

Historicising perceptions and the national management framework for invasive alien plants in South Africa

ABSTRACT

This article offers a historical framework for understanding changes to human perceptions and efforts to manage invasive alien plants and weeds in South Africa from the mid-nineteenth century until the present. The article argues that South African legislation and policy for managing invasive alien plants and weeds has historically been limited because people have held contradictory values about plants, many private land owners have lacked resources and have not been compelled to follow government legislation, and because policy has reflected the interests of a small group of farmers or scientific experts who have had limited influence on most private land owners and traditional land users. Successful control efforts often relied on technical expertise that was applied controversially or could be implemented on government land without extensive public consultation or social conflict. The creation of a national framework for invasive alien plants through the Working for Water Programme in 1995 and National Environmental Management of Biodiversity Act (no. 10) of 2004 (NEMBA) has increased public awareness, but the Programme and NEMBA remain limited by many of the same institutional and social constraints that experts and institutions faced in the past. In conclusion, the article draws on history to provide insights to contemporary challenges.

KEY WORDS: culture-nature; invasive alien plant; South Africa; Working for Water; weeds

1. INTRODUCTION

Researchers in the field of invasion ecology have begun to incorporate social scientific and humanistic insights into research and management efforts because they recognise the need to

understand and work with people of diverse viewpoints (Kueffer 2013; Vaz et al. 2017; Bennett et al. 2017). They increasingly acknowledge that humans and nature are interconnected rather than strict dichotomies, an idea that has been advanced by scholars in the humanities and social sciences for more than a decade. (McNeely 2001; van Sittert 2002; Robbins 2004; Head and Muir 2004; Larson 2007; Larson 2010). There is no easy solution to integrating scientific and human perceptions because invasions are a “wicked problem” undergoing constant change (Woodford et al. 2016), and because science and non-science perspectives are not always mutually compatible (Pooley 2013). Despite challenges, the more knowledge researchers have of history, culture, and society the better they will be able to understand and engage with stakeholders who hold alternative views (Humair et al. 2014; Crowley et al. 2017; Vaz et al. 2017; Zengeya et al. 2017; Crowley et al. this issue).

Scientists and managers need a useable framework that can be applied to a variety of situations to explain variations in human perception. Without understanding why people hold a certain belief, it is difficult to devise a successful and equitable plan of action. A new conceptual framework developed by Shackleton et al. (this issue) proposes six factors shaping human perception of invasion. Perceptions are defined as “dynamic mental constructs which are influenced by individuals’ experience and environments through time and space” (Shackleton et al. this issue). A theoretical framework is developed to describe how individual perceptions of invasions are determined by characteristics of the invasive alien species itself; effects of the invasion (negative and positive/benefits and costs); socio-cultural contexts; landscape contexts; and institutional and policy contexts. Shackleton et al.’s model utilises a historical approach to explain the development of contemporary perceptions and policies.

South Africa provides a particularly rich site to apply this framework because of the significant number of invasions and the rich history documenting them. South Africa has eleven

official languages and nine biomes, including the smallest floral kingdom in the world, the Cape Floral Kingdom. It also hosts extensive plant invasions. According to 2010 data, South Africa had 660 naturalised alien plant species out of a total of 8750 that have been introduced into the country. Around 200 species are legally designated as invasive alien species (Wilson et. al. 2013). At least 66 species of Australian *Acacia* have been introduced into South Africa, more than any other region in the world (Rouget et al. 2016). The South African government has spent around 500 million USD through the Working for Water Programme to manage alien invasive species, especially trees, to improve water supplies in catchments, protect biodiversity and agriculture, and provide employment and skills training (van Wilgen and Wannenburg 2016). This significant investment has reduced some of the worst invasions, but the sheer scale of the problem means that managing invasion requires wider societal participation along with new tools for management. Harnessing the power of people requires rethinking how scientists and the state engage with society.

There is a growing literature on the history of perceptions and management of introduced, naturalised and invasive alien vegetation in South Africa (Comaroff and Comaroff 2001; van Sittert 2000; van Sittert 2002; Pooley 2010; Carruthers and Robin 2010; Beinart and Wotshela 2012; Pooley 2014; Bennett 2014; Bennett 2015b; Pooley 2018). Historians have not yet synthesised these findings across time and space or compared different parts of the country in a single analysis. Nor has there been an effort to link these historical findings to social scientific models, such as that proposed by Shackleton et al (this issue). This makes it difficult for non-historians to utilise this information when trying to devise contemporary policy or management options. To bridge disciplines and create a bigger framework, this article offers a national historical assessment of how perceptions of invasive plants formed throughout the country in relation to characteristics, effects, socio-cultural contexts; landscape contexts and institutional and policy contexts.

One fact dominates the history of invasive plants in South Africa. The Cape has consistently led national planning and action on weeds and alien invasive species, especially relating to agricultural weeds and invasive trees. The belief that invasion constituted a national problem, and required a national policy to manage them, developed late in the twentieth century, and only became implemented through management after the end of apartheid in 1994. Concerns about weeds emerged first in the Cape Colony. Interest in preserving alien and indigenous flora was also stronger there than elsewhere in the country throughout the twentieth century. The first coherent national programme for managing invasive species began in 1995 with the Working for Water Programme. Working for Water drew heavily on hydrological and ecological insights from tree invasions in the Cape.

Though the Cape led national efforts to control weeds and invasive plants, legislation and scientific efforts to manage undesirable plants was only moderately successful. Government officials, whether under colonial law or national times, rarely used legislative power to compel private land owners to manage weeds or invasive species. The most effective action occurred in places where scientists used laws to compel action (usually on crown land), such as when foresters managed catchments using fire in the 1970s and 1980s (Pooley 2014), where wealthy white farmers or residents used levers of the state or community action to manage weeds or invasive alien plants (van Sittert 2002; Beinart and Wotshela 2012), or where local communities came together to form “hack parties” to clear invasive trees (Bennett 2014).

The article is organised chronologically, beginning with colonial legislation and ending with the establishment of contemporary legislation and policy. Each section identifies variations in how people throughout the country and from different backgrounds perceived weeds

and invasive alien plants. Specific focus is paid to laws and scientific ideas that informed perceptions. Scientific ideas and law were not hegemonic, but they nonetheless created the institutional framework in which people worked and thought. Individuals and people of different backgrounds often challenged and disagreed with these valuations.

The terms weeds and invasive alien plant (IAPs) are often used interchangeably within management plans and public perceptions (see Bach et al. this issue). For historical accuracy, weeds and IAP are here understood as distinct but sometimes overlapping concepts. Awareness of weeds, and research into weeds, undoubtedly influenced the emergence of the concept of IAP (and the more widely used but more general term invasive alien species or IAS) in the 1980s but the two are different. Historically, weeds have been more commonly understood as plants “out of place” that cause problems for humans, most especially farmers. Being alien (often known as exotic or foreign) has not been a precondition for a plant being declared a weed. For instance, around 20% of all weeds declared in the Cape in the first half of the century were indigenous species. Many of the first-generation of ecologists maintained that alien plants were no more likely to be weedy than indigenous plants (Bennett 2015b). The connection between alienness and weediness become more pronounced in the Cape in the 1940s to 1970s before becoming a national issue in the late 1970s and 1980s (Bennett 2014). It is now widely believed that introduced species are more likely to become invasive or weedy than indigenous species because of the growth of invasion ecology in the 1990s and 2000s.

2. MATERIALS AND METHODS

This paper uses methods from environmental history and historical geography to identify geographic variations in the public perception and management of weeds and IAPs throughout the twentieth century. It provides a qualitative and quantitative analysis of geographic information

imbedded within legislation, archival documents, and secondary literatures in history, geography and ecology.

Published and archival materials compose the primary materials of analysis. A complete inventory of provincial and national weed control legislation from 1910 to 1983 was compiled and analysed to provide a proxy that traces public awareness of weeds and IAPs. Archival materials have been collected from the National Archives of South Africa and primary sources from the University of Cape Town, National Library of South Africa, and Kirstenbosch to trace the views and actions of individuals and institutions.

3. RESULTS

3.1 Variations in Colonial and Early Provincial Weed Legislation, 1861-1937

South Africa's contemporary legislation for managing IAPs evolved out of a longer history of weed control dating back to the colonial (pre-1910) and Union (1910-1961) eras (Fig. 1). The high number of invasive plants in South Africa reflects the country's many treeless biomes, its climate and its recent history of colonialism. The lack of closed canopy forest cover (less than 1%) led European migrants, who began settling in 1652, to import alien trees (Bennett and Kruger 2015). Farmers purposefully brought agricultural plants, such as wheat, that also led to the introduction of unwanted plants, such as *Xanthium spinosum*, that became problematic weeds (Crosby 1986; van Sittert 2000).

In 1861, the Cape Colony parliament passed its first law (no. 22 of 1861), requiring that all land owners eradicate *xanthium spinosum* (van Sittert 2000). Natal Colony followed in 1874 (no. 38 1874) with weed legislation and the Transvaal (no. 17 1909) and Orange Free State (no.

23 1909) adopted similar laws after the British took them over during the Second Anglo-Boer War. Colonial laws remained in force in each province after the Union of South Africa in 1910.

From 1910 to 1913, the Union delegated weed control to the provinces, a practice that was enshrined within the Financial Relations Act (no. 10) of 1913 (Secretary for Agriculture to Secretary for Justice 13 Sept 1912). From 1913 to 1937, provincial administrators had the responsibility for controlling weeds through Part 5 of the South Africa Act of 1909. Each province relied on colonial laws that were amended to reflect emerging weeds. There was a push to harmonise national legislation that fell short. In 1916, the South African Farmers Union asked the Minister of Agriculture, “that the various laws governing the extermination of noxious and other weeds in the several Provinces shall be amended in such a way as to apply uniformly in the Union” but their request went unfilled (Secretary South African Agricultural Union to Hon. Minister of Agriculture). The Provincial Administration Commission suggested that the Cape’s system be applied nationally, but this ruling was not followed (Union of South Africa 1916). The Cape model was attractive because Cape divisional councils customized noxious weed prohibitions to the local needs of their farmer constituents. As a result, the Cape Province proclaimed nearly twice as many species as all the other provinces combined (Fig. 2).

Wealthier white farmers in the Cape ensured that parliament declared weeds within their home divisions (van Sittert 2000). The Cape’s parliament passed ten pieces of legislation from 1905 to 1933 focused on weeds compared with four in Natal, three in the Transvaal, and two in the Orange Free State (Statutes of Union of South Africa 1937). With the example of prickly pear (*Opuntia ficus-indica*), politically connected and wealthy farmers had the capital to manage invasive species, ran large farms focused on selling to external markets, and believed that scientific and technical solutions could be applied to manage invasions (van Sittert 2002). Even today, many white farmers who own private land are more knowledgeable about weeds and

invasive plants in comparison with other members of society, especially those with the least wealth and power (Shackleton et al. 2015). In terms of prickly pear, the views of wealthy farmers were at odds with the values of other people without wealth or power (van Sittert 2002). Africans and poor whites used prickly pear for food and alcohol and some farmers who had the spineless variety suffered under legislation (Beinart and Wotshela 2012).

Provincial legislative data prior to the creation of national legislation in 1937 is best used to measure perceptions rather than using it to determine the extent of invasions. Van Sittert argues that historians must acknowledge that the “limits of the historical record, which does not permit a ‘biological’ reconstruction” (van Sittert 2002). The higher number of listings may have indicated the greater extent of problematic invasions in agricultural landscapes in the Cape. Data collected from the Agricultural Pests Act reveal that the Cape Provinces housed 62% of the country’s distribution sources for alien plants. The greater abundance and longer resident time of alien species in the Cape helps explain why the region had the highest measured rates of invasion during the 1980s to early 2000s despite bioclimatic modelling suggesting that other regions in the country could house a greater number of invasive species (Rouget et al. 2004; Richardson and van Wilgen 2004).

People outside of the Cape clearly recognised the problem of weedy plants but they received less legislative attention. Legislation in Natal, the Orange Free State and the Transvaal proclaimed a generic short list of burrs (*Xanthium* spp.), spear thistle (*Cnicus lanceolatus*, now *Cirsium vulgare*), jointed cactus (*Opuntia aurantiaca*) and dodder (*Cucuta* spp.).

The smaller number of declared weeds outside of the Cape Colony was possibly shaped by species and landscape contexts. Some of the most aggressive invaders in the Cape, namely

species of *Opuntia* and of *Hakea*, did not cause similar problems in other provinces with different climates and land use history. The shorter history of European colonisation outside of the Cape (less than 100 years versus 200+ years) and smaller white farming population (which imported most of the invasive plants) may have meant that the landscape had fewer actual problematic agricultural invasions. The lag between introduction and invasion may have created what some ecologists describe as an “invasion debt” or “lag phase,” which possibly explains the increase in invasion in areas outside of the former Cape Province at a later time (Rouget et al. 2004).

3.2 Weak National Weed Planning, 1937-1983

In the 1930s, the national government passed legislation to take greater control over weeds and environmental management because of growing anxiety about problem weeds, declining rangeland quality and drought and erosion (Beinart 2008). This reflected a shift towards state centralisation that intensified with the onset of the apartheid era with the election of the National Party in 1948. Three key national agencies—Agriculture, Forestry, and Native Affairs—managed weeds, respectively, on private land, crown land, and Trust/Native land. A few weeds of significance, *Opuntia* in the 1930s and *Hakea* in the 1960s, received a coherent national response across departments, but these remained exceptions (van Wilgen et al. 2016) before the 1980s and 1990s. Scientific experts often wished for greater powers but often found themselves stymied against officials from Native Affairs, private land owners, and politicians who were wary of upsetting rural constituents.

The Weeds Act (no. 42) of 1937 remained the centrepiece of national weed control until the implementation of Conservation of Agricultural Resources Act (no. 43) of 1983. Nationally, the total number of species listed *declined* after its passing (Fig. 3). Throughout its life, the Act

focused primarily on agricultural weeds rather than plants that caused problems in protected areas. For instance, only three non-agricultural weeds were declared in the Weeds Act (no. 42) of 1937 for the Cape Floristic Region despite widespread recognition by scientists that invasive plants constituted a major threat to the indigenous vegetation (van Wilgen et al. 2016).

The Weeds Act relied upon officials from the Department of Agriculture and Forestry and the Department of Native Affairs to enforce it. The Department of Agriculture and Forestry could provide a notice compelling eradication with a maximum fine of 50 pounds, but in “practice though, this legislation was not enforced and therefore ineffective” (van Wilgen et al. 2016). The Act applied to all Native Lands but was administered by Native Affairs officials, who often took a cautious approach. Tribal Authorities were required to compel weed control on all communal land by Proclamation no. 116 of 1929), Proclamation (no. 110) of 1957, and Proclamations nos. 265 of 1924 and 238 of 1941 for the Transkei.

The prickly pear infestation in the Eastern Cape Province during the 1930s proved one exemption of the general rule of weak state enforcement of weed legislation (Beinart 2008; Beinart and Wotshela 2012). To solve the perceived problem, government experts received significant powers under the Jointed Cactus Eradication Act (no. 52) of 1934 to take a strong interventionist approach on private land. For over a decade Agricultural officials recognised prickly pear as “probably the most serious weed in the country” (Secretary for Agriculture to Secretary for Justice, 4 April 1923). Department officials used teams of labourers to mechanically clear private farm lands, which then received a certificate of clearance that then required private owners to manage the land. Soon after, the Department of Agriculture instigated a program of biological control using imported cochineal beetles and using the moth, *Cactobalstas cactorum*. The use of biocontrol alarmed many of the same farmers who supported the Act because they worried that the biocontrol might harm valuable crops and the government would

not compensate them. This instance highlights how the shift of power—from land owners to experts—led to competing viewpoints on how to manage weeds. Farmers have been reluctant to give up control over land management and tended to prefer importing state aid and science and technology on their own terms. At the same time, the state was wary of action due to potential litigation (Secretary of Agriculture to Secretary for Justice 1932).

The Department of Agriculture led government research and control at national levels. Weeds remained a thoroughly agricultural concern. The Division of Botany, founded in 1918 within the Department of Agriculture, played a leading role in researching and advising on weeds. Studying weeds and advising farmers on how to identify and control them was just one of the Division's extensive responsibilities, which also included investigating native plants for economic purposes, offering the first systematic study of the country's vegetation types, and providing advice to farmers on how to improve pasture and select crops. From 1921, the Division offered illustrations and advice on controlling weeds in bulletins. The Division of Soil and Veld Conservation, created in 1939, helped to actively manage *Opuntia* and other weeds (Beinart 2008). In 1951, the Division of Botany was renamed the Botanical Research Institute (BRI). A Plant Protection Research Institute was established in 1961 out of the Division of Plant Pathology and Division of Entomology. Researchers from the BRI and PRI helped coordinate national weeds conferences that started in 1974. The creation of national weeds conference (1974, 1977, 1979, 1981, etc.) facilitated interdisciplinary discussion that brought attention to problems throughout the country (Bennett 2014). Discussions at weed conferences informed the passing of the Conservation of Agricultural Resource Act (no. 43) of 1983 (CARA), which replaced the Weeds Act and remains to this day. CARA listed invasive trees that threatened protected areas, but the legislation did not include tree species with significant commercial value (van Wilgen et al. 2016).

Like the earlier Weeds Act, CARA regulations have proved difficult to manage invasive species on private lands because of a lack of private funds (van Rensberg et al. 2017), because costs are perceived to exceed benefits (Shackleton et al. 2015), and because the government is unwilling or lacks the will to enforce legislation on private land, problems that continue in post-apartheid South Africa under both CARA and NEMBA (Urgenson et al. 2013; Shackleton et al. 2016). Many private owners also expect the government to control AIPs (Urgenson et al. 2013; Shackleton et al. 2016). Farmers have also complained historically that many weeds come from crown land onto private; they argue the state should bear some cost (Secretary for Farmers and Traders Association to Minister for Justice 12 August 1925). For instance, like the Weeds Act, CARA's legislative powers have not often been used against private owners to regulate declared invasive species on private property (Lidström et al. 2015). Successful control efforts tended to rely on direct intervention by the state on crown land (forestry and then after 1995 the Working for Water Programme, discussed in the next two sections) or through the efforts of private land owners (van Rensberg et al. 2017) who utilise their own management efforts (eradication, use, etc.) to regulate invasion.

3.4 Alien Trees and the Beginning of Coordinated National IAP Management

Alien tree invasions in the fynbos biome helped provide the catalyst for the development of the first coherent national framework for invasive species management. The concerns raised by tree invasions were broader than the narrower agricultural concerns that informed the Weeds Act and colonial weed legislation (Fig. 5). Anxieties about the ecological and hydrological impacts of invasive alien trees emerged in the Cape among botanists, ecologists and foresters during the first half of the twentieth century, but these concerns remained muted elsewhere in the country (Bennett 2014). In the 1970s and 1980s, scientists drew on the example of the Cape

to spread concerns about invasion, especially tree invasions, throughout the country (Fourie 1978; Henderson and Musli 1987). Cape research and initiatives on invasive trees informed the creation of the Working for Water Programme in 1995.

Between the 1880s and 1910s, the Cape government gave away millions of free seeds of *Hakea*, *Acacia*, *Casuarina*, and *Grevilla* to stop drifting sands. Observers considered *Hakea* to be a weed as early as the 1890s (Beinart 2008) but government depositories continued giving seeds away into the early twentieth century (Union of South Africa 1911). The University of Cape Town ecologist Richard Adamson wrote in 1927 that *Hakea* was the only “rampant weed on the Cape Peninsula” (Adamson 1927). The listing of Australian trees in the genus *Hakea* as weeds in the Cape in the 1920s marked the first time an alien tree was legally deemed to be an agricultural pest. *Hakea* received listing because people believed that it “overruns large areas of veld and renders it useless” (du Toit 1942). Few farmers disagreed with the management of *Hakea*, but the costs made the regulations burdensome. In 1953, Adamson reported: “Unfortunately the expense of clearing infested land is such that the ordinance has never been fully enforced” (Adamson 1953).

Concern about weeds on protected crown land was more muted. Many ecologists and botanists did not initially view the spread of alien trees as an ecological problem. The dominance of Frederic Clements’ idea of succession ecology, which posited that undisturbed climax communities would be resistant to invaders, led ecologists to downplay potential ecological concerns (Pooley 2010; Bennett 2014). Within this viewpoint, invasion could only happen after human activity, fire, or any other major outside disruption disturbed the climatic community (Pooley 2010). Examples of invasion near Kynsna and around Cape Town were not seen as problems because people, not plants, were viewed by most ecologists as the primary cause of invasion (Bennett and Kruger 2015; Bennett 2015b).

The continued expansion of alien *Hakea*, *Pinus*, and *Acacia* eventually challenged Clementsian orthodoxy. In 1941, Adamson expanded his list of rampant weeds to include species of *Pinus* and *Acacia* and described them as “the new Cape flora.” By examining previous catalogues of exotic plants, Adamson noted that “the associated assemblage of foreign plants...shows every sign of being on the increase.” He argued that they were “beginning to bring about changes that are not directly associated with man’s activity” (Adamson 1941). The view that plants rather than people possibly constituted the biggest threat to the Cape’s flora was the key finding of a landmark report on the Cape’s vegetation headed by Christiaan Wicht. The report warned bluntly: “One of the great, if not the greatest, threats to which the Cape vegetation is exposed, is suppression through the spread of vigorous exotic plant species” (Wicht 1945; van Wilgen et al. 2016).

Scientific interest catalysed community engagement. In the 1950s, community efforts from Cape Town’s middle class whites fought against the expansion of invasive trees (Bennett 2014). Members of the Mountain Club of South Africa, earlier in the century a promoter of alien tree planting, and the BSSA began to organise “hack” parties to kill pines on Table Mountain. The BSSA established the Control of alien Vegetation Committee in 1958. These community organisations catalysed the Cape Province to publicise law regarding flower conservation and to create awareness of indigenous vegetation through education programs, colourful books and strict legislation against flower picking. This built on early flower legislation in the Cape, which protected rare species against flower picking (Bennett 2014). Evidence from the southwest Cape suggests that fears about the possible extinction of indigenous plants by alien invasive plants grew out of an earlier celebration of the flora’s uniqueness and beauty. There was no comparable legislative push to protect rare indigenous species in other parts of South Africa,

partly because there was no similar awareness or celebration of indigenous vegetation by local communities (Fig. 4).

In the late 1940s, forestry research from the hydrological experiment set up at in the southwestern Cape Province research station at Jonkershoek in 1935 found that planted and invasive alien trees decreased streamflow, a view that undermined the longstanding view that trees improve stream flow (Bennett and Kruger 2015). This view led foresters to eventually link the spread of invasive trees with decreasing streamflow in grassland and fynbos ecosystems, a finding that forms the basis of the Working for Water Programme. Findings from Jonkershoek informed the passing of The Mountain Catchment Areas Act (No. 63) 1970, which gave foresters responsibility for managing catchments on public and private lands to improve waterflow and maintain indigenous biodiversity (Bennett and Kruger 2015). The amended Act (1981) mandated the control of “intruding vegetation,” which referred primarily to invasive alien trees in the southwest Cape. The Department of Forestry established a program of catchment management in the late 1970s to 1986 using fire to manage invasive species and water flow (Pooley 2014). The program ended in 1986 when the national government gave catchment management over to provincial conservation authorities (Pooley 2014). Provincial authorities lacked the funding and expertise to continue this programme, and the law and associated management program has fallen into abeyance (Bennett and Kruger 2015).

Apartheid ended with the election of the African National Congress in 1994. Environmental legislation underwent significant shifts because of changing political priorities that sought to uplift disadvantaged Africans and to preserve the country’s biodiversity. A group of scientists presented evidence to government from Jonkershoek and other hydrological studies (Bennett and Kruger 2015) suggesting that up to 50% of the water in catchments could be lost due to the water-use of invasive alien trees (Hobbs 2004). Kader Asmal, the ANC Minister of

Water Affairs, agreed to a proposal to create the Working for Water Programme. WfW employed disadvantaged poor to clear invasive plants for water conservation, job creation and skills training (Ntshotsho et al. 2015).

WfW was the first national program designed to manage and monitor IAPs across the entire country. The national program is divided between a central office and has regional, provincial, and project portfolios. WfW engages with scientists, who inform policy, but do not implement management themselves in the same way that foresters did in catchment areas in the 1970s and 1980s (Pooley 2014). The move away from forestry to ecological expertise mirrors global trends, but is pronounced in South Africa because of the lack of indigenous closed-canopy forests requiring forest management (Bennett 2015a). Foresters believed that it was possible to balance the production of timber with ecological and hydrological concerns (Bennett and Kruger 2015), a view that is contested today. For instance, some ecologists argue that the economic value of plantations in the Cape Floristic Region is lower than their hydrological and ecological costs caused by lowered streamflow and the loss of biodiversity (van Wilgen 2012 and Richardson).

There has been a greater use of unskilled labour and of other knowledge systems in the post-apartheid period, although the effort to balance the needs of job creation with the management and monitoring of invasive plants sometimes contradict (van Wilgen and Wannenburgh 2016). Apartheid environmental management policies relied on a small cohort of scientists who used scientific information to inform technical solutions, such as using fire in a catchment. Science now plays a role in decision-making, but it often takes a back seat to procedure, bureaucracy, and politics (Ntshotsho et al. 2015). There have been a series of retrospective studies highlighting some of the advantages of the system implemented by foresters in the 1970s and 1980s (Pooley 2014; van Wilgen et al. 2016) when scientific input played a greater role in

management, although there was much less attention given to ensuring equality and development of rural communities, especially in the former Bantustans.

Since 2004, WfW has fitted within a broader framework of biodiversity management created largely through the National Environmental Management Biodiversity Act (no. 10) 2004 (NEMBA). NEMBA was the country's first legislation created to conserve the country's biodiversity, defined as "variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems." A centrepiece of NEMBA was the creation of the South African National Biodiversity Institute, a government entity that studies, monitors and creates public awareness of indigenous biodiversity, threatened and conserved species, and alien invasive species. Chapter 5 of the revised NEMBA (2014) created new regulations relating to the control of alien and alien invasive species. Section 73(2) (a) compels all South Africans, including private land owners, to attempt to control listed alien invasive species in order to abate threats to biodiversity. Legislation requires managers of protected areas to create invasive species management plans.

NEMBA has similar problems to CARA, the Weeds Act, and provincial weed legislation because it requires private compliance but lacks the capacity to compel private land owners to follow its broad requirements. In theory, NEMBA could be used to require all private land owners to control listed alien invasive species. In practice, the majority of private land owners lack the financial resources to clear and control invasive species and the state lacks funding and the will to prosecute private land owners. There is also a significant conflict of interest that many land owners have relating to potentially valuable or desirable AIPs on their property (Woodford et al. 2016).

4. Discussion: Historical Insights

What insights can be learned from the history of weed and IAP management and legislation in South Africa? First, more attention should be paid to cultivating strong local ties and enforcement mechanisms that complement national strategies. The long history of weed and invasive species management in the Cape lends weight to calls for greater local inclusion in environmental planning (Shackleton et al. 2011; Shackleton et al. 2017). Efforts in the Cape have been led by diverse local initiatives and research that can be traced as far back as the late nineteenth century. Provincial and local efforts influenced national policy and often ran parallel to them (Bennett 2014). Successful clearings on Table Mountain, for instance, have engaged with municipal, provincial and national agencies (van Wilgen et al. 2016). The history of weed and invasive plant management in the Cape is instructive, but it needs to be recognised that this history has often been dominated by wealthier interests. Greater efforts need to be made to listen to and include other perspectives (Shackleton et al. 2015) when determining management frameworks.

Second, scholars should pay more attention to geography and social networks when discussing IAPs, IAS, and weeds. This paper suggests that concerns about weeds and invasive plants have historically been interlinked but distinct issues. People who expressed worries and sought to manage weeds and IAPs have generally tended to be wealthier, have more education, and agree with scientific viewpoints (van Sittert 2000; van Sittert 2002; Shackleton et al. 2015). Conversely, those of a poorer background often took different viewpoints.

There are also other key differences, especially between groups who are vocal about the management of weeds and IAPs. Farmers have focused primarily on agricultural pests rather

than ecological invasions outside of agricultural areas. The agricultural industry looks at agricultural production as a matter of self-interest and survival. Many farmers care about invasions but funds for ecological concerns are limited and it is time consuming to clear IAPs (Shackleton et al. 2015; Van Rensburg et al 2017). Farmer support for WfW varies although many recognise the problems they cause (Shackleton et al. 2015). Most surveys of farmers focus on the Cape, which has a longer history of legislation and public awareness of invasion, so it is likely that attitudes are even less receptive outside of the Cape.

Concerns about tree invasions in the Cape Floristic Region emerged from the strong scientific and amateur interest in the region's distinct vegetation and its protected areas (Pooley 2014; Bennett 2014; Bennett and Kruger 2015; van Wilgen et al. 2016). Invasion ecologists studying protected areas are interested in agricultural weeds but the problem of protecting biodiversity and producing crops are fundamentally different in terms of scales of economy, resources devoted by the state and private sector, and the type of land use (production versus protection).

These motivations and groups have bearing on the success of wider environmental education initiatives, especially as they relate to disadvantaged South African communities in rural and urban areas. Historically, urban middle class whites in the southwest Cape have shaped agendas and concerns about alien trees and the hydrological impact of invasive trees (compared to say, planted forests, which did alarm white farmers). WfW draws its core ideas and leadership from this region (Bennett 2014). For instance, many rural African users of invasive *Acacia* differ in their viewpoint from official WfW policy and CARA and NEMBA legislation (Aitken et al. 2009; Ngorima and Shackleton this issue). Environmental management legislation and management, past and present, has been designed by scientists and bureaucrats rather than with communities from the ground-up (Ntshotsho et al. 2015). Researchers are now

trying to include community viewpoints into national management frameworks for different taxa as a way forward (Novoa et al. 2016; and Shackleton et al. 2017), but there is a difficulty resolving conflicts. Though challenging, if diverse perspectives are not included into frameworks, it is less likely that public attitudes will continue to change in the way the government and many scientists want.

Scientists and the state have historically lacked the ability to force people to act or change. The most successful efforts – with a few exceptions involving technical expertise – involved engaged communities that had a cultural as well as an economic stake in the issue. History can inform whether to take a “soft touch or firm hand” (Novoa et al. 2015) on conflict-generated invasive species (Zengeya et al. 2017) based on the context of each place. In some locations, it may be desirable to accept some IAPs as part of the ecological community whereas complete eradication may be desirable in others (Gaertner et al. 2016).

5. CONCLUSIONS

As the article has argued, the history of IAP and weed management has been chequered in its environmental and social outcomes. Legislative and government efforts to manage IAPs have faltered because of the difficulty of engaging private land owners, competition local viewpoints, and limited support for technical interventions by scientists and managers. Geographic, wealth and educational imbalances relating to perceptions of invasive species have meant that some regions are better endowed with facilities and awareness than others to tackle the complex challenges associated with invasion. Perceptions of invasion that developed across the twentieth century in discrete locales, especially in the former Cape Province, have informed the creation of a national framework for managing invasive species that has emerged in the post-apartheid

period. The idea that IAPs, especially trees, are a national problem is now widely recognised by scientists and a growing percentage of the population, but individual perceptions about what species cause the most problems and require management vary, with some people believing that many invaders are useful and others seeing them as threats to agriculture, biodiversity and livelihoods. Recognising that there are distinct groups and historical trajectories to specific concerns may help scientists and managers to improve the existing regime to better protect the environment and to benefit people.

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