APPENDIX G

BROAD-HEADED SNAKE REVIEW

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Assessment of Habitat for the Broad-headed Snake *Hoplocephalus bungaroides* Coalpac Consolidation Project – Contracted Project

Introduction

The Coalpac Consolidation Project is the consolidation of two existing mines, Invincible Colliery and Cullen Valley Mine at Cullen Bullen, NSW. The Contracted Project mine plan will remove 762 ha of native forest, woodland and grassland by open cut mining. Highwall mining is proposed along sections of the eastern escarpments where Significant Pagoda Landforms (SPLs) and Sandstone Outcrops occur. The highwall mining excavations proposed for the Project are considered to be much more stable than longwall mining excavations, and minimal subsidence (< 20 mm) is predicted to occur (GEONET 2011). Hebblewhite (2013) provides further comment on these aspects.

The area bordering the western flanks of the Newnes Plateau contains habitat for the endangered Broad-headed Snake *Hoplocephalus bungaroides.* These snakes are not well studied in this northern part of their range and preliminary field studies on this species in the nearby Wollemi and Yengo National Parks has already indicated some behavioural differences for snakes in these areas. (B. Croak pers. comm.). Most ecological information about this species is derived from detailed studies carried out in the southern parts of their range, especially in the Morton National Park, in the southern highlands of New South Wales (Webb and Shine 1997a, b; 1998 a, b).

Unlike most threatened reptiles in NSW the ecology of the Broad-headed Snake has been well documented (see Newell and Goldingay 2004). It is a habitat

specialist, often relying on tree hollows during summer and exfoliated rock in rock outcrops during the cooler months (Webb and Shine 1997a, 1998a). These factors may make it particularly vulnerable to anthropogenic disturbance. Depletion of rock habitat via the collection of bush rock for garden ornamentation in areas around Sydney has been extensive (Shine *et al*. 1998). This has led to the listing of bush rock removal as a threatening process under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Other forms of habitat degradation have been documented and appear to be extensive (Goldingay 1998; Goldingay and Newell 2000; Pringle *et al*. 2003).

This species was known from Blue Mountains and Wollemi National Parks (NP) (Cogger *et al*. 1993; Shine *et al*. 1998), Yengo NP (Shine *et al*. 1998), Dharug NP (NPWS 1998), Marramarra NP (NPWS 1999) and Ku-ring-gai Chase NP (NPWS 1999).

Newell and Goldingay (2005) surveyed for this species across its entire range and assessed habitat suitability in each area on the basis of the number and suitability of surface shelter rocks and the availability of its main prey items, the Lesueurs Velvet Gecko *Oedura lesueuri*. They found that there was little correlation between the amount of habitat available and the density of snakes in an area. For example, the Blue Mountains NP contained the highest levels of suitable surface rocks and prey items yet it ranked as one the lowest in terms of snake density. The reason for this was attributed almost entirely to reptile poaching in accessible areas.

Habitat areas in Wollemi and Yengo NP rated fairly poorly for both surface rocks and prey availability and snake density were relatively low.

In 2012, a Broad-headed Snake was reported from an area immediately east of the Project Boundary (Wildlife Atlas). This was the first record of the species in the general vicinity of the Project Boundary.

In February 2013, Dr Arthur White from Biosphere Environmental Consultants P.L. and Mr Ryan Sims from Cumberland Ecology P.L. surveyed the sandstone escarpment areas close to or within the Project Boundary to determine where habitat for the Broad-headed Snake was present and whether habitat areas were likely to be impacted by the proposed Contracted Project Disturbance Boundary.

Methods

Aerial survey maps of the Project Boundary and immediate surrounds were examined to determine the extent of sandstone escarpment areas and to determine access to each area. Having located all potential habitat areas, the sites were visited on the 6th of February 2013 so that each area could be

“ground-truthed” to validate or refute the presence of habitat suitable for the Broad-headed Snake in each area.

Sandstone exposures were deemed to contain habitat for the Broad-headed snake if they also contained (Webb and Shine 1997a):

1. medium to tall forest within 250 m of the sandstone outcrop
2. the outcrop contained loose, exfoliated pieces of sandstone that were not underlain by organic matter or on soil, that could be used as refuge habitat by either the Broad-headed Snake or their prey;
3. the sandstone contained deep fissures or cracks that could be used as shelter habitat by either the Broad-headed Snake or their prey.

Results

Using GPS tracking technology, it was possible to track the routes taken through the sandstone areas and to use the GPS way points and routes taken to demarcate the areas of potential habitat for the snake.

Using this technology, eight areas of potential habitat were located: six of these areas (areas 1-6) were located in the eastern areas of the Project Boundary adjacent the SPL (Figure 1); Two further sites were located in the northern portion of the Project Boundary , area 7 was located on the eastern side of the Castlereagh Highway (south of the Baal Bone Mine Precinct (Figure 1), while area 8 was located on the western side of the Castlereagh Highway, north of Tyldesley Hill (Figure 1).

Coordinate System: MGA Zone 56 (GDA 94)

Grid North

Legend

- Project Boundary
- Contracted Project Disturbance Boundary
- Significant Pagoda Landforms
- Broad-headed Snake Habitat

Image Source:
Image © 2011 DigitalGlobe
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CUMBERLAND ECOLOGY

500 0 500 1000 1500 2000 m

I:\...\13007\Figures\Arthur White Report_20130220\Figure 1. BHS Habitat

Figure 1. Broad-headed Snake Habitat

Discussion

The Extent of Broad-headed Snake Habitat

Sandstone escarpments and outcrops are quite numerous and extensive in the areas around the Project Boundary. Prominent sandstone walls, rounded pagoda landforms and sandstone ledges demarcate the edges of the Sydney Basin sandstones, where they have been incised or weathered away to create narrow gullies or broad valleys.

Despite the extent of the sandstone exposures in the Project Boundary, the amount of potential habitat for the Broad-headed snake was quite modest in comparison. A lot of the sandstone areas were discounted as snake habitat as they devoid of exfoliating rocks and lacked crevices or cracks. There appears to some variation in the integrity of the sandstone in this area: in some areas of the Project Boundary the sandstone was fine-grained and only poorly consolidated. As this sandstone weathered, it did not crack or peel, but shed sandstone grains as loose dust. Consequently, there were no surface rocks to be found, nor any talus scree (Figure 2).

Figure 2
Sandstone Exposures in Area 2 Devoid of Exfoliating Rocks

The pagoda shape was created by ironstone bands within the sandstone. The ironstone was more resistant to weathering than the sandstone; thus unprotected sandstone above the ironstone layers eroded quickly and smoothly to produce round domes. The ironstone layers halted the mass erosion but were gradually being etched away wherever the ironstone was thin or disrupted. The resultant weathering created the rounded, but layered tower features known as pagoda landforms.

Broad-headed Snake habitat was present in some areas of the Project Boundary where the coarser grained sandstones were present. These rocks peeled when weathered, but in places, they also contained deep joints which had weathered out to produce crevices and narrow canyons. This sort of weathering is most noticeable around the incised gullies behind the sandstone walls (i.e. where the Newnes plateau was being actively incised).

Newell and Goldingay (2005) also commented on the relative paucity of suitable habitat for the Broad-headed Snake in the northern parts of its range (although they had not surveyed the Newnes plateau or the plateaus to the west in the Cullen Bullen area). Ben Croak, a Ph.D student from the University of Sydney is undertaking studies of the Broad-headed Snake in the northern parts of their range and struggled to locate suitable habitat in the areas of Wollemi and Yengo NP where he searched (B. Croak pers. comm.; Croak *et al.* 2013). Both Yengo and Wollemi NP are renowned for the spectacular sandstone walls and canyons that make up these parks but this does not appear to constitute habitat for the snakes.

Broad-headed Snake Record in Ben Bullen State Forest

During our survey of the site we also visited the area where the 2012 record was made. The site visited was based on the GPS data provided by the OEH Wildlife Atlas. The site was devoid of sandstone and was not habitat for the Broad-headed snake.

Either the GPS record is faulty or the observation was faulty. Of these two scenarios, it is likely that the GPS record is faulty as the comments provided with the record report that the snake was under rock. This needs to be further resolved.

Areas of Broad-headed Snake Habitat likely to be Impacted by the Expansion of the Mine

The vast majority of potential Broad-headed Snake habitat falls outside the Contracted Project Disturbance Boundary (Figure 1). Coalpac's reduced open cut footprint around the SPL will mean that no potential habitat will be directly impacted in this area.

Despite the provision of these stand-offs there is always some chance of minor direct or indirect impacts on the few areas of habitat within the Contracted Project Disturbance Boundary. The proportion of impacted habitat is very low in comparison to the amount of potential habitat to be avoided by the Contracted Project. Moreover there are large areas of potential habitat conserved in Ben Bullen State Forest, to the immediate east of the Project Boundary. Given the patchy distribution of suitable winter habitat, the apparent paucity of available prey habitat and accessibility to the area by snake poachers, these habitat areas would support few (if any) Broad-headed Snakes, and the impacts are not likely to be detrimental to the species in the local area.

Moreover there are large areas of potential habitat remaining in Ben Bullen State Forest, to the immediate east of the Project Boundary. Given the patchy distribution of suitable winter habitat, the apparent paucity of available prey habitat and accessibility to the area by snake poachers, these habitat areas would support few (if any) Broad-headed Snakes, and the impacts are not likely to be detrimental to the species in the local area.

A comprehensive suite of mitigation measures is proposed by Coalpac to further reduce impacts (see below).

Mitigation Measures Proposed to Offset Potential Impacts on the Broad-headed Snake

Cumberland Ecology (2013) has proposed a series of mitigation measures to offset any potential impacts on Broad-headed snake habitat. These include:

- winter pre-clearance surveys when the snake is likely to be under rocks on the escarpment areas; captured snakes to be relocated into suitable habitat areas to the east in the Ben Bullen State Forest;
- clearing summer habitat during winter (the area of potential habitat inside of the mining boundary as indicated by the purple lines in figure 1.)
- replacement of bushrock and incorporation of artificial bushrock (eg. Webb and Shine 2000) in rehabilitation and within selected cliff areas inside of the disturbance boundary;
- not clearing all tree with hollows from the bases of the pagodas and cliffs;
- provision of funding for an indirect offset that entails funding for additional habitat surveys of Broad-headed Snake in the wider area of the western Blue Mountains to further the knowledge of the species (as suggested by Webb pers. comm.).

All of these measures are quite sensible and likely to assist Broad-headed Snakes to persist in the area. From my assessment, I see the most useful direct action to be the replacement of bushrock and the incorporation of artificial rock in selected areas during mine rehabilitation.

It is apparent that very little exfoliation occurs in the sandstone areas in the Project Boundary and the absence of surface rocks appears to be a major habitat deficiency. Increasing the amount of surface rock in the area will assist gecko prey species to increase their abundance, which in turn, may assist the Broad-headed Snakes to be able to access a more plentiful food resource.

The proposal to conduct targeted surveys for the snakes in the wider area is also a useful action. Based on the extent of habitat close to the Invincible Colliery mine site, it would appear that Broad-headed Snakes are likely to be very uncommon in the immediate area. However, this may not be the case deeper into the plateau to the east of the Project Boundary.

The protection of core habitat area is a much better conservation strategy that devoting most resources towards the protection and enhancement of marginal habitat areas.

Broad-headed snakes are patchily distributed within their distributional range (Newell and Goldingay 2005). In many locations (especially in the northern parts of its range), the species is only recorded once. The lack of sightings may be a reflection of the nocturnal activity patterns of this snake as well as a true reflection of its scarcity in certain areas.

There is only one sighting on the Wildlife Atlas within 5 km of the mine boundary and that was made last year. The area in question is frequented often by bushwalkers and trail bikers and the snakes are not observed.

The relative lack of prey species along most of the sandstone areas also implies that the snakes are likely to be very scarce in this area.

Dr Arthur White
25 February 2013.

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