Adequacy of rehabilitation monitoring practices in the Western Australian mining industry

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Summary Currently in Western Australia (WA) there are no mandated standards for assessing rehabilitation success for the mining industry. We argue a case for focusing on the creation of near-natural, self-sustaining, functional ecosystems as the primary objective for rehabilitation programs and where this is not achievable, mines should plan to be ‘environmentally neutral’ by undertaking some improvements to degraded landscapes. We suggest that flora and fauna monitoring are appropriate tools for managers and regulators to obtain information on the extent to which a rehabilitated area has achieved a near natural, self-sustaining, functional ecosystem similar to that in the adjacent undisturbed area. This monitoring can also be used for completion criteria and closure plans. We report results from a short questionnaire sent to mine site environmental managers to assess the extent of flora and fauna monitoring in rehabilitation areas. Survey results highlighted the need for a more systematic and consistent approach to the monitoring of flora and fauna in rehabilitated mining areas in WA. Of 36 respondents, 23 mines monitored flora, three monitored fauna and two monitored both.

Key words fauna, flora, mining, monitoring, rehabilitation.

Introduction

The mining industry, government authorities and the community acknowledge the need for criteria to determine when active involvement in rehabilitation of mined lands is complete (Elliott et al. 1996; Tacey et al. 1993; Department of Minerals and Energy 1996; Muir 1996; Nichols 1997; Bellairs 1998; Osbourne & Brearley 1998; Minerals Council of Australia 2000; Chamber of Minerals and Energy 2000; Grant et al. 2001). A decade ago, the focus of most mine site rehabilitation programs was to establish good density and cover of vegetation across the disturbed area. While this resulted in rehabilitated sites that were essentially stable and may have looked aesthetically pleasing, it did not necessarily mean that the rehabilitated sites were moving towards the establishment of functional ecosystems (Bellairs 1998). Because of this focus on vegetation, a narrow set of vegetation indices were established to measure early developmental stages of revegetation (Department of Minerals and Energy 1996).

Currently the Department of Industry and Resources (DoIR; formerly Department of Minerals and Energy – DME) in WA requires rehabilitated areas to be safe, stable and non-polluting landscapes (Anderson 2001), but says little about the re-establishment of sustainable, functional ecosystems. For example, the DME (WA) Department of Minerals and Energy (1996 p. 37) states that ‘...the re-establishment of self-perpetuating vegetation, which is integrated with the surrounding ecosystem, is the most common land use objective...’ for mine site rehabilitated areas. Such criteria could be met by a vegetation community of non-local species, which probably would not provide the range of niches necessary for the fauna in the adjacent undisturbed area to colonize the rehabilitated area and eventually create a self-sustaining, functional ecosystem. The use of non-local species also creates potentially serious weed problems. Specific monitoring protocols and rehabilitation standards are currently ill defined (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia 2000) and mining companies in WA are being released from their environmental obligations before they can demonstrate the creation of, or significant progress towards, a near natural, self-sustaining, functional ecosystem (Anderson et al. 2002). A number of researchers have argued that there is a compelling case for industry and regulators to adopt an approach that focuses on creating functional ecosystems rather than just revegetation (Anderson 1994; Bisevac & Majer 1999). Bisevac and Majer (1999) suggested that the goal for rehabilitated mined land should be to restore the structure, diversity, function and dynamics of the undisturbed ecosystem. In many circumstances this will mean the creation of a self-sustaining, functional ecosystem similar to that in the adjacent undisturbed area from which the rehabilitated area will recruit most of its fauna. The need for ‘high-quality’ rehabilitation has become necessary with the phasing in of performance standards for assessing the development of rehabilitated areas (Bisevac & Majer 1999). Mine site rehabilitation should be viewed as managing succession processes towards the creation of ecosystems that are functionally compatible with that which existed before the disturbance or in the adjacent undisturbed areas.

Thirty of the respondents (83%) to a questionnaire sent to all mine site environmental managers in WA indicated that some rehabilitation had been completed on their mine since operations began, with 8 years being the average age of the oldest rehabilitated area. There was considerable variability in the method, scope and rehabilitation
techniques being used. Twenty-three mines (64%) indicated they systematically monitored flora, but only three mines (8%) systematically monitored fauna. Two mines monitored both flora and fauna. Each mine had used different monitoring strategies and there was no generally accepted protocol for monitoring flora, and there were insufficient responses to comment on fauna monitoring practices. It was noted that most mines were outsourcing their monitoring. Results from this questionnaire confirmed and raised a number of issues including: (i) the lack of systematic monitoring of flora in rehabilitated areas; (ii) few mines monitor fauna; (iii) the creation of functional ecosystems is not a primary objective for rehabilitation programs; (iv) the lack of clear guidelines for monitoring protocols; (v) no clear end point evident for most rehabilitation programs; and (vi) closure criteria are at best vague and ill defined. These data suggest that there is a need for clear rehabilitation objectives and a consistent protocol for monitoring rehabilitated areas.

Waggett and McQuade (1994) reported that generic environmental criteria, or standards regarding closure and rehabilitation monitoring, are not supported across the industry and in most cases only broad guidelines exist. This apparent lack of industry-wide support is perhaps due to the range of final land uses and variations in soil and environmental conditions encountered across Australia. Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia (2000) Strategic Framework for Mine Closure advocate that closure planning should be an integral part of mining operations, but there is little evidence of this occurring in the planning stages of a mine. We concur with Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia (2000, p. 14) view that “insufficient attention is being directed to the establishment of sustainable ecosystems as a long-term goal. The issue of developing guidelines or standards for closure purposes needs to be addressed. Where possible appropriate standards should be developed that provide benchmarks against which to measure performance”.

The higher incidence of flora monitoring compared with fauna monitoring in WA mines probably reflects the DoIR focus on soils and vegetation in rehabilitation rather than the development of functional ecosystems (Department of Minerals and Energy 1996). This was most evident in the Department of Minerals and Energy Guidelines for Mining in Arid Environments that provide only a passing reference to fauna, where the rehabilitation chapter focuses on the soils, erosion control and vegetation. No mention was made of restoring habitats that were destroyed by mining; the closest this document gets to the notion of creating a functional ecosystem is to “use a variety of local seeds in the revegetation process”. Mining companies, as land managers, should aim to leave the site in a condition where their past existence could go unnoticed. We acknowledge that this is not always possible for mining companies as the scale and impact of the disturbance (i.e. pits and waste dumps) fundamentally alter the landscape. For example, creating a waste rock dump in an area that was a mulga flat and rehabilitating it with mulga flat vegetation is unlikely to result in the development of a mulga flat functional ecosystem, as some of the fauna species will not colonize or survive on hilly areas. Some mining companies would argue that the creation of functional ecosystems similar to those that existed prior to the disturbance would make the mine economically non-viable, particularly as overseas competitors are not required to meet similar standards. In circumstances where it is neither reasonable nor feasible to achieve this standard, then being “environmentally neutral” may be the next best option (Thompson & Thompson 2002). Environmentally neutral in this context means that if the mine can not return the site to its predisturbance functional ecosystem, then a contribution elsewhere to restoring a degraded environment can be used to offset the environmental damage done by the mine.

Can a self-sustaining functional ecosystem similar to that in the adjacent undisturbed area be created on a waste dump?

Currently mining companies are able to reseed with species that are cheap and easy to grow, but may not be similar to the species that existed prior to the disturbance or similar to that in the adjacent areas. For example, it is common in the Goldfields in WA for disturbed sites in eucalypt or acacia shrubland to be rehabilitated with chenopods (e.g. Bottle Creek; Anderson et al. 2002). Chenopods are often used in reseeding because they are cheap, highly fecund, germinate quickly and are generally more accessible than eucalypt seed. Vegetation communities created from a mix of non-local seed are unlikely to develop into a functional ecosystem that approximates that which existed or similar to that in the adjacent undisturbed areas, as it is unlikely to create the appropriate range of habitat niches. There are a number of reports in the literature that have assessed the similarity of the developing ecosystem on rehabilitated lands with the adjacent disturbed areas (Majer 1983/84; Fox & Fox 1978; Kabay & Nichols 1980; Fox & Fox 1984; Nichols & Bamford 1985; Majer 1990; Twigg & Fox 1991; Majer & de Kock 1992; Halliger 1993; Knight 1998; Armstrong & Nichols 2000; Thompson 2001; Andersen et al. 2003) and only one of these reported convergence in faunal indicators in Australia (Andersen et al. 2003). Andersen et al. (2003) are the first to report a rehabilitated area having similar functional groups and species richness for ants compared to an unmined reference site and even then it was achieved in only one of eight sites examined.

Presuming it is the objective of the mine to create a self-sustaining, functional ecosystem in the rehabilitated area that is similar to that in the adjacent undisturbed area, then both flora and fauna monitoring strategies must be implemented. Monitoring with a single bioindicator taxon or group (e.g. invertebrates, mammals, reptiles or avifauna, etc.) is probably insufficient to obtain a complete picture of rehabilitation success. Other aspects of the rehabilitation program need to be monitored. Ecosystem Function Analysis (‘Tongway & Ludwig 1994; Tongway 2001a, b; Tongway & Hindle 2002) has recently become a popular monitoring strategy to assess some of these parameters. This approach looks at the structural stability of a created landform and the vegetation and habitat complexity; however, it reveals nothing about the development
of faunal assemblages. Therefore, an integrated monitoring program that assesses both physical and bio-indicators is necessary to obtain a complete picture of progress towards creating a functional ecosystem. It is obviously incorrect to assume that by providing a suitable substrate and a vegetation community similar to that in the adjacent undisturbed area, fauna from the adjacent area will colonize the rehabilitated site eventually creating a functional ecosystem. This is only likely to occur if there are suitable interfaces between the undisturbed area and the rehabilitated site as some species may be barred from entering the area if they have to travel across inhospitable terrain.

Recently in WA, the onus was put on mining companies to provide regulators with details of what they felt were suitable rehabilitation outcomes (Biggs 2000). Once these details have been approved and the level of rehabilitation achieved, the performance bonds for the land can be returned. One must seriously question the wisdom of this government approach when there is little evidence to suggest mining companies are committed to the development of functional ecosystems in rehabilitated areas. It must also be of concern that government regulators are prepared to sign-off on rehabilitated areas when there is no evidence to indicate that a functional ecosystem will eventually evolve in the rehabilitated area (e.g. Anderson et al. 2002).

Some respondents to our survey commented that monitoring was planned for the future, but it was not considered a major concern at present. Acceptance that monitoring will be done in the future when closure is a more pressing issue does not reflect the policy of Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia (2000) and possibly reflects a level of apathy in the WA mining industry towards this aspect of mine operations. Rehabilitation monitoring should be planned from the outset and not as an afterthought. Monitoring, however, should have a clear purpose. There is no point in monitoring higher order bio-indicators (e.g. reptiles or mammals, etc.) until the vegetation in the rehabilitated areas is well established.

Although there are a variety of strategies and techniques being used in rehabilitation monitoring, there was no evidence of a consistent and systematic pattern or protocol being used in the WA mining industry. Comments like ‘...visually inspect at times...’ and ‘...photographic records of opportunistic sightings...’ recorded on our questionnaire are not systematic methods of monitoring. If the rehabilitation objective is to create a near-natural, self-sustaining, functional ecosystem, all components of the system, including soil stability, floral structure, habitat construction and faunal diversity in the ecosystem must be able to tolerate stochastic disturbance events (i.e. fire, droughts, floods and human disturbance) similar to that in an undisturbed environment. Regular and systematic monitoring of the flora and fauna on rehabilitated land and the adjacent undisturbed areas must therefore become integral components of a rehabilitation process. Monitoring of adjacent undisturbed areas enables environmental managers to understand natural seasonal and year-to-year variation in faunal diversity and abundance that could otherwise be misinterpreted.

If the mining industry in WA wishes to be environmentally responsible we argue that it should focus its rehabilitation objectives on the creation of self-sustaining, functional ecosystems similar to those in the adjacent undisturbed areas. This will require that industry monitors the stability of the earth works in rehabilitated areas, and systematically monitors the flora and fauna to determine progress towards creating the appropriate functional ecosystem. Likewise, if the industry is to become more environmentally responsible, then regulators need to indicate that the primary objective for most rehabilitation programs is to create self-sustaining, functional ecosystems similar to those that existed prior to the disturbance.

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