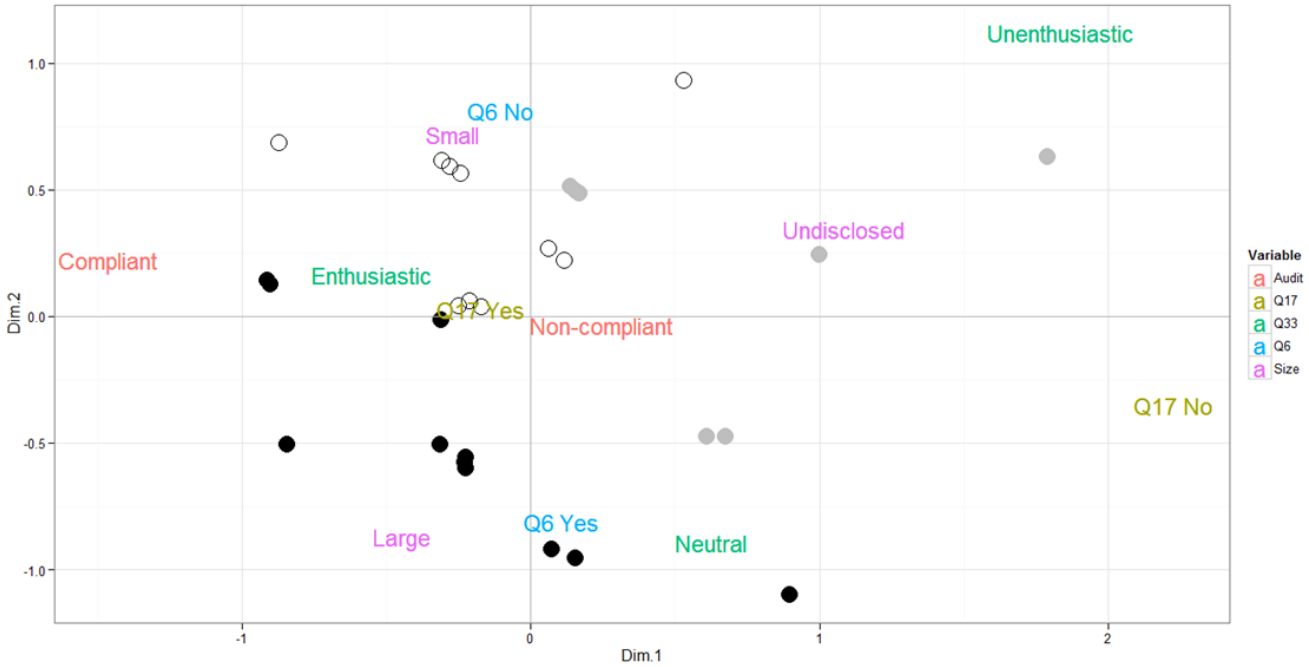

Figure 1. Scatterplot of respondents (n=28) along the first two components of a multiple correspondence analysis (MCA) using stock audit data and responses to Q3/Size ("*What is your nursery's approximate annual turnover?*"), to Q6 ("*Are you aware that new invasive species regulations (NEMBA) have been enacted?*"), Q17 ("*Do you think it is important to control the spread of IAPs?*"), and Q33 ("*How do you feel about complying with the new NEMBA regulations on IAPs?*"). Nurseries with an annual turnover of less than R1 million were deemed small ('open' data points) and those with an annual turnover of greater than R1 million were deemed large ('closed' data points). Some respondents were not prepared to disclose information on the turnover of their nurseries ('opaque' data points).

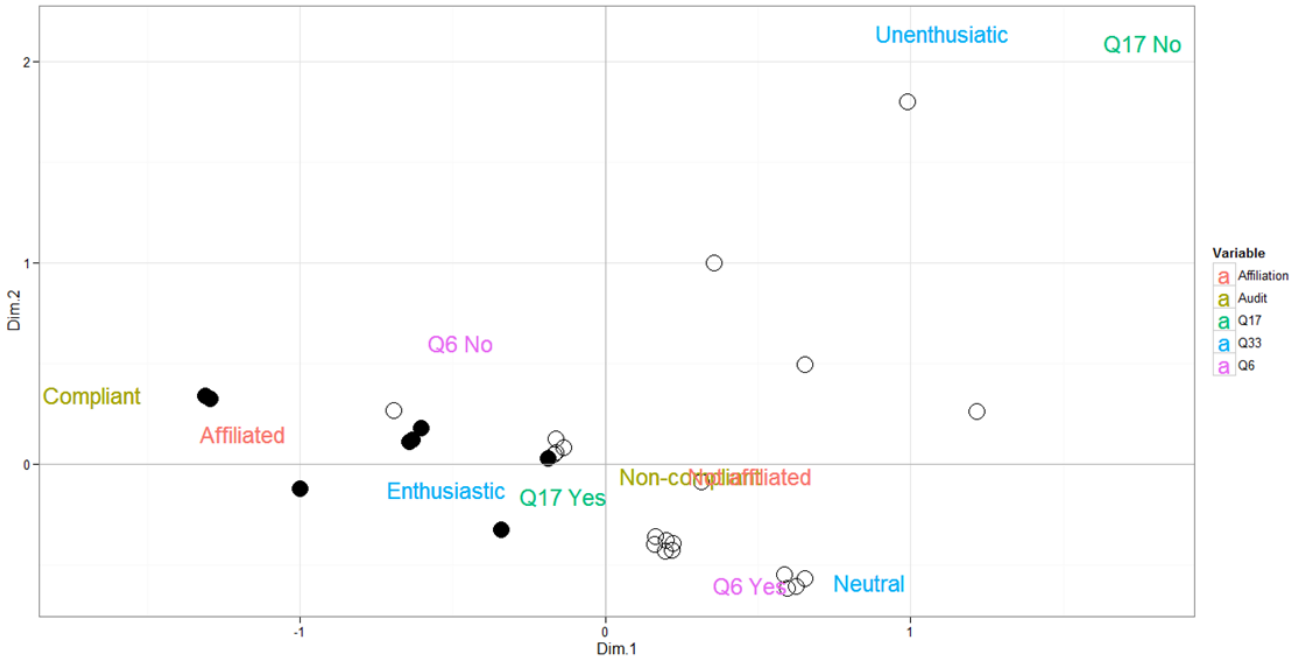

Figure 2. Scatterplot of respondents (n=28) along the first two components of a multiple correspondence analysis (MCA) using stock audit data and responses to Q4/Affiliation ("*Does your nursery belong to a trade or industry association?*"), to Q6 ("*Are you aware that new invasive species regulations (NEMBA) have been enacted?*"), Q17 ("*Do you think it is important to control the spread of IAPs?*"), and Q33 ("*How do you feel about complying with the new NEMBA regulations on IAPs?*"). Nurseries that belong to one or more trade associations are represented by 'closed' data points, while nurseries that are not affiliated with a trade association are represented by 'open' data points.

Analysis of the results from the MCA plotting trade association nurseries against non-trade association nurseries (Figure 2) revealed that a total of 55.1% of the variability in the data is explained by dimension 1 (Eigen value = 33.1%) and dimension 2 (Eigen value = 22%). The factor most strongly separating affiliated and non-affiliated nurseries is compliance which is indicated by audit status (contributing the greatest proportion of loading to dimension 1, eta^2 = 0.5). Affiliated nurseries are more strongly associated with compliance, whereas non-affiliated nurseries appear to be linked to non-compliance.

Awareness about IAPs and associated regulations

Half of the nursery managers that were interviewed were not aware that new invasive alien species regulations, specifically NEMBA, had recently been enacted (Table 2). When asked how they first heard of the existence of NEMBA, the majority of respondents who had heard of the regulations indicated that they had been alerted by work colleagues. More than two-thirds of the respondents disagreed or strongly disagreed with the statement that government has provided sufficient information on what nursery managers need to do in order to comply with the new regulations. Only one nursery manager stated that he had

received official notification from government about the promulgation of the NEMBA regulations. The same manager was the only respondent to agree with the statement “My nursery receives regular (at least once a year) updates about IAPs from government.”

At the time of data collection (October and November 2014), just under a third of the sample of nursery managers (or two-thirds of those who were aware of NEMBA) indicated that they had seen the NEMBA list of IAPs that had been published on 1 August that year (Table 2). Of the ten nursery managers who had seen the lists, only two were members of a trade association. Four managers stated that they had a copy at hand which they could consult. However, as many as 70% of respondents declared that they were reasonably to very confident that they would know whether any of the 379 NEMBA listed IAPs were in their nurseries.

Respondents were also asked a number of questions regarding the set of IAP regulations associated with the Conservation of Agricultural Resources Act (CARA) which has been in place since 1983 and is still in force. In comparison with levels of awareness about NEMBA, 20% more respondents (70% in total) could positively identify CARA as a set of regulations controlling the sale of listed IAPs by the nursery industry (Table 2).

In relation to awareness about the problems associated with IAPs, almost all nursery managers agreed that it is important to control the spread of these plants, and could list two relevant ecological reasons to motivate their answers (Table 2). The two nursery managers who dismissed the idea of controlling the spread of IAPs indicated that this was partly based on sentimental factors. The following comment from one of the managers encapsulates the shared sentiment: “I grew up on a farm bordered by beautiful blue gums. What would the Karoo landscape be without those gum trees?” The managers also provided utilitarian reasons: “These ‘invasive exotics’ are essential on the Cape Flats. They stop the sand dunes from blowing into the homes of the poor,” and, “Some of those trees produce good shade.”

Table 2. The percentage of respondents (n=30) selecting each response choice for questions relating to awareness about the NEMBA regulations and invasive alien plants.

Question	Respondents selecting each choice (%)						
Q6. Are you aware that this year, new IAP regulations (specifically NEMBA) have been enacted?	**Yes** 50.0	**No** 50.0					
Q7. Through which source did you first learn of the existence of these regulations?	**Internet** 6.6	**Trade assoc.** 26.6	**Colleagues** 33.4	**Govt** 6.6	**Media** 6.6	**Interviewer** 13.4	**Customers** 6.6
Q8. Government has provided sufficient information on what we need to do to comply with NEMBA.	**Strongly agree** 10.0	**Agree** 10.0	**Neutral** 10.0	**Disagree** 30.0	**Strongly disagree** 40.0		
Q9. What regulations existed to control the sale of IAPs before the NEMBA regulations were in place?	**Don't know** 30.0	**Named CARA** 70.0					
Q10. What percentage of the nursery industry has been compliant with previous regulations over the last three years?	**<30%** 3.3	**30-49%** 0.0	**50-69%** 6.7	**70-94%** 23.3	**95-100%** 36.7	**Don't know** 30.0	
Q11.To what extent was your nursery compliant with the previous regulations?	**Fully** 46.7	**Mostly** 23.3	**Partially** 16.7	**Limited** 3.3	**Don't know** 10.0		
Q12. Have you seen the NEMBA list of IAPs published in August 2014?	**Yes** 30.0	**No** 70.0					
Q13.Please rate how confident you are that you would know whether any of the 379 NEMBA- listed plants are in your nursery.	**Very confident** 43.3	**Reasonably confident** 26.7	**Somewhat uncertain** 13.3	**Very uncertain** 16.7			
Q14. Do you have a copy of the NEMBA IAP list?	**Yes** 13.3	**No** 86.7					
Q15. Has your nursery received official notification from government about the NEMBA regulations that became law on 1 Oct 2014?	**Yes** 3.3	**No** 96.7					

Q16. My nursery receives regular (>once a year) updates about IAPs from government.	**Yes** 3.3	**No** 93.3	**Don't know** 3.3
Q17. Do you think it's important to control the spread of IAPs?	**Yes** 93.3	**No** 6.7	**Don't know** 0.0

Q18. List two reasons for why you think it is/ is not important to control the spread of IAPs:	Respondents mentioning each reason (%)
– IAPs deplete water resources	40
– IAPs disrupt ecological systems	33.3
– IAPs displace indigenous flora	66.7
– I don't want to break the law	3.3
– IAPs aren't aesthetically pleasing	3.3
– Eradication creates jobs	6.7
– IAPs have an impact on the economy	6.7
– IAPs are a fire hazard	3.3
+ IAPs are essential for dune stabilisation	3.3
+ IAPs produce shade	3.3
+ IAPs are aesthetically pleasing	6.7

Audited compliance

The stock assessment based on the DEA's audit data revealed that only four out of the 41 audited nurseries in Cape Town were a hundred percent compliant with the NEMBA IAP regulations. All four of these nurseries participated in the nursery manager interviews. Non-compliant nurseries were found to be selling up to seven NEMBA-listed IAP species, but on average, most of the audited nurseries were stocking three listed species (Table 3). A cross comparison of the audit data against the interview data revealed that of the non-compliant nurseries selling five or more IAPs, only one respondent was aware of the enactment of

NEMBA and a third expressed enthusiasm for compliance. The most commonly stocked invasive alien plants were non-sterile forms of category 3 invader *Hedera helix*, single petal invasive cultivars of category 1b invader *Nerium oleander*, category 1a invader *Iris pseudacorus*, and category 3 invader *Hedera canariensis* (Table 4). Although various cacti were recorded in most nurseries, the DEA's audit officer was not able to identify the specimens to species level and could therefore not be certain of their NEMBA statuses.

The vast majority (73.5%) of IAP species found in nurseries are category 1b invaders, that is, species that are widespread and well-established invaders that require control (Table 4). Less than half (44.1%) of the species are listed under the 2001 amendments to CARA. Four additional species are listed under CARA's Table X, a list of potentially invasive plants that do not require official regulation under CARA. Apart from *Nerium oleander,* none of the three remaining most commonly stocked NEMBA-listed species are included in the CARA lists. However, *Hedera helix* is listed in CARA's Table X. Out of all the nurseries included in the audit, just over half (51.2%) stocked species that are listed in CARA.

During the second phase of the DEA's audit - conducted a month after the first - a few nurseries belonging to a single chain of outlets were revisited by the auditing official. Although these chain nurseries were not included in the analysis, it is interesting to note that during the first phase of auditing, in October, all outlets belonging to the chain were stocking *Hedera helix.* A month later, repeat visits to the same chain outlets revealed that all *Hedera helix* plants had been removed from the shelves.

Table 3. The number of NEMBA-listed invasive alien plant species found at each of the 41 audited nurseries.

Nursery	IAPs	Nursery	IAPs	Nursery	IAPs	Nursery	IAPs	Nursery	IAPs	Nursery	IAPs
1	7	**8**	4	**15**	4	**22**	3	**29**	2	**36**	1
2	7	**9**	4	**16**	3	**23**	3	**30**	2	**37**	1
3	7	**10**	4	**17**	3	**24**	2	**31**	2	**38**	0
4	6	**11**	4	**18**	3	**25**	2	**32**	1	**39**	0
5	6	**12**	4	**19**	3	**26**	2	**33**	1	**40**	0
6	5	**13**	4	**20**	3	**27**	2	**34**	1	**41**	0
7	5	**14**	4	**21**	3	**28**	2	**35**	1		

Table 4. NEMBA-listed invasive alien plants stocked by nurseries in Cape Town. Category listings are restricted to Western Cape statuses. Asterisks indicate plants for which sterile hybrids or cultivars exist. Plants were only included in the inventory if they were identified as non-sterile forms. Invasive cacti that could not be identified to species level are grouped under 'Various Cacti'. Data was obtained from the Department of Environmental Affairs.

Plant	CARA category	NEMBA category	No. of nurseries	Freq. (%)
Agave americana (Spreading century-plant)	NA	3	4	9.8
Alisma plantago-aquatica (Water alisma)	NA	1b	1	2.4
Alpinia zerumbet (Shell ginger lily)	NA	3	1	2.4
Ardisia crenata (Coralberry tree)	NA	1b	2	4.9
Bryophyllum proliferum (Green mother of millions)	NA	1b	1	2.4
Canna indica (Indian shot)*	1	1b	5	12.2
Catharanthus roseus (Madagascar periwinkle)*	NA	1b	1	2.4
Coreopsis lanceolata (Tickseed)*	Table X	1b	1	2.4
Echinopsis schickendantzii (Torch cactus)	1	1a	1	2.4
Egeria densa (Dense water weed)	1	1b	1	2.4
Eriobotrya japonica (Loquat)	3	1b	1	2.4
Hedera canariensis (Canary ivy)	Table X	3	6	14.6
Hedera helix (English ivy)*	Table X	3	18	43.9
Hedychium flavescens (Yellow ginger lily)	1	1b	4	9.8
Houttuynia cordata (Chameleon plant)	NA	3	1	2.4
Hylocereus undatus (Dragon fruit)	NA	2	1	2.4
Iris pseudacorus (Yellow flag)	NA	1a	6	14.6
Lantana montevidensis (Lantana)*	1	1b	5	12.2
Melaleuca quinquenervia (Bottle brush tree)	NA	1b	2	4.9
Myriophyllum spicatum (Spiked water-milfoil)	1	1b	1	2.4
Nephrolepis exaltata (Sword fern)*	1	1b	1	2.4
Nerium oleander (Oleander)*	1	1b	7	17.1
Opuntia ficus – indica (Mission prickly pear)	1	1b	1	2.4
Opuntia microdasys (Yellow bunny-ears)	NA	1b	3	7.3
Passiflora caerulea (Blue passion flower)	1	1b	4	9.8
Passiflora subpeltata (Granadina)	1	1b	1	2.4
Pontederia cordata (Pickerel weed)	3	1b	1	2.4
Psidium durbanensis (Durban guava)	3	1b	1	2.4
Pyracantha coccinea (Red firethorn)*	NA	1b	2	4.9
Sambucus nigra (European elder)	Table X	1b	2	4.9
Schinus terebinthifolius (Brazillian pepper tree)	3	3	1	2.4
Tradescantia fluminensis (Wandering Jew)	NA	1b	1	2.4
Tradescantia zebrina (Wandering Jew)	NA	1b	1	2.4
Vinca major (Greater periwinkle)*	NA	1b	4	9.8
Various Cactus (Unidentified)	NA	NA	26	63.4

Self-reported compliance

In contrast with the audited NEMBA compliance rate of 13.3% across the survey sample population, most nursery managers perceived the industry to be largely compliant, as evidenced by the high proportion of respondents that disagreed or strongly disagreed (Table 5) with the statement, “Most nurseries stock and sell invasive alien plants.” In a further apparent disparity with the level of non-compliance (51.2%) with CARA, almost two-thirds of the nursery managers reported that 70-100% of the nursery industry has been compliant with the CARA regulations in recent years (Table 2). A cross comparison of the audit data against the interview data revealed that all of the managers who claimed to have seen the NEMBA lists (see ‘Awareness’ section) were selling invasive alien plants in their nurseries, and only one of the nursery managers that reported having heard of the regulations was a hundred percent compliant. Of those who had said they had seen the lists, 55.6% reported having had to dispose of some of their plant stock in order to comply with the NEMBA regulations.

Less than a quarter of the total sample of nursery managers reported having had to dispose of NEMBA-listed plant stock (Table 5). According to the audit data, not one of these nurseries was a hundred percent compliant. The majority of the managers indicated that they had composted the dumped IAP material. In response to the question of whether government had provided any information about how to safely dispose of invasive plants, respondents unanimously indicated that they had not received any such guidelines.

Despite the fact that 70% of respondents asserted confidence in their ability to know whether they had any of the NEMBA listed plants in their nurseries (‘Awareness’ section), the majority were unsure whether they had stocked NEMBA IAPs in the last three years (Table 5).

Questions assessing nursery managers’ role in educating the public and building customer awareness revealed that at most nurseries, staff members have not been formally trained to advise customers on IAPs, and virtually none provide posters for customers with information on IAPs (Table 5). Seven managers commented that they had received posters from government in the early 2000s, but that these were now outdated. The vast majority of respondents indicated that they recommend non-invasive alternatives when customers ask for listed IAPs.

Table 5. The percentage of respondents (n=30) selecting each response choice for questions relating to compliance with the NEMBA regulations on invasive alien plants.

Question	Respondents selecting each choice (%)					
Q19. Have you disposed of any of your plant stock in order to comply with the NEMBA regulations?	**Yes**	**No**				
	20.0	80.0				
Q20.1 Please give a rough estimation of the retail value of the plants you have disposed of.	**Negligible**	**R1000**			**R4000-R5000**	
	6.7	10			3.3	
Q20.2 Where did you dispose of the plants?	**Compost**	**Burn**			**Bury**	
	50.0	16.7			33.3	
Q20.3 Has government provided you with any information about how to safely dispose of these plants?	**Yes**	**No**			**Don't know**	
	0.0	100.0			0.0	
Q21. Have you recently (last 3 years) stocked plants that are now on the NEMBA lists?	**Yes**	**No**			**Don't know**	
	20.0	36.7			43.3	
Q22. Which category would the NEMBA listed plants you recently stocked fall under?	**Cacti**	**Trees**	**Woody shrubs**	**Herbaceous**	**Climbers**	**Aquatic**
	0.0	0.0	16.7	50.0	0.0	33.3
Q23. Has your staff received training enabling them to advise customers about IAPs?	**Yes**	**No**			**Don't know**	
	36.7	63.3			0.0	
Q24. Does your nursery display posters that provide information about IAPs?	**Yes**	**No**			**Don't know**	
	6.7	93.3			0.0	
Q25. Do you recommend non-invasive alternatives to customers?	**Yes**	**No**			**Don't know**	
	86.7	13.3			0.0	
Q26. Most nurseries stock and sell IAPs.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	
	3.3	6.7	13.3	53.3	23.3	

Analysis of the results of the MCA which shows the potential underlying factors that influence whether a nursery is compliant or not (Figure 3) reveals that a total of 36.6% of the variability in the data is explained by dimension 1 (Eigen value = 20%) and dimension 2 (Eigen value = 16.6%). Given that Q31 contributes the largest proportion of the loading on dimension 1 (eta^2 = 0.3), and that the alternative forms of answers to the question are strongly dissociated (Figure 3), it would appear that the major factor separating compliant and non-compliant nurseries is the perceived expense of compliance. Non-compliant nurseries are strongly associated with the perception that compliance is inexpensive, while compliant nurseries are more strongly associated with the perception that compliance is costly. The question that contributes the largest proportion of loading to dimension 2 (eta^2 =

0.7) is Q30. Although this question does not seem to definitively separate compliant and non-compliant nurseries, it appears that non-compliant nurseries are more strongly associated with the perception that government is not able to enforce the NEMBA regulations. Non-compliant nurseries also appear to be more strongly associated with the belief that it is important to control the spread of IAPs (Q17) and with a fear of breaking the law (Q36).

Figure 3. Scatterplot of respondents (n=28) along the first two components of a multiple correspondence analysis (MCA) using stock audit data and responses to Q6 ("*Are you aware that new invasive species regulations (NEMBA) have been enacted?*"), Q17 ("*Do you think it is important to control the spread of IAPs?*"), Q30 (Statement: "*Government is not able to enforce the regulations*"), Q31 (Statement: "*Compliance is expensive*"), and Q36 (Statement: "*I do not want to incur a penalty for breaking the law*"). Compliant nurseries are represented by 'closed' data points, while non-compliant nurseries are represented by 'open' data points.

Attitudes

The majority of nursery managers expressed confidence about the efficacy of the NEMBA regulations in helping prevent the spread of IAPs (Table 6). However, when probed further, and in response to questions which highlighted potential constraints on the effectiveness of NEMBA, nearly three-quarters of respondents felt that government is not able to enforce the regulations. During informal discussion, 53.3% of nursery managers qualified their answers by explaining that their nurseries have never been visited by an official from the DEA. One manager claimed, "No one has come to check my plant stock since the Eighties." Another manager commented, "Enforcement is a real problem. There is not enough regional funding relative to the size of the problem."

Eighty percent of the sample agreed or strongly agreed that government should encourage self-regulation by the industry as a means of boosting levels of compliance (Table 6). Respondents were encouraged to discuss additional reasons for their confidence or uncertainty in the efficacy of the regulations. Nine nursery managers expressed concern that the regulations would not be effective until consumers were made aware of NEMBA and educated about the problems that IAPs cause.

Several questions, in the form of statements, aimed to elucidate potential challenges faced by nursery managers in relation to compliance (Table 6). None of the listed factors seemed to be perceived as a major barrier to compliance by nursery managers, with the majority disagreeing or strongly disagreeing that compliance is expensive, and that growers do not provide retail nurseries with enough saleable alternatives to declared IAPs. Most managers were not sure if the regulations are confusing and complicated. Of those who reported having seen the NEMBA regulations, a third indicated that they were unclear about certain aspects of the legislation. One nursery manager flagged a number of issues that he considers "grey areas" that are likely to cause a certain amount of confusion, "Plant labelling is a big grey area. There is a lack of congruence between the names of plants on the NEMBA lists and the way the plants are labelled in nurseries. To address the problem, we need frequent nursery inspections involving an education approach, rather than a crackdown." Another grey area that was mentioned pertained to sterile cultivar and hybrid exemptions, "The NEMBA lists indicate that sterile cultivars and hybrids of certain species are exempted from listing. But nurseries are not given access to the formal lists of cultivars and hybrids that have been cleared and registered with the DEA. We can't just assume that all hybrids and cultivars are sterile." Another manager expressed confusion arising from the concurrent existence of two different sets of regulations governing the sale of IAPs, "Guavas aren't listed for the Western Cape on the new [NEMBA] list, but they are on the old [CARA] list. Does this mean I can sell guava trees?"

Table 6. The percentage of respondents (n=30) selecting each response choice for questions relating to attitudes towards the NEMBA regulations on invasive alien plants.

Question	**Respondents selecting each choice (%)**		
Q27. Were you informed about government's invitation to comment on the draft NEMBA IAP lists in Feb 2014?	**Yes**	**No**	**Don't know**
	13.3	83.3	3.3
Q28. Did you submit comments on the lists?	**Yes**	**No**	
	3.3	96.7	
Belief in the effectiveness of the regulations			
Q29. Are the NEMBA regulations likely to be effective in helping prevent the spread of IAPs?	**Yes**	**No**	**Don't know**
	63.7	26.7	10.0

Q30.1 There are important IAPs that are not on the NEMBA lists.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	3.3	10.0	70.0	13.3	3.3
Q30.2 Government is not able to enforce the regulations.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	26.7	46.7	10.0	13.3	3.3
Q30.3 Imposed regulations are not an effective way of getting cooperation form the industry.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	0.0	40.0	10.0	50.0	0.0
Q30.4 Government should encourage self-regulation as this would boost levels of compliance.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	20.0	60.0	6.7	10.0	3.3
Challenges faced in terms of compliance					
Q31.1 Compliance is expensive.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	3.3	6.7	10.0	63.3	16.7
Q31.2 Not being able to sell NEMBA listed plants will significantly reduce the turnover of my nursery.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	0.0	6.7	6.7	73.3	13.3
Q31.3 The regulations are confusing and complicated.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	3.3	26.7	43.3	26.7	0.0
Q31.4 Growers do not provide enough saleable alternatives for some of the plants on the list.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	3.3	23.3	3.3	56.7	13.3
Q32. Which of the above factors is the biggest challenge for your nursery?	**31.1**	**31.2**	**31.3**	**31.4**	**None**	**Other**
	3.3	3.3	10.0	10.0	60.0	13.3
Q33. Please indicate how you feel about complying with the NEMBA regulations.	**Very enthusiastic**	**Enthusiastic**	**Neutral**	**Unenthusiastic**	**Very unenthusiastic**
	33.3	30.3	26.7	6.7	3.3
Factors that limit compliance					
Q34.1 There is a lack of enforcement.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	40.0	33.3	10.0	10.0	6.7
Q34.2 Other nurseries continue to sell profitable NEMBA-listed plants.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	6.7	20.0	23.3	30.0	20.0
Q34.3 Some of the plants on the list should be de-restricted because they are not an invasive threat.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	20.0	33.3	33.3	6.7	0.0
Q34.4 Government does not communicate effectively with the nursery industry.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	53.3	33.3	6.7	6.7	0.0

Q34.5 There is a high consumer demand for some of the listed IAPs.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	20.0	36.7	3.3	33.3	6.7
Q34.6 Government does not draw on the knowledge and expertise of the nursery industry.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	13.3	46.7	20.0	20.0	0.0

Q35. Which of the above factors has the biggest negative impact on your enthusiasm for compliance?	**34.1**	**34.2**	**34.3**	**34.4**	**34.5**	**None**	**Other**
	6.7	0.0	10.0	60.0	3.3	13.3	3.3

Factors that incentivise compliance

Q36.1 It is important to protect the environment.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	70.0	30.0	0.0	0.0	0.0
Q36.2 It is important to have a 'green' business image.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	60.0	23.3	6.7	6.7	3.3
Q36.3 Consumers are demanding non-invasive plants.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	13.3	36.7	10.0	36.7	3.3
Q36.4 There is pressure from other compliant nurseries.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	3.3	13.3	26.7	50.0	6.7
Q36.5 There is pressure from a trade association to comply.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	0.0	26.7	20.0	53.3	0.0
Q36.6 I do not want to incur a penalty for breaking the law.	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	50.0	30.0	6.7	10.0	3.3

Q37. Which of the above factors has the biggest positive impact on your level of enthusiasm for compliance?	**31.1**	**31.2**	**31.3**	**31.4**	**31.5**	**31.6**	**None**
	80.0	13.3	3.3	0.0	0.0	0.0	3.3

Nursery managers' responses to questions probing factors that potentially limit compliance revealed that most respondents perceive their limited relationship with government and the lack of support for compliance to be major factors that negatively affect compliance motivation levels (Table 6). Sixty percent of the sample agreed or strongly agreed with the statement that government does not draw on the knowledge and expertise of people working in the nursery industry, and well over 80% indicated that they believe government does not communicate effectively with the industry. In the case of one manager, the medium of communication was singled out, "The lists are only available on the internet, and I don't have access to the internet." Out of the 13.3% of managers who reported having been informed about government's invitation to comment on draft versions of the NEMBA lists, only one

actually submitted comments. One respondent commented, “Even if I had known about the invitation to comment on the lists, I wouldn’t have bothered to comment because they [government] don’t listen to us anyway.”

Other factors that most managers agreed or strongly agreed negatively affect their level of motivation for compliance include a lack of enforcement, disagreements regarding the species listed, and consumer demand for listed exotics (Table 6) such as *Nerium oleander, Duranta erecta* and *Echium plantagineum*. A number of nursery managers listed plants they thought should be derestricted. Individual nursery managers argued for the derestriction of *Pennisetum clandestinum* because “it helps stabilise river banks”, *Metrosideros excelsa* because “it is one of the few trees that can survive harsh coastal conditions”, and *Eucalyptus spp.* because “bees and farmers need them.” Plants that individual nursery managers felt should be derestricted because they consider them to be non-invasive include *Jacaranda mimosifolia, Opuntia ficus-indica, Murraya paniculata* and *Morus alba.* Some managers reported additional limiting factors during informal discussion. One manager expressed frustration at the lack of compensation for compliance, “I have been selling these plants for years and suddenly this legislation is in place and we must get rid of the stock immediately. Why can’t we get compensation for our losses? I refuse to get rid of those plants. I have to sell them off first.”

The majority of nursery managers reported being enthusiastic about complying with NEMBA (Table 6). When managers were asked about factors that potentially incentivise compliance, 80% indicated that a sense of duty to protect the environment has the biggest positive impact on levels of enthusiasm for complying with the regulations. Other factors that respondents agreed or strongly agreed positively affect motivation included the importance of having a ‘green’ business image, a fear of breaking the law, and, to a lesser extent, consumer demand for non-invasive plants.

DISCUSSION

This study set out to probe the levels of awareness, compliance, and attitudes of Cape Town nursery managers towards the newly promulgated NEMBA regulations on IAPs. The results of the study suggest factors that are likely to impact on the effectiveness of NEMBA as a means of influencing the horticultural industry's role in the spread of IAPs. However, it is important to acknowledge that all questionnaire-based studies have certain limitations with regard to how representative of the population of interest they are (Kelley, 2003). Given the sensitive nature of the research, there is a possibility of non-response bias. For instance, all nine of the managers that indicated that they were too busy to be able to participate in the study belonged to very small and sometimes informal nurseries that were reported to be short-staffed. Self-selection amongst respondents may also mean that compliant nursery managers with little to hide would be more likely to agree to the interview. However, the results from the audit data, showing that only ten percent of the sample was compliant, suggest that this is not the case. Given that the nursery managers were aware of the conservation-related focus of the study, there is a possibility that satisficing – the tendency of a respondent to answer in a way that would please the interviewer (Holbrook, Green and Krosnick, 2003) – influenced the survey results. This bias is most likely to have affected responses to compliance-related questions. Respondents may have provided perceived socially desirable or socially acceptable answers. However, the use of data triangulation highlighted the discrepancy between the audit data and the self-reported levels of compliance, enabling the researcher to limit the effects of this potential source of bias.

Compliance

A key finding of the research is that the overwhelming majority of Cape Town nurseries that were included in the audit were not compliant with the new NEMBA IAP regulations at the time of their promulgation. This is an important finding given that over 70% of Cape Town's nurseries were included in the audit. A further finding that has important implications for potential compliance-challenges with NEMBA is that over 50% of the audited nurseries were found to be selling IAPs that have been listed in the CARA regulations since 2001, and, in some cases, since 1983. This is despite high levels of reported awareness about the CARA regulations, reported enthusiasm for compliance, apparent concern for the environment amongst nursery managers, evidence that they understand the problems that IAPs cause, extensive reported support for the control of IAPs, and a reportedly strong sense of duty to protect the environment.

Somewhat unexpectedly, these low levels of compliance with CARA are at odds with the findings of other studies which found extensive compliance with the regulations between 2002 and 2011 (Nurseries Partnership Education Programme, 2003; 2010; Badenhorst, 2011). These previous studies were not based on findings from Cape Town nurseries, but it is possible that this represents a slippage in compliance since 2011. Based on nursery managers' interview responses, it is possible that this slippage could be related to an increasingly secure sense that government is not monitoring the industry's compliance.

A further noteworthy aspect of the findings on compliance is that the nurseries with the lowest levels of audited compliance, according to the results of the MCA, are those that are not affiliated with trade-associations. These tend to be smaller nurseries with low turnover which also report low levels of awareness about the recent promulgation of the NEMBA regulations.

The most commonly stocked NEMBA-listed IAP in KwaZulu Natal nurseries in 2011, *Hedera helix* (Badenhorst, 2011), continues to be widely used by the horticultural industry, and, in Cape Town, is the most commonly stocked listed invasive plant. Invasive, single-flowering forms of *Nerium oleander* also continue to be widely available in nurseries in Cape Town despite the species' long-standing listing in CARA (Act No. 43 of 1983) as a declared category 1 weed. The species was found to be the second-most widely sold IAP in Cape Town nurseries in 1991 (Laros, 1991), consistent with the results of the present study.

A possible explanation for the continued widespread availability of *Nerium oleander* and *Hedera helix*, suggested by comments from some of those interviewed, relates to the long-standing exclusion of sterile cultivars of certain species that is now entrenched in NEMBA's exemptions. Over ten years ago, agreement was reached between government and the horticultural industry that trading can continue with sterile cultivars of listed species that have been registered with government and listed in the official exemption register (Montgomery, 2003). However, the government has not made the official NEMBA exemption register of sterile cultivars and hybrids available to the public (South African Green Industries Council, personal communication). As a result, Cape Town nursery managers may be responding to the resulting lack of clear and accessible specification in order to continue selling two popular, and probably lucrative ornamental plants that are nevertheless problematic invaders. *Nerium oleander* with its 'water-wise' characteristics, robustness and attractive flowers is widely used as an ornamental and screening plant, including in roadside and street plantings (Fitzpatrick, 1980; Henderson, 2001). Both *Nerium oleander* and *Hedera helix* are well known for their ability to tolerate dry summers (Demming et al, 1988; Sack and Grubb, 2002) which is a very important characteristic for Cape Town gardeners. As a result,

in the absence of a clear, accessible and enforceable list of sterile cultivars, nursery managers may succumb to the pressures of consumer demand and commercial viability.

The majority of the remaining listed IAPs found in Cape Town nurseries are less consistently carried and are generally stocked by only one or two outlets. However, given that many of the world's most critically endangered indigenous plant species occur within the bounds of the city (Holmes et al, 2012), it is of particular concern that most of these IAPs (including *Egeria densa, Nephrolepis exaltata and Opuntia ficus-indica*) are recognised as some of the very worst invasive species, that is, category 1b invaders. Although the NEMBA regulations had only just been promulgated at the time of the study and it fell within the 60-day grace period given for compliance, the continued pervasive stocking of CARA-listed IAPs is a major cause for concern. This indicates an entrenched pattern of non-compliance that suggests that simply issuing further regulation is unlikely to be effective in curbing the horticultural industry's role in spreading IAPs. This is particularly so given that NEMBA continues to include features that Paterson (2006) identified as contributing to the limited impact of CARA such as a reliance on a 'command and control' approach and a reported lack of enforcement.

In relation to NEMBA, the results of the study provide a benchmark at the point of NEMBA's promulgation for assessing changes in the level of compliance. The study also provides a basis for better understanding the underlying situational pressures and attitudinal factors that influence compliance so that this can be used to develop increasingly effective mechanisms for controlling the spread of IAPs. Indeed, this study suggests that it is the underlying factors that need to be the focus of any strategy for the control of IAPs and that a failure to do so would not bode well for the long-term effectiveness of NEMBA in helping prevent the spread of IAPs.

The influence of awareness

Awareness of the regulations is a necessary condition for basic compliance. The fact that at least fifty percent of the nursery managers report not being aware of the enactment of the NEMBA IAP regulations suggests that this needs to be urgently addressed. A failure to do so may mean that current levels of noncompliance are likely to persist. The low-levels of awareness are likely to be linked to a reported lack of communication from government, with all but one manager indicating that they had not received official notification from government about the new regulations or any communication on IAPs. In fact, the current study confirms previous research indicating that since the 2004 promulgation of the

Biodiversity Act and draft NEMBA IAP lists, nurseries appear to have received little or no official communications from government about IAPs and successive versions of the regulations (Badenhorst, 2011).

An interview with an official from the DEA's Biosecurity Unit (DEA Biosecurity Unit, personal communication) suggests that government's recent attempts to communicate with the industry are inadequate, and that its plans to raise awareness are long-overdue. The official explained that all South African Nursery Association (SANA) members were sent emails in February and August 2014 informing them of government's invitation to the public to comment on the draft NEMBA lists, and of NEMBA's promulgation. The official indicated that the DEA only communicates with SANA members, and regards other non-affiliated nurseries (which make up the bulk, roughly 62%, of Cape Town's nursery industry) as, in the words of the official, 'lone rangers'. These non-affiliated nurseries do not receive any communications because government does not have an official database of nurseries. It is perhaps not surprising then that non-affiliated nurseries were more strongly associated with non-compliance than affiliated nurseries. Assuming trade associations can be relied on to communicate with their members, it is the non-affiliated nurseries that government might be expected to target directly in order to enhance the reach of the regulations. However, government acknowledges that even SANA-affiliated nursery managers may be ignorant about the regulations because the NEMBA legislation was not sent out to members as it 'could not be reduced in a readable format to be less than 1 megabyte' (DEA Biosecurity Unit, personal communication). As such, only links to the relevant government websites were sent out to a community that government acknowledges 'is not very computer literate'.

The department indicated that it is planning to distribute a booklet with the National List of Invasive Species to all nurseries in the country as part of a Biosecurity Advocacy Programme to inform and educate the public about the NEMBA regulations. This initiative would be regarded as important by the many conservationists who regard education as the key to solving invasive species issues (de Poorter, 2001; Le Maitre, Richardson and Chapman, 2004; Bremner and Park, 2007) through building commitment rather than simply compliance. The perception is that if people are made aware of the social and environmental issues, they will change their behaviour accordingly. However, research has shown that educational approaches (such as the awareness-raising campaigns planned by the government) rarely have much success in promoting new, pro-environmental behaviour when undertaken in isolation (Stern 2000a; Stern 2000b). Educational approaches are limited because they are typically informed by single-variable explanations for human behaviour. The assumption is that environmentally destructive behaviour is purely informed by a lack of awareness. Stern (2000a; 2000b) and Reaser (2001) argue that in order for pro-

environmental campaigns to successfully bring about change, they need to be built on an understanding of the multiple variables that influence behaviour particularly the beliefs, attitudes and situational pressures that influence them.

The results of the study indicate that an initiative to increase awareness will not, on its own, ensure compliance or reduce the impact of the nursery industry as a vector for the spread of IAPs. Only one of the 50% of managers who reported that they had heard of the enactment of the new regulations was a hundred percent compliant with NEMBA and, in the case of the 30% of managers who had actually seen the regulations, none were NEMBA-compliant. This therefore contradicts the common assumption that awareness is positively associated with support for IAP control initiatives (Le Maitre, Richardson and Chapman, 2004; Bremner and Park, 2007). Indeed, there appear to be many factors, other than a lack of awareness, that are motivating non-compliant behaviour.

The influence of attitudes and beliefs

It has been argued that the cognitive foundation of attitudes is basic beliefs (Fulton, Manfredo and Lipscomb, 1996; Ajzen 2001). As a result, in order to assess how nursery managers' behaviour may be influenced by their attitudes, it is useful to organise these attitudinal factors into an analytical framework of beliefs. Ajzen (1991; 2002) provides a useful conceptual framework for understanding the multiple factors that guide human behaviour. According to his 'theory of planned behaviour', an individual's behavioural intentions are shaped by three factors: behavioural beliefs (beliefs about the consequences of a certain behaviour which determine attitudes towards that behaviour), normative beliefs (beliefs about the expectations of society which influence perceptions about social pressure to perform a certain behaviour), and control beliefs (beliefs about the presence of factors that may impede or facilitate the performance of particular behaviour which influence the perceived difficulty of performing it) (Ajzen, 2002). The present study has, without being exhaustive, measured all three belief concepts. An examination of the potential contribution of each type of belief towards compliant behaviour provides a basis for understanding the cognitive foundation underlying low levels of compliance.

In terms of behavioural beliefs, the findings suggest that nursery managers are not very fearful of potential negative consequences for non-compliance, given the overwhelming perception that government is not able to enforce the NEMBA regulations. With regard to normative beliefs, the general perception amongst nursery managers is that there is minimal societal pressure to comply. The majority of respondents indicate that their motivation for

compliance is not affected by expectations from competitor nurseries or trade associations and, in fact, that there is strong consumer pressure to stock listed plants. Finally, in terms of control beliefs, there are a number of issues, aside from a lack of awareness about the regulations, which are widely perceived as factors inhibiting motivation for compliance by nursery managers. Many of these reported impediments relate to the lack of a perceived partnership approach from government. For example, there is a sense of frustration at the lack of support for compliance from government and the perceived lack of meaningful involvement in the regulatory decision-making process. This is evidenced in disagreements about the listing of certain plants, the perception that government does not communicate effectively with the nursery industry, that there is a lack of fair and effective enforcement, and that government does not draw on the knowledge and expertise of nursery managers.

Another factor that was highlighted as having a potentially limiting effect on the impact of NEMBA is the lack of clarity of the regulations, and what is required of nursery managers to comply with the regulations. Although most managers were unable to comment on this issue because they had not seen the regulations, those who had, flagged areas of confusion and grey areas in the legislation.

Firstly, as already discussed, the lack of a publicly available exemption register of sterile cultivars and hybrids, if not addressed, is likely to be a major impediment to operational compliance. A second area of potential confusion relates to the coexistence of two pieces of legislation (CARA and NEMBA), each with a separate list of IAPs whose sale is regulated. Some nursery managers indicated that they were not sure whether NEMBA's region-specific regulations of particular plants supersede CARA's blanket nation-wide regulations. For example, in the CARA regulations, *Metrosideros excelsa* is listed as a category 3 invader across the country, whereas in the NEMBA regulations, the species is only listed for the Overstrand District of the Western Cape. To add to the confusion, the Department of Environmental Affairs has indicated that there is no plan to repeal the CARA regulations (DEA Biosecurity Department, personal communication), while the Department of Agriculture, Forestry, and Fisheries (DAFF), has indicated that there are plans to remove non-agricultural weeds from the CARA lists, and that NEMBA will most likely in the near future supersede CARA in terms of regulating the sale of environmentally destructive IAPs (DAFF, personal communication).

Implications for improvement

The key to improving the impact of the regulation of the horticultural industry's role in the spread of IAPs will be to address each of these multiple systemic factors that hinder compliant behaviour. However, it is also important to supplement a narrowly regulatory approach by strengthening the partnership between government and the industry. The findings of the survey suggest that nursery managers do not feel as if they are treated as partners in a joint initiative with government. It is increasingly recognised that the effectiveness and relevance of policy implementation is enhanced by public participation in the decision-making and management processes, particularly if active and detailed enforcement is not going to be effective (Stern, 2000a; Bremner and Park, 2007; García-García-Llorente et al, 2008; Humair, Siegrist and Kueffer, 2014). This approach not only provides a basis for informed decision-making, improved relevance and ongoing improvement of policy formulation, but is also crucial for encouraging stakeholder support for management interventions (Humair, Siegrist and Kueffer, 2014). Internationally, a growing number of invasive species management schemes are drawing on participatory approaches to regulate the horticultural industry. For example, the New Zealand Pest Plant Accord is a cooperative agreement that promotes the active participation of the horticultural industry in the development and assessment of IAP regulations (Wilson et al, 2013). Similarly, in Australia, the nursery industry has collaborated with the government to jointly develop prohibited species lists and initiate public awareness campaigns (Niemiera and Von Holle, 2009). This level of collaboration or legislative consultation has not been developed in South Africa (Wilson et al, 2013).

However, in 2002, a cooperative agreement between SANA, the National Department of Agriculture, and the Working for Water (WfW) programme (the DEA-led national agency responsible for managing IAPs) was formed (Montgomery, 2003; Foxcroft, Richardson and Wilson et al, 2008). Amongst other roles, the key aim of the Working for Water Nurseries Partnership Programme (WfW NPP) is to enhance the levels of awareness amongst horticulturalists and the public about IAPs and relevant legislature (Montgomery, 2003; Wilson et al, 2013). In November 2004 and February 2006, a range of programmes were initiated, including public awareness campaigns, workshops that were used to inform stakeholders about the implications of the NEMBA regulations, and a training programme in which 110 nursery staff members from across the country received training on IAP issues (Montgomery, 2003, Badenhorst, 2011). However, it appears that these initiatives have had little impact on Cape Town's nurseries. Although most of the interviewed nursery managers have been in the industry for ten or more years, the majority reported little input from government and indicated that staff members have never received IAP training. While this

may not be uniformly the case for nurseries in other major South African cities, Badenhorst (2011) also reported that, in 2011, the majority of nurseries in Durban had not heard of WfW NPP, nor participated in any of its programmes.

While the WfW NPP's efforts represent an important acknowledgement of the need to engage with the industry this appears to not yet have been achieved. Although the intention of the WfW NPP may have been to build a relationship between government and the horticultural industry, the partnership is only extended to SANA-affiliated nurseries. Given that the majority of Cape Town nurseries are not members of SANA, this limits the scope of the initiative to a small proportion of the industry.

However, the existing structures of the WfW NPP could be used to extend the scope and scale of the initiative to develop an inclusive working partnership and oversight system that could ensure contextually relevant mechanisms are developed and jointly implemented. It could also enable self-regulation to be used wherever possible, so that enforcement and sanctions need only be applied where self-regulation fails to ensure the effective control of IAPs.

The industry would be actively involved in the process of deciding how best to address each of the challenges that they are faced with in terms of compliance. A number of suggestions arising from the interviews are made in this regard (see Table 7). In order to address the problems related to perceived poor communication, lack of support, and perceived lack of inclusion, the partnership could facilitate mutual information exchanges. This would allow nursery managers to stay informed about IAP issues and legislation, government to learn from the experience of nursery mangers, and for collaborative decisions to be made about how to address the grey areas in the legislation. The partnership could also ensure positive compliance pressures by fostering greater public awareness and enhancing pro-environmental consumer pressure through collaborative consumer awareness-raising campaigns that could involve labelling of IAPs and the promotion of non-invasive alternatives. In order to tackle the perception that there are no repercussions for non-compliance, enforcement of the NEMBA regulations will need to be augmented, but only once enabling conditions for compliance have been established and without defaulting to a 'command and control' approach. An inclusive approach to enforcement could involve encouraging the nursery industry to police itself. One way to enhance the effectiveness of self-regulation would be to create public awareness and a demand for environmentally responsible nurseries and to initiate a publically recognisable certification system for nurseries that are fully compliant with IAP regulations. Aside from fostering a sense of involvement in the regulatory process and therefore of shared responsibility, this approach

would also enhance efficiency by taking some of the pressure off government which has limited resources for enforcement (Badenhorst, 2011). In this regard, most recent international efforts designed to prevent the spread of IAPs centre on nurturing and promoting voluntary self-regulation of the horticultural industry (Baskin, 2002; Burt et al, 2007; Drew, Anderson and Andow, 2010; Vanderhoeven et al, 2011). It is important to note that self-regulation may need to be complemented with formal legal enforcement to deal with individuals that resist self-regulation so that the industry's efforts are not undermined by those who continue to profit from non-compliance (Drew, Anderson and Andow, 2010).

Table 7. Summary of suggested responses to important awareness and attitudinal factors impacting on compliance. This is conceptualised within Ajzen's (1991,2001) analytical framework of belief concepts.

Belief concept	**Problems arising from attitudes and awareness**	**Addressing the problems**
Behavioural belief	Perception that government is not able to enforce IAP regulations	Develop self-regulation supported by legal enforcement
Normative belief	Perception that there is demand for IAPs and minimal societal pressure to comply with IAP regulations	Build positive consumer pressure through awareness-raising campaigns
Control beliefs	Perceived lack of inclusion in the regulatory process Perceived lack of communication Perceived lack of support for compliance Perceived lack of clarity of the regulations Lack of awareness about IAP regulations	Facilitate mutual information exchanges between government and nursery industry stakeholders

While there are clearly many inhibiting factors that will need to be addressed in order to improve the impact of regulation of the horticultural industry, it is encouraging to note that there are also a number of enabling factors that present positive opportunities for regulation. Some of the enabling conditions required for effective self-regulation (Dehnen-Schmutz and Touza, 2008; Drew, Anderson and Andow, 2010), appear to be in place. For instance, the expense of compliance is not widely reported to be an obstacle by nursery managers. In addition, there is evidence of widespread understanding of the problems that IAPs cause and reported support for the control of invasives. There is also a reportedly strong sense of duty to protect the environment. Indeed, the overwhelming majority of nursery managers indicated that levels of compliance would be boosted if government were to encourage a self-regulatory approach. An applied pilot study is urgently needed to assess whether the suggested interventions are likely to be effective in addressing the complexities and dynamics of Cape Town's horticultural industry.

CONCLUSION

The results of this study have revealed that there is a deep-rooted pattern of non-compliance with IAP regulations in Cape Town's nursery industry. The ongoing relatively high level of non-compliance with previous (and still in force) regulations suggests that simply issuing further regulations is unlikely to have an adequate impact on the industry's role in the spread of IAPs. The limitations of a reliance on regulation alone have been compounded in this case by issues arising from the levels of awareness and attitudes of many nursery managers. These include the following: perceptions regarding a lack of enforcement, weak and top-down communication from government, the lack of clarity of the regulations, low levels of inclusion in the regulatory process and a reported lack of awareness about the enactment of NEMBA.

This study suggests a range of relatively concrete actions that may be taken to strengthen the level of commitment and compliance of nursery managers. It is suggested that this could be done in two major ways. The first could be relatively quickly achieved in the short term and would involve strengthening the operational elements of regulation itself. This could involve enhanced user-friendly communication with key role players, ensuring the list of approved sterile cultivars is publically available, agreeing with the nursery industry on standardised plant labelling, and improving the clarity of the regulations and their implications, including their relation to CARA. The second group of actions is likely to have a longer-term time frame. This would be focused on supplementing the regulatory 'command and control' approach with a longer-term orientation to strengthening a partnership with the nursery industry. The objective would be to develop a common commitment to relevant values and goals, creating a situation in which responsibility for controlling the spread of IAPs can be increasingly shared, ultimately reducing the need for active and detailed enforcement by government officials. The interviews suggest that there is already a good foundation for this approach and that regulation alone will be unlikely to harness adequate and sustained compliance. It is suggested that these two broad measures will provide a stronger basis for future successful control of IAPs in Cape Town.

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APPENDIX I: QUESTIONNAIRE COVERING LETTER

Information on the aims, focus and confidentiality of the study

Principle investigator:

Kate Cronin

Conservation Biology Masters Candidate, University of Cape Town

Aim of the research:

The project is intended to draw on the experience and understanding of nursery managers in Cape Town to inform thinking on how best invasive alien plants could be controlled. The specific aim is to gain an understanding of the awareness, attitudes and response of nursery managers to the newly published NEMBA (National Environmental Management: Biodiversity Act 2004) regulations on invasive alien plants. The interview is designed to probe the reasons for varying levels of compliance, the challenges nurseries face as well as factors that would enhance efforts to control the further spread of invasive alien plants.

This study is independent academic research and is required to comply with the rules of the UCT research ethics committee regarding confidentiality and anonymity. Participants in interviews will be guaranteed **COMPLETE ANONIMITY**. All information collected is part of the research and only information relevant to the study will be collected. The names of nurseries and personal information of research participants will not be disclosed.

For research purposes, it is important that you answer every question. We rely on you for open, honest responses so that we can generate a deeper, more informed understanding of the implications of these regulations for the nursery industry. However, should you wish to terminate your involvement in this interview, you may do so at any time.

Thank you for agreeing to participate – I sincerely value your input and the time you have set aside at this busy time of year!

APPENDIX 2: NURSERY MANAGER QUESTIONNAIRE

1. How many years have you been working in the horticultural industry?

2. What qualification do you have, if any, in the field of horticulture?

3. What is your nursery's approximate annual turnover? Please choose one:

1) More than R10 million	2) R5-10 million	3) R2-4.9 million	4) R1-1.9 million	5) Less than R1 million	Not prepared to disclose

4. Does your nursery belong to a trade or industry association?

Yes	No	Don't know

5. If yes, please name the trade or industry association(s) your nursery belongs to:

6. Are you aware that this year, new invasive alien plant regulations (specifically, the National Environmental Management: Biodiversity Act 2004 (NEMBA): Alien Invasive Species Regulations 2014) have been enacted?

Yes	No

7. If so, through which of the following sources did you first learn of the existence of the regulations? Please choose one, or, if none apply, please indicate the source.

A) Internet
B) Trade/industry association
C) Colleagues
D) Direct communication from government
E) Media
F) Social media
G) Other (please specify) ……

8. Please rate your response to the following statement: *Government has provided sufficient information on what nursery managers need to do in order to comply with the NEMBA regulations.*

1) Strongly Agree	2) Agree	3) Neutral	4) Disagree	5) Strongly disagree

9. What regulations existed to control the sale of invasive alien plants by the nursery industry before the NEMBA regulations were in place?

10. In your opinion, what percentage of the nursery industry has been compliant with the previous regulations in force over the last three years?

1) Less than 30%	2) 30-49%	3) 50-69%	4) 70-94%	5) 95-100%	6) Don't know

11. To what extent was your nursery compliant with the previous regulations?

1) Fully	2) Mostly	3) Partially	4) To a limited extent	5) Don't know

12. Have you seen the NEMBA list of invasive alien plants that was published on 1 August 2014?

Yes	No

13. There are 379 invasive alien plants on the NEMBA lists. Please rate how confident you are that you would know whether any of those listed plants are in your nursery?

1) Very confident	2) Reasonably confident	3) Somewhat uncertain	4) Very uncertain

14. Do you have a copy of the NEMBA invasive alien plants list?

Yes	No

15. Has your nursery received official notification from government about the NEMBA invasive alien plant regulations that became law on 1 October 2014?

Yes	No

16. Please rate the following statement:
My nursery receives regular (at least once a year) updates about invasive alien plants from government.

Yes	No	Don't know

17. Do you think it is important to control the spread of invasive alien plants?

Yes	No	Don't know

18. List two of the main reasons for your answer to question 17:
1.
2.
19. Have you disposed of any of your plant stock in order to comply with the NEMBA regulations?

Yes	No

20. If **yes**:
    - Please give a rough estimation of the retail value of the plants you have disposed of
    - Where did you dispose of the plants?
    - Has government provided you with any information about how to safely dispose of invasive alien plants?

Yes	No	Don't know

21. Have you recently (in the last three years) stocked plants that are now on the NEMBA lists?

Yes	No	Don't know

22. If **yes**, please indicate the category or categories that these plants would fall under:

1) Cacti	2) Trees	3) Woody shrubs	4) Herbaceous plants	5) Climbers	6) Aquatic plants

23. Have your staff members received training enabling them to advise customers regarding invasive alien plants?

Yes	No	Don't know

24. Does your nursery display posters that provide information to customers about invasive alien plants?

Yes	No	Don't know

25. When customers ask for plants that are listed as invasive, do you and your staff recommend non-invasive alternatives?

Yes	No	Don't know

26. Please rate the following statement:
Most nurseries stock and sell invasive alien plants.

1) Strongly Agree	2) Agree	3) Don't have a view	4) Disagree	5) Strongly disagree

27. In February this year, government published the draft NEMBA Alien and Invasive Species List and asked for public comment. Were you informed about this invitation to comment on the lists?

Yes	No

28. Did you submit any comments on the lists?

Yes	No

29. In your opinion, are the new NEMBA regulations likely to be effective in helping prevent the spread of invasive alien plants?

Yes	No	Don't know

30. Rate your response to the following :

There are important invasive plants that are not on the NEMBA list	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Government is not able to enforce these regulations	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Imposed regulations are not an effective way of getting cooperation from the industry	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Government should encourage self-regulation by the industry as this would boost levels of compliance	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Please list any additional reasons for why you think the NEMBA regulations may/may not be effective in helping prevent the spread of invasive alien plants ……..					

31. Do any of the following factors make it difficult for you to comply with government legislation on invasive alien plants? Please rate the following:

Compliance is expensive	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Not being able to sell NEMBA-listed plants will significantly reduce the turnover of my nursery	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
The regulations are confusing and complicated.	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Growers do not provide enough saleable alternatives for some of the plants on the list	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Please list any additional factors					

32. Which of the **above** factors is the biggest problem for your nursery? Please name **one**:

A) Compliance is expensive
B) Not being able to sell NEMBA-listed plants will significantly reduce the turnover of my nursery
C) The regulations are confusing and complicated
D) Growers do not provide enough saleable alternatives for some of the plants on the list
E) An additional factor (please specify from above)……..
F) None of the above

33. Please indicate how you feel about complying with the new NEMBA regulations on invasive alien plants.

1) Very enthusiastic	**2) Enthusiastic**	**3) Neutral**	**4) Unenthusiastic**	**5) Very unenthusiastic**

34. What factors negatively affect your level of motivation for compliance with the new NEMBA regulations? Please rate the following:

There is a lack of enforcement	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Other nurseries continue to sell profitable NEMBA-listed plants	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Some of the plants on the list should be de-restricted because they are not an invasive threat	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Government does not communicate effectively with the nursery industry	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
There is a high consumer demand for some of the listed invasive alien plants	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Government does not draw on the knowledge and expertise of the nursery industry	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Please list any additional factors					

35. Which of the **above** factors has the biggest negative impact on your level of enthusiasm? Please name **one**:

A) Lack of enforcement
B) Other nurseries continue to sell profitable NEMBA-listed plants
C) Some of the plants on the list should be de-restricted because they are not an invasive threat
D) Government does not communicate effectively with the nursery industry
E) There is a high consumer demand for some of the listed invasive alien plants
F) Government does not draw on the knowledge and expertise of the nursery industry
G) An additional factor (please specify from above)……..
H) None of the above

36. What factors positively affect your level of motivation for compliance with the new NEMBA regulations? Please rate the following:

It is important to protect the environment	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
It is important to have a 'green' business image	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Consumers are demanding non-invasive plants	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
There is pressure from other compliant nurseries	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
There is pressure from a Trade / Industry Association	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
I do not want to incur a penalty for breaking the law	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Please list any additional factors					

37. Which of the above factors has the biggest positive impact on your level of enthusiasm? Please circle one:

A) It is important to protect the environment
B) It is important to have a 'green' business image
C) Consumers are demanding non-invasive plants
D) There is pressure from other compliant nurseries
E) There is pressure from a Trade / Industry Association
F) I do not want to incur a penalty for breaking the law
G) An additional factor (please specify from above)……
H) None of the above

------ THANK YOU VERY MUCH FOR GIVING YOUR TIME TO THIS STUDY! ------