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6th August 2020

VRX Silica

Arrowsmith Silica Sands Project Rehabilitation Strategy

Discussion on the potential foraging value of the rehabilitated landscape for Carnaby's Black-Cockatoo

BACKGROUND

VRX Silica Pty Ltd (VRX) is seeking to develop the Arrowsmith Silica Sand Project and is developing a rehabilitation strategy to inform the environmental assessment of the first phase of this project, Arrowsmith North (MLA 70/1389). The rehabilitation strategy utilises new guidance from Department of Mining, Infrastructure, Resources and Safety, and the Western Australian Biodiversity Science Institute, on post-mining land use and rehabilitation objectives. These provide guidance on post-mining land use, and the rehabilitation strategy for Arrowsmith North proposes a return to the native Kwongan Heath as a functioning and self-sustaining ecosystem. A key indicator of success of the rehabilitation will be the extent to which the rehabilitated landscape supports fauna species of conservation significance, and in particular its value as foraging habitat for Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*.

The emphasis on Carnaby's Black-Cockatoo is because Kwongan is moderate to high foraging value and the species is of high conservation significance (Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* and Schedule 2 (Endangered) under the *WA Biodiversity Conservation Act 2016*). Because of its conservation significance, projects that cause loss of foraging habitat for the species are required to fund offsets under the EPBC Act, and therefore effective rehabilitation has implications for the calculation of offsets for the Arrowsmith North project.

The rehabilitation strategy (Preston Consulting 2020) presents a detailed discussion on the environmental commitments of the Arrowsmith North project and outlines a novel approach that is proposed for rehabilitation, referred to as Vegetation Direct Transfer (VDT). This involves removing blocks of vegetation and soil in large sods with a customised fitting on a front-end loader. The soil and surface profile remain intact and are moved direct to a prepared, post-mining surface. VDT has been found to have a high success rate for recalcitrant plant species as surface roots, tubers, soil micro-flora, fungi and associated biota are transferred intact (Mattiske Consulting 2019). It is likely that invertebrates and small, fossorial vertebrates

will also be transferred. Large plants, however, will not survive as they are deep-rooted and the sods created by VDT have a depth of about 0.5m. This includes key food plants for Carnaby's Black-Cockatoo such as *Banksia* and *Eucalyptus* species. Monitoring of trial VDT at Eneabba (Matiske Consulting 2019) found almost no recruitment of these species. The rehabilitation strategy therefore factors in approaches to ensure that these species are represented in the rehabilitated ecosystem through a combination of infill planting and direct seeding.

CALCULATION OF FORAGING VALUE FOR CARNABY'S BLACK-COCKATOO

Kwongan at Arrowsmith North

For the rehabilitated ecosystem to provide the same foraging value for Carnaby's Black-Cockatoo as the original Kwongan Heath, it needs to have a similar density/cover of the same or equivalent food plants. The Carnaby's offset calculator of the EPBC Act requires a foraging value score out of 10. The Department of the Environment and Energy (DEE 2017) provides guidance for the calculation of a foraging value score for each of three significant black-cockatoo species, while Bamford Consulting Ecologists (BCE) has independently developed a system that is based upon the DEE guidance but provides a more detailed description of vegetation characteristics (floristics and structure) that is useful when assessing an original and a rehabilitated landscape. The BCE system is also quantified in terms of distances and percentages of foraging habitat.

The DEE guidance proposes that the foraging score be based upon vegetation characteristics, site context and species density or abundance. It then uses a system of assigning a starting score based very broadly upon vegetation characteristics and site location, then adjusts (context adjustors) this score on the basis of other parameters that factor in context and species presence. The BCE system is broadly similar but more descriptive, and is outlined in Appendix 1. It assigns vegetation a score out of 6 for site condition (vegetation composition, condition and structure), a score out of 3 for site context and a score out of 1 for density/abundance. Under the BCE system, Kwongan in the Arrowsmith North project area was assessed by Bamford *et al.* (2019) and received a total foraging value of 7 (out of 10) based on:

- Site condition. Kwongan/shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover. Score of 4.
- Site context. The project area represents a small percentage of available foraging habitat in the local area, with possible breeding nearby. Score of 2.
- Species density. Carnaby's Black-Cockatoo present. Score of 1.

The DEE (2017) system automatically assigns Kwongan a score of 7 out of 10. There are no context adjustments required for the Arrowsmith North area, so the final score remains 7.

Rehabilitation vegetation

The BCE scoring system provides a very simple measure of the effectiveness of the VDT and infill planting method of rehabilitation; it is primarily a question of projected foliage cover of shrubby banksias. Projected foliage cover is a more relevant measure than stem density, as the cover of the banksia canopy affects the number of banksia cones that will be available to the

birds, and stem density may not relate directly to foliage cover. Stem density, however, is a useful measure, particularly when plants are young (thus small) and have not achieved mature cover. The number of cones will vary annually with rainfall or cyclically (Copland and Whelan 1989), and with time since fire (Valentine *et al.* 2014), but these are short-term perturbations and it is the underlying potential productivity of the vegetation, based upon the ‘volume’ of foliage, that ultimately determines the food resource.

For the original purpose of assessing foraging value, projected foliage cover was estimated in the course of a rapid ecosystem assessment by Bamford *et al.* (2019), but for the purpose of evaluating the effectiveness of the rehabilitation strategy in the Arrowsmith North area, the opportunity exists to accurately measure project foliage cover in both reference (existing kwongan heath) and rehabilitation areas. Further detail can be gained by determining species composition with the aim of achieving a similar composition between reference and rehabilitation sites. The rehabilitation strategy mentions the possibility of the rehabilitation environment achieving a higher foraging value for Carnaby’s Black-Cockatoo, which would require a higher density of key food plants. Studying the foraging preferences of Carnaby’s Black-Cockatoo in the area would be useful to develop an understanding of which plant species they actually rely upon most, as these may not be the most abundant species. Bamford *et al.* (in prep.) discuss the importance of beetle larvae in the cones of *Banksia attenuata* and suggest that this is an under-appreciated facet to the biology of the black-cockatoo.

The actual foraging value for black-cockatoos of revegetation created through VDT and infill planting will depend largely on the density/projected foliage cover of key food plants (shrubby banksias). As banksias have been found to be underrepresented in trial VDT (Mattiske Consulting 2019), it is almost certain that direct seeding and/or infill planting of banksias will be required, and the effectiveness of this is uncertain. After 10 years, it can probably be assumed that some establishment of banksias can be achieved, perhaps with a site (vegetation) condition score of 2 or even 3 (out of 6 for vegetation condition using the BCE scoring system). A site condition score of 3 would result in a total score of 6 (out of 10), but a site condition score of just 2 would receive no additional scores for context and species density (Appendix 1). This is a limitation of the BCE scoring system, but it does recognise that vegetation of low condition may not be used by birds at all, especially when the surrounding vegetation has a high foraging value.

CONCLUSION

The foraging value of the rehabilitated landscape for Carnaby’s Black-Cockatoo will depend upon the success of establishing key food plants, particularly the larger *Banksia* species, in that landscape. While VDT favours many plants and may preserve soil characteristics favourable to the *Banksia* species, infill planting will be essential. For the rehabilitated landscape to have a comparable foraging value to the original Kwongan heath, key food plants need to occur at a similar projected foliage cover and species composition as reference areas. Foraging value in the rehabilitated landscape would only exceed that of reference areas if key food plants provide more foraging habitat, which may be affected by the cover and type of food plants present. Investigating the relative importance of different key food plant species might provide a means for enhancing the foraging value of rehabilitated areas.

If the potential for rehabilitation areas to provide habitat is to be considered as an offset, it needs to be demonstrated that banksia densities comparable with reference Kwongan sites can be achieved. Calculation of offsets is not done on a simple 'like for like' area basis, but contains adjustments for likelihood of ongoing degradation and nett loss. As a result, if the intention was to use the rehabilitation as a complete offset for clearing, and given that there will be some long-term loss for infrastructure, the rehabilitation would have to have a higher foraging value than the original Kwongan and some off-site offset areas are likely to be required. The progressive nature of the project means that recovery in rehabilitated areas will be well advanced long before the whole development area has been impacted. This will complicate the offset assessment.

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Appendix 1. Scoring system for the assessment of foraging value of vegetation for Carnaby's Black-Cockatoo. Revised 5th June 2020

Bamford Consulting Ecologists

Introduction

Application of the Offset Assessment Guide (offsets guide) developed by the federal environment department for assessing black-cockatoo foraging habitat requires the calculation of a score out of 10. The following system has been developed by Bamford Consulting Ecologists (BCE) to provide an objective scoring system that is practical and can be used by trained field zoologists with experience in the environments frequented by the species.

The foraging value score provides a numerical value that reflects the significance of vegetation as foraging habitat for Black-Cockatoos, and this numerical value is designed to provide the information needed by the Federal Department of Agriculture, Water and the Environment (DAWE) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components as detailed below. These three components are drawn from the DAWE offsets guide but the scoring approach was developed by BCE and includes a fourth (moderation) component.

Calculating the total score (out of 10) requires the following steps:

- A Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus
- B Site context. Determining a score out of three for the context of the site; plus
- C Species stocking rate. Determining a score out of one for species density.
- D Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

Calculation of scores and the moderation process are described in detail below.

A. Site condition. Vegetation composition, condition and structure scoring

Site Score	Description of Vegetation Values for Carnaby's Black-Cockatoo
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: <ul style="list-style-type: none">• Water bodies (e.g. salt lakes, dams, rivers);• Bare ground;• Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes.• Mown grass

Site Score	Description of Vegetation Values for Carnaby's Black-Cockatoo
1	<p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees; Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source; Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).
2	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover; Woodland with tree banksias 2-5% projected foliage cover; Open eucalypt woodland/mallee of small-fruited species; Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source.
3	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover; Woodland with tree banksias 5-20% projected foliage cover; Eucalypt Woodland/Mallee of small-fruited species; Eucalypt Woodland with Marri < 10% projected foliage cover.
4	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover; Kwongan/shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover; Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover.
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover; Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; Pine plantations with trees more than 10 years old (but see pine note below in moderation section).
6	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).

B. Site context.

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access foraging sites. Based on BCE observations, Carnaby's are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with DAWE, provides a *guide* to the assignment of site context scores. Note that 'local area' is defined as within a 15 km radius of the centre point of the study site. This is greater than the maximum distance of 12 km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

Site Context Score	Percentage of the existing native vegetation within the 'local' area that the study site represents.	
	'Local' breeding known/likely	'Local' breeding unlikely
3	> 5%	> 10%
2	1 - 5%	5 - 10%
1	0.1 - 1%	1 - 5%
0	< 0.1%	< 1%

The table above provides weighting for where nearby breeding is known (or suspected) and for the proportion of foraging habitat within 15km represented by the site being assessed. Some adjustments may be needed based on the judgement of the assessor and in relation to the likely function of the site. For example, a small area of foraging habitat (eg 0.5% of such habitat within 15km) could be upgraded to a context of 2 if it formed part of a critical movement corridor. In contrast, the same sized area of habitat, of the same local proportion, could be downgraded if it were so isolated that birds could never access it.

C. Species density (stocking rate).

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignment of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate condition score that is part of a network of such habitat where a black-cockatoo species is known would get a species density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low.

D. Moderation of scores for the calculation of a value out of 10.

The calculation out of 10 requires the vegetation characteristics (out of 6) to be combined with the scores given for context and species density. It is considered that the context and density scores are not independent of vegetation characteristics; otherwise habitat of absolutely no value for black-cockatoo foraging (such as concrete or a wetland) could get a foraging score out of 10 as high as 4 if it occurred in an area where the species breed (context score of 3) and are abundant (species density score of 1). Similarly, vegetation of negligible or low characteristics which could not support black-cockatoos could be assigned a score as high as 6 out of 10. In that case, the score of 6 would be more a reflection of nearby vegetation of high characteristics than of the foraging value of the negligible to low scoring vegetation. The Black-Cockatoos would only be present because of vegetation of high characteristics, so applying the context and species density scores to vegetation of low characteristics would not give a true reflection of their foraging value.

For this reason, the context and species density scores need to be moderated for the vegetation characteristic score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. A simple approach is to assign a context and species density score of zero to sites with a Condition score of low (2), negligible (1) or none (0), on the basis that birds will not use such areas unless they are adjacent to at least low-moderate quality foraging habitat (≥ 3). The approach to calculating a score out of 10 can be summarised as follows:

vegetation composition, condition and structure score	context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances. Such as when very close to a major breeding area or if strategically located along a movement corridor.