

Bridging the research–implementation gap: Mainstreaming biodiversity into the South African mining sector



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Background: ‘Mainstreaming biodiversity’ aims to integrate biodiversity priorities directly into the policies and practices of production sectors, including the mining sector. In South Africa, the need emerged for a biodiversity guideline specifically relevant to the mining sector that would interpret a wide range of available spatial biodiversity information and frame it in a user-friendly format.

Objectives: The aim of this article was to document and review the development of the *Mining and Biodiversity Guideline*. This serves as a case study of a product developed to assist in bridging the gap between available biodiversity information and use of this information by a production sector.

Methods: We examined the development of the *Mining and Biodiversity Guideline* with reference to three factors known to be beneficial to creating policy-relevant science: a sound scientific foundation (credibility), relevance to decision-making (salience) and involvement of stakeholders (legitimacy).

Results: The *Mining and Biodiversity Guideline* was developed through collaboration between the mining and biodiversity sectors. It provides a tool that contributes to the sustainable development of South Africa’s mineral resources in a way that enables regulators, industry and practitioners to minimise the impact of mining on biodiversity and ecosystem services. It includes a single integrated map of biodiversity priority areas summarised into four sensitivity categories relevant for the mining industry, with detailed guidance on how these should inform the application of the mitigation hierarchy.

Conclusion: The *Mining and Biodiversity Guideline* has received political endorsement from the relevant regulatory government departments. A focussed training programme has promoted awareness and understanding of the *Guideline*. Preliminary reports indicate that the *Guideline* has been effective in influencing decision-making.

Introduction

The scientific literature documents a disconnection between available scientific research and the practical use of such research, known variously as the ‘research–implementation gap’, ‘knowledge–action gap’ or ‘knowing–doing gap’ (Cook et al. 2013; Cowling et al. 2008; Knight et al. 2007; Pierce et al. 2005; Toomey, Knight & Barlow 2017; Von der Heyden et al. 2016). Much conservation research intends to provide useful information to the people who make decisions about land use that may have an impact on biodiversity (Knight et al. 2007; Toomey et al. 2017). However, land use decisions mostly fall to government departments or production sectors (Pierce et al. 2005), which may be limited in their capacity to interpret the results of this research or may not consider it relevant to their objectives. Thus, the findings of biodiversity research are not used by those who have the authority to take action (Sutherland & Wordley 2017). The gap between research and its applied use has prompted increasing interest in what is termed boundary work, which involves developing the processes for communication that bridge the boundary between knowledge generation and use of that knowledge by policymakers and production sectors (Wyborn 2015). Cash et al. (2003) proposed that bridging this boundary would require that information be seen as credible (having a sound scientific basis), salient (relevant to decision-making) and legitimate (considers the values of other stakeholders) (Game, Schwartz & Knight 2015). Ideally, boundary

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work involves the co-production of appropriately customised biodiversity information that first identifies, and then meets, the needs of the users (Nel et al. 2016; Von der Heyden et al. 2016).

In South Africa, there has been a concerted effort to interpret the available biodiversity information for use by other sectors (Huntley 2014; Manuel et al. 2016). 'Biodiversity mainstreaming' refers to

the process of embedding biodiversity considerations into policies, strategies and practices of key public and private actors that impact or rely on biodiversity, so that it is conserved and sustainably used both locally and globally (Huntley & Redford 2014).

Mainstreaming biodiversity is an increasingly important concept within conservation and attracts significant international funding (Huntley 2014; Redford et al. 2015). It has been acknowledged as an important strategy in South African national policy, and the National Development Plan 2030 stresses that long-term planning to conserve biodiversity and rehabilitate natural assets is critical to sustainable development (National Planning Commission 2012). Mainstreaming biodiversity makes the consideration of biodiversity part of production sector governance, rather than just the domain of environmental departments (Huntley 2014).

The mining sector in South Africa is one of the production sectors that impacts biodiversity. South Africa has an abundance of mineral resources and a large mining sector. In 2015, mining directly contributed 8% of the country's gross domestic product (GDP) and was a significant source of employment (4.7% of the employed workforce; IDC 2016). Mining has a substantial direct impact on biodiversity at mine sites, usually through the removal of natural vegetation, the abstraction of water and production of waste materials (DEA et al. 2013). Off-site impacts can occur in a much broader area and may have significant downstream catchment-level impacts on scarce water resources and biodiversity (DEA et al. 2013). These impacts are caused not only at the mining site, but also at the associated infrastructure (tailings deposits, roads, etc.). The impacts can continue to manifest long after mining has ceased (e.g. acid mine drainage).

The mining sector is regulated primarily by the Department of Mineral Resources (DMR) using the *Mineral and Petroleum Resources Development Act* (Act 28 of 2002). The regulation of the environmental impacts of mining has been incorporated into the *National Environmental Management Act* (Act 107 of 1998) (NEMA), in terms of which the DMR is recognised as the competent authority (decision-making authority) and the Minister of Environmental Affairs as the appeal authority. Activities associated with mining, such as transportation of ore, ore storage areas and extraction plants, are also subject to NEMA. Water-use licences are awarded in terms of the *National Water Act* (Act 36 of 1998). The mining sector's consideration of biodiversity issues has traditionally been focused on management of environmental impacts during

mine operations and through site-level rehabilitation, largely because of regulatory requirements. Although the legislation controlling impacts of particular mining activities was in place, the industry had little experience in the use of biodiversity information for strategic planning and in broader business decisions.

This article details the process of developing the *Mining and Biodiversity Guideline*, a collaborative product of the South African mining and biodiversity sectors. The *Guideline* helps to bridge the research–implementation gap such that the wealth of scientific biodiversity information available is appropriately used to inform strategic planning and decision-making by the mining sector, thereby reducing business risk for mines as well as improving biodiversity outcomes.

Developing the *Mining and Biodiversity Guideline*

The *Mining and Biodiversity Guideline* was developed between 2009 and 2013. Here, we examine how it met the requirements for credibility, salience and legitimacy (Cash et al. 2003) that are necessary to bridge the research–implementation gap:

Credibility: A sound scientific basis

South Africa has a strong biodiversity sector that produces high-quality, science-based information and products. Key among these is a suite of spatial biodiversity plans and land-use decision support tools based on the South African landscape approach to conservation (Cadman et al. 2010; Von der Heyden et al. 2016). The National Biodiversity Assessment (NBA; Driver et al. 2012) is a spatial assessment of the current biodiversity status, threats and protection levels. The NBA is complemented by a National Protected Area Expansion Strategy (Government of South Africa 2010), which uses systematic conservation planning to detail priority areas for the expansion of the protected area estate. All provinces have developed spatial biodiversity plans using methods of systematic conservation planning to identify areas for managing and conserving biodiversity (e.g. Mpumalanga Tourism and Parks Agency 2014; Pool-Stanvliet et al. 2017). A variety of other biodiversity data, related to specific threatened species and priority ecosystems (such as freshwater ecosystems; Nel et al. 2011), are available in the country.

These biodiversity plans are based on sound science and are a valuable resource for practical decision-making by the sectors and regulatory authorities responsible for land-use change. Many of them are embedded in regulatory instruments, such as the Environmental Impact Assessment regulations. However, practical use of these science-based biodiversity planning products by some production sectors, such as the mining sector, remained limited. The reasons for limited implementation included the number of potentially relevant biodiversity information resources, high levels of technical detail, lack of clarity on the most up-to-date versions

and uneven accessibility. Clear guidance was needed on how the information should best be incorporated into mine planning and operations. While the biodiversity information available satisfied the requirements for credibility, it required additional interpretation to improve the salience and legitimacy that would make it relevant specifically to the mining sector.

Salience: Aligned objectives, coordination and consultation

In 2005, the Chamber of Mines of South Africa, in partnership with government and the biodiversity sector, established the South African Mining and Biodiversity Forum (SAMBF). This forum serves as a platform for mining companies, non-governmental organisations and government to participate in discussions in an effort to enhance biodiversity management in the mining industry. The SAMBF can be considered as a focused boundary organisation (Cook et al. 2013), which seeks to provide a bridge between the worlds of biodiversity research and mining implementation. The SAMBF is involved in developing and providing biodiversity-related resources and information in the form of user guides, tools and processes targeted towards various stages of the mining life cycle. The SAMBF, in consultation with the Department of Environmental Affairs (DEA), conceptualised an integrated resource that would provide a single reference point containing all biodiversity information relevant to mining. In this manner, they aligned interests around a common product (boundary object) that would support the objectives of multiple organisations. This product would become the *Mining and Biodiversity Guideline*.

As a member of the SAMBF, the South African National Biodiversity Institute (SANBI) helped to coordinate the *Mining and Biodiversity Guideline*. SANBI serves as a broader boundary organisation (Cook et al. 2013), with a mandate to provide science-based biodiversity policy advice to organs of state and other biodiversity stakeholders. A significant amount of funding for the development of the *Mining and Biodiversity Guideline* came from the United Nations Development Programme–Global Environmental Facility – funded Grasslands Programme, which aimed to mainstream biodiversity into production sectors operating in the Grasslands Biome, including the mining sector (UNDP-GEF 2006). Donor funding often plays a significant role in biodiversity mainstreaming (Huntley 2014). The Chamber of Mines also provided funding and played a coordination role in organising input from its members, particularly ensuring that technical mining information was incorporated into the *Guideline*. These resources provided the focused capacity to coordinate and direct the process of developing the *Guideline*. An important lesson learnt was that investing the necessary time and effort in the social process of bringing different partners together was as important as the technical process of developing the content of the *Guideline*. Leadership that is able to build such social capital is essential for ensuring that all partners remain committed and feel included in both the product and the process (Cowling et al. 2008).

There are significant challenges to finding common ground between stakeholders with widely differing mandates and objectives, such as the biodiversity and mining sectors. Much discussion was required even to understand the terminology used by either party and develop boundary terms (Nel et al. 2016). The SAMBF provided a platform for interaction that helped to identify aligned objectives between the biodiversity and mining sectors. Aligned objectives were framed around proactive planning for mine development. This would aid the biodiversity sector by ensuring that mines avoided impacts on areas of high biodiversity priority. It would simultaneously benefit the mining industry by reducing business risk to mines through clarity on environmental requirements related to biodiversity (e.g. this could limit negative decisions on applications, reduce legal challenges and minimise requirements for rehabilitation relating to biodiversity impacts) (Bennun et al. 2018).

The process of stakeholder engagement was a valuable exercise in consultation and compromise for all parties (Ncube 2015). A useful lesson was that a coherent first draft provided a good basis for negotiations. Iterative revisions could then gradually accommodate all perspectives – ensuring practical industry requirements were met within a scientifically robust guideline. The co-production of knowledge that is relevant to all parties is a valuable way of bridging the divisions between the sectors and improving the likelihood of robust implementation (Nel et al. 2016). The *Mining and Biodiversity Guideline* was edited extensively with inputs from stakeholders including key government departments and industry representatives. In this manner, stakeholders could see their views and objectives being integrated into the *Guideline*. A key compromise during writing was the balance between strongly representing best practice while also not exceeding legal obligations under current law. There was legal debate over the terms ‘may’ and ‘must’, as the mining sector was hesitant to state anything more strongly than was required by law. Importantly, this compromise was acceptable to the biodiversity sector because of the disparity between existing regulations (which are generally seen to be strong and progressive) and compliance. Complementing scientific biodiversity information (credibility) with practical considerations (salience) is necessary to close the gap between research and implementation (Cook et al. 2003; Knight et al. 2007). The revisions of the *Guideline* were focused on clearer communication and better presentation of the scientific information rather than on changes to the scientific foundations.

Legitimacy: Approval and endorsement

To develop legitimacy, the *Mining and Biodiversity Guideline* went through several stages of approval from two national government departments and the Chamber of Mines. Biodiversity scientists had to be willing to engage with uncertainties and practicalities of government’s political and administrative processes (Cowling et al. 2008; Pierce et al. 2005). The differing mandates among government departments were a challenge to stakeholder engagements.

There is little practical precedent for united input into documents from departments with very different mandates, and they are sometimes hesitant to comment on documents that they are not responsible for drafting. The different levels and structures of government, overstretched civil servants as well as the need to have related but parallel processes running in different divisions often made progress difficult. A better initial understanding of government structures and processes may have helped to clarify these interactions (Manuel et al. 2016). The concept of 'mainstreaming biodiversity' was useful to bridge the differing mandates and explain why departments should work together. Ultimately, working within the protocols of government facilitates buy-in from both government stakeholders and those who look to government for leadership.

Making the document a guideline, rather than a mandatory regulation, was fundamental in attaining broad endorsement from the mining sector. A voluntary guideline is more acceptable to industry, which wishes to enhance its social licence to operate and reduce business risk, without adding regulatory requirements (Ncube 2015). It is acknowledged that larger mining companies are more likely to be interested in a business risk incentive than smaller companies (Bennun et al. 2018). Regulations play an important role in instances where voluntary guidelines are less effective, and the *Mining and Biodiversity Guideline* also sought to provide clarity on existing regulations. A voluntary guideline was an acceptable compromise for the biodiversity sector because there were many existing legal provisions that could be better applied. For example, the Environmental Impact Assessment legislation already called for the use of best available information and the application of the mitigation hierarchy. The *Guideline* gave the opportunity to provide guidance on how these requirements should be interpreted and applied by the mining sector.

The final version of the *Guideline* was first approved by a series of working groups reporting to a ministerial committee within DEA. Subsequently, formal approval processes were followed with the Chamber of Mines and the DMR to get the necessary endorsements from various levels up to the minister. The process of steering the *Guideline* through the various steps towards formal approval was sometimes slow. Such processes are, however, critical for achieving high-level political approval and official endorsement. The SAMBF became a particularly valuable forum to drive this process with its stakeholders, convening regular meetings to ensure that the approval process did not stall.

The final *Mining and Biodiversity Guideline* is a 114-page document, jointly published by DEA, DMR, the Chamber of Mines, SAMBF and SANBI (DEA et al. 2013). High-level endorsement by the relevant government departments was very important to indicate to the mining industry and others that there was agreement and clarity on where, when and how biodiversity considerations should be integrated

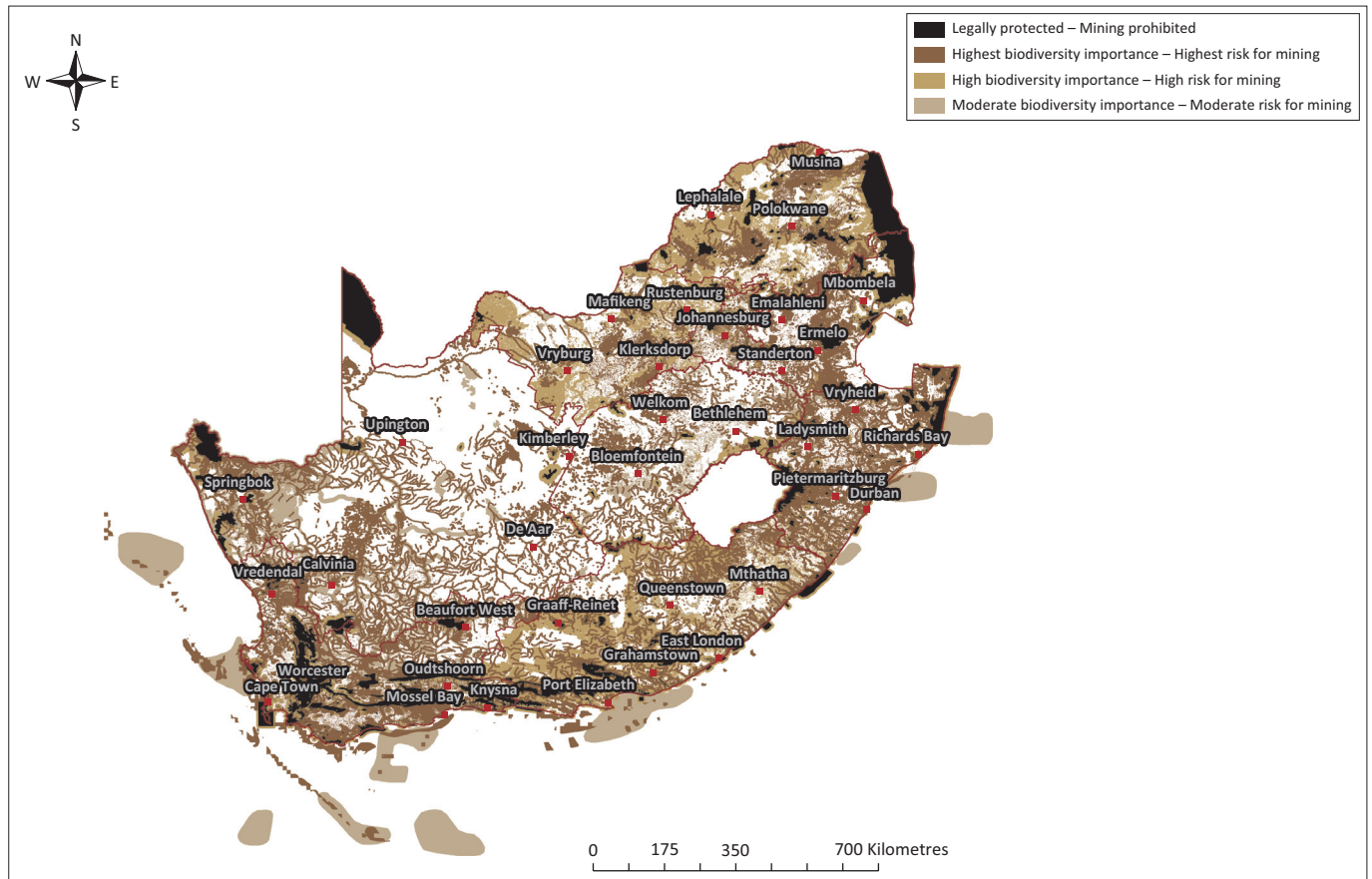
into the full life cycle of a mine. This would support transparency, predictability and consistency in decision-making. In addition to the co-authorship, the endorsement was demonstrated by a foreword jointly signed by the ministers of Environmental Affairs and Mineral Resources. The Minister of Environmental Affairs and the chief executive officer (CEO) of the Chamber of Mines together launched the *Guideline* on International Biodiversity Day (22 May 2013).

Content of the *Mining and Biodiversity Guideline*

The *Mining and Biodiversity Guideline* includes background information explaining the concept of biodiversity and its importance. It then provides links between biodiversity and the mining life cycle and makes the business case for dealing proactively with biodiversity issues. Finally, it details the specifics of how biodiversity should be considered during decision-making. Such interpretive material is necessary for encouraging effective implementation (Pierce et al. 2005). The *Guideline* complements international best-practice guidelines, such as the International Council for Mining and Metal's *Good Practice Guideline* or the International Finance Corporation's *Performance Standards*, and pursues many similar objectives (Ncube 2015). However, it provides specific considerations that are relevant in the South African context (Ncube 2015).

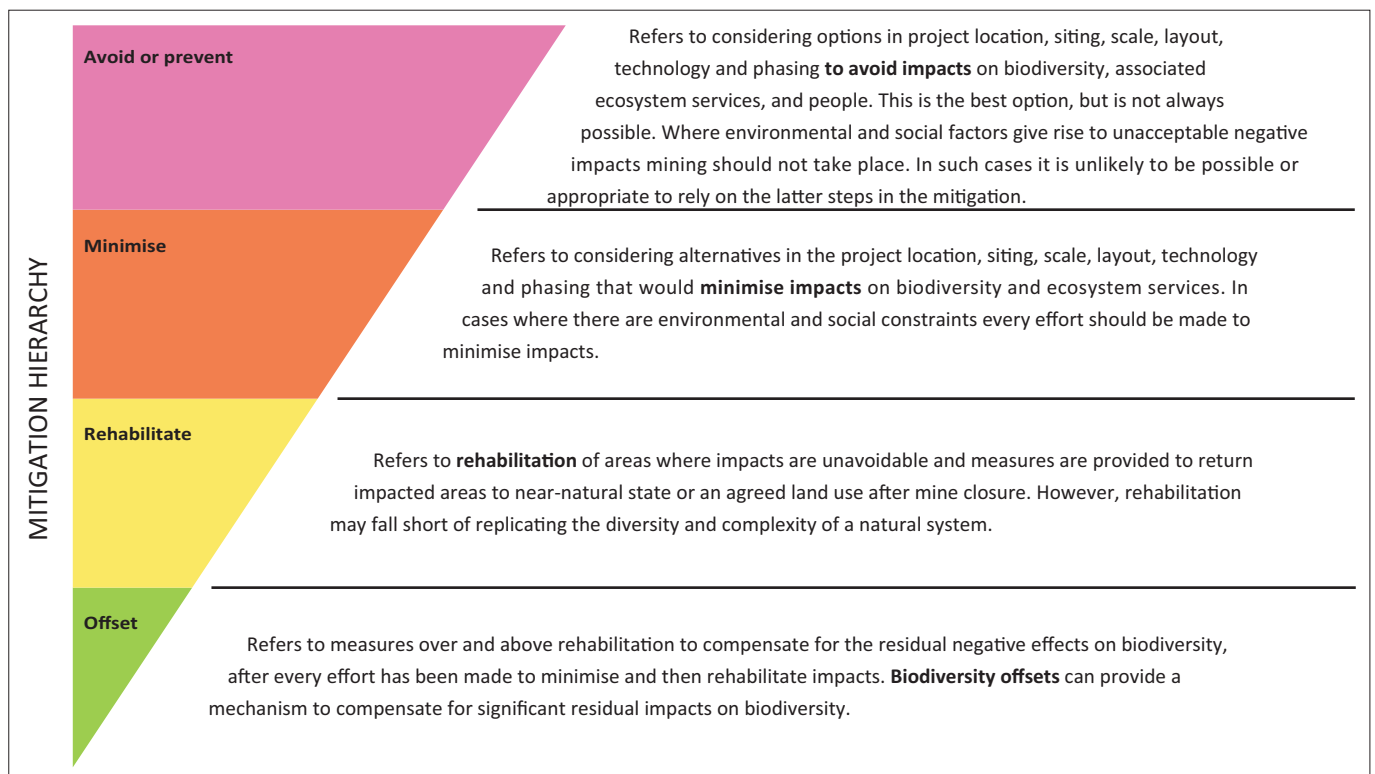
An important feature of the *Guideline* is a single map that integrates a wide variety of spatial biodiversity information in a form that is specifically relevant to mining. The map of biodiversity priority areas classifies the country into four categories according to sensitivity to the impacts of mines, ranging from areas where mining is legally prohibited to parts of the country where mining is likely to have a limited impact (Figure 1; DEA et al. 2013). The map is useful because its simple categories display biodiversity sensitivity, specifically in relation to mining business risk. This is where the languages of mining and biodiversity were integrated, through the translation of biodiversity information into information that was relevant to mining. The map is available as a wall chart and the spatial data are available for download from the Biodiversity Geographic Information Systems (BGIS) website, SANBI's online portal for spatial biodiversity information. The four categories provide a consistent classification such that the underlying spatial data sets may be updated as required, but the conceptual framework remains clear.

The *Guideline* also contains an explanation and visual depiction of the mitigation hierarchy (Figure 2), which is enshrined in legislation and constitutes international best practice for environmental impact management across a range of sectors. It guides decision-makers through the stepwise options of avoiding, minimising, rehabilitating and, finally, offsetting the impacts of mining on biodiversity (DEA et al. 2013). Through the development of the *Guideline*, it was identified that the most significant biodiversity gains



Source: DEA, DMR, CoM, SAMBF & SANBI, 2013, *Mining and biodiversity guideline: Mainstreaming biodiversity into the mining sector*, Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute, Pretoria.

FIGURE 1: Biodiversity priority areas sensitive to the impacts of mining categorised into four categories.



Source: DEA, DMR, CoM, SAMBF & SANBI, 2013, *Mining and biodiversity guideline: Mainstreaming biodiversity into the mining sector*, Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute, Pretoria

FIGURE 2: The mitigation hierarchy for dealing with negative impacts on biodiversity.

could be achieved at earlier stages in the mitigation hierarchy, specifically through avoiding impacts on areas of high biodiversity priority. For this reason, the *Guideline* emphasises the use of biodiversity information during strategic planning.

Uptake of the *Mining and Biodiversity Guideline*

The rollout of the *Mining and Biodiversity Guideline* took place over more than a year and is still continuing. The extensive training programme included dissemination, workshops and the inclusion of the *Guideline* in the curriculum for mining engineering students. Training under the SAMBF banner has included more than 1000 participants from government, the private sector, academic institutions and non-governmental organisations (Table 1).

The *Guideline* was presented at the Global Partnership for Business and Biodiversity conference in 2013, where it was well received. It has garnered interest from other developing countries, such as Peru, China and Vietnam, which have similar mineral wealth and high biodiversity. It has been included as one of the biodiversity mainstreaming stories of change by the International Institute for Environment and Development (IIED 2015), and as a case study for biodiversity mainstreaming for the Organisation for Economic Co-operation and Development (Manuel et al. 2016).

An informal online survey conducted in 2014 assessed the degree to which the *Mining and Biodiversity Guideline* was being used to influence planning decisions (43 respondents). Most of the respondents (97%) indicated that they had used the *Guideline* to varying extents in the process of their work and 56% of the respondents felt that the *Guideline* had been used to some extent to influence outcomes. Although this survey was of limited extent, it gives some indication that the *Guideline* has been valuable in closing the research–implementation gap. However, there is a need to more accurately measure the uptake of the *Guideline*, both nationally and internationally.

Conclusion

Throughout the development of the *Mining and Biodiversity Guideline*, steps were taken to ensure that it overcame the disconnection that is sometimes seen between biodiversity research and implementation. It began with a stated need from within the mining sector for a product that interpreted the available biodiversity information (Pierce et al. 2005). The *Guideline* applied several factors that have been found to close the research–implementation gap, including the establishment of a multi-sector team (Cowling et al. 2008), consultation with the sector about their needs (Pierce et al. 2005) and the collaborative development of products (Knight et al. 2007; Nel et al. 2016). Extensive consultation and co-production of the *Guideline* with the mining sector accounted

TABLE 1: Participants in training sessions between May 2012 and August 2014, shown by sector.

Training	Civil society		Mining industry and representatives				Government and parastatals					Unspecified		Total
	Academic	Non-governmental organisation	Sub-total	Consultants	Mineral Resources	Environmental Affairs	Mineral Resources	Water and Sanitation	Other national departments	Other provincial departments	Local authorities	Parastatal	Sub-total	
Mining and Biodiversity Guideline training	47	15	62	108	93	21	11	233	47	15	16	52	210	573
Mixed training event	15	24	39	85	62	11	9	167	9	61	10	38	161	517
Total	62	39	101	193	155	32	20	400	56	76	26	65	371	1090

Source: Attendance records collated by authors

Note: The *Mining and Biodiversity Guideline* focused training events were specifically intended for dissemination and training on the guideline. Training was also conducted at other mixed training events, which included the *Mining and Biodiversity Guideline* as part of a broader training package involving biodiversity offsets and the use of spatial information.

for the practicalities that would be involved in its implementation (Cowling et al. 2008; Knight et al. 2007; Nel et al. 2016). High-level endorsement sends a message that the *Guideline* is supported by both the mining and biodiversity sectors. Finally, ongoing training raises awareness and ensures that the *Guideline* remains active within the sector. The *Mining and Biodiversity Guideline* provides evidence that a collaborative process can make significant progress towards bridging the research–implementation gap. Offering the best available science in a user-friendly, accessible format is one action among many that are required for successful mainstreaming of biodiversity.

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Competing interests

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Authors' contributions

S.H., A.S. and A.G. were involved in the development of the *Mining and Biodiversity Guideline* through the Grasslands Programme. A.S. was the director of the Grasslands Programme, S.H. was the mining component coordinator and A.G. was the learning network coordinator. E.B. wrote the lessons learnt documents for the Grasslands Programme. E.B. was the primary writer of the article, with input from S.H., A.S. and A.G. Additional input was received from A.D., J.M., K.M., P.W., W.L., T.M., P.M. and S.M., who were all involved in the development of the *Mining and Biodiversity Guideline*. All authors reviewed the manuscript for intellectual content.

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