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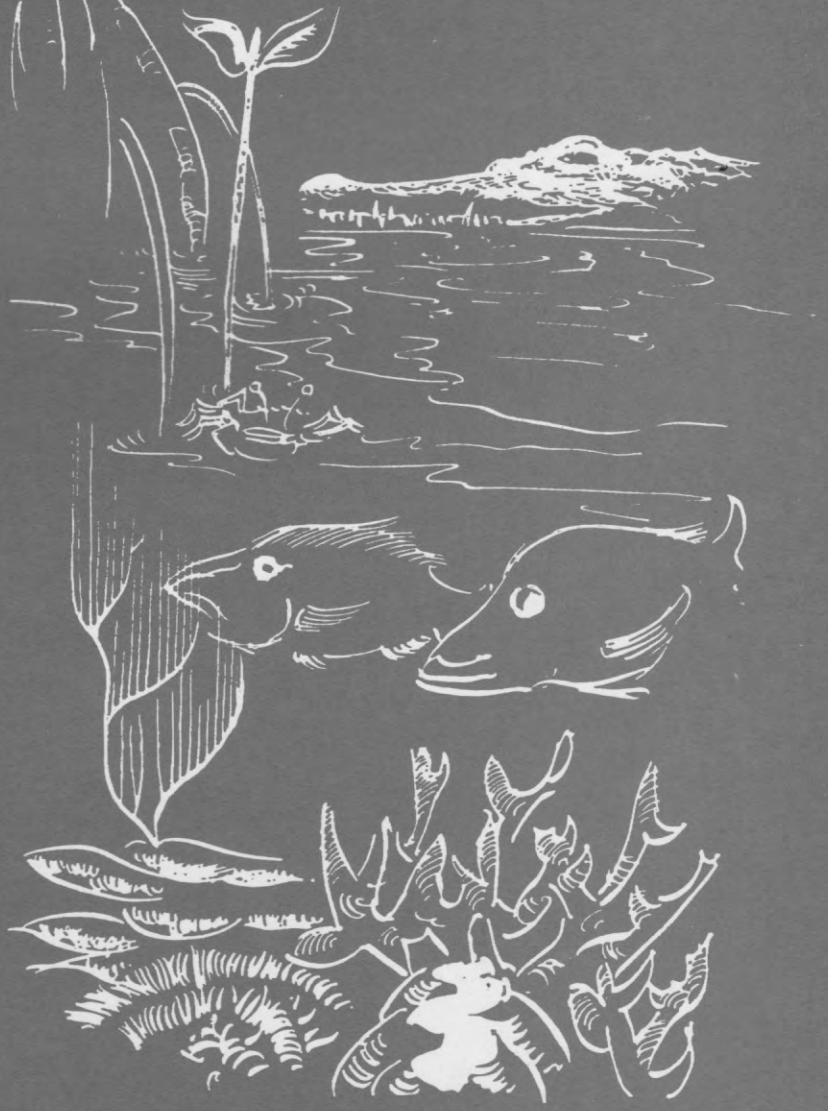

Compiled by
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These proceedings are abstracts from papers presented at the postgraduate conference of the Department of Zoology, James Cook University. The conference is held on the weekend before Easter each year. All students enrolled in Master of Science or Doctor of Philosophy degrees in the Department of Zoology attend and present papers at least once every two years. In consequence these abstracts range from project proposals to progress reports and in some cases summaries of completed work. Therefore, these proceedings are not intended to be viewed as publications but as a record of the research being undertaken by postgraduate students in the Department of Zoology. The information contained in the abstracts should not be cited without the prior approval of the appropriate researcher.

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BOREHOLES - ESTIMATING THEIR EFFECT ON THE TERRESTRIAL VERTEBRATE FAUNA OF WEIPA

Alexander James Thomas

ABSTRACT

It is estimated that over the 35 year life of Comalco's Weipa bauxite mine 2.6 to 4.7 million amphibians and reptiles (equivalent to 9.6-28.4 tonnes of biomass) have fallen into uncapped exploratory boreholes.

INTRODUCTION

In 1957 the Comalco Aluminium Corporation Pty. Limited started a large-scale bauxite mining operation at Weipa. Weipa is located on the west coast of Cape York Peninsula (longitude 144°53' east and latitude 12°38' south), and is set in a landscape dominated by a tall woodland savanna (Specht, 1977; Godwin, 1985; Wharton, 1988).

Since 1989 Comalco have employed a fauna conservation strategy consisting of a contiguous network of corridors and patches (Winter, 1989). This strategy recommended that a minimum corridor width of 200m of woodland be retained around vegetation formations associated with swamp, creek and marine habitats.

The mining process begins by mapping the extent and quality of the orebody by drilling exploratory boreholes. Boreholes are cylindrical excavations, consisting of a circular orifice at the ground surface, a collar and a 0.5-8m shaft. The orifice at the ground surface is either 19 or 28cm in diameter - the difference arising from the use of different equipment. For the purpose of this study it was assumed that all holes had a 19cm diameter.

Fauna moving along the ground can encounter the edge of the borehole and fal in. When the wet season passes remnant fragments may become embedded within a stratum of silt, forming an historical record of the distribution and abundance of the fauna.

The density of boreholes varies across the landscape, depending on the underlying bauxite orebody. The habitat most heavily sampled has been the tall open woodland, while habitats associated with swamp, creek and coastal dune elements should theoretically be comparatively free of boreholes.

In 1958 Comalco commenced its programme of borehole drilling and mining, but it was from the late 60's through 1978 that widespread borehole driling occurred. Growth in the abundance of boreholes over this time suggests a systematic sampling strategy, persisting until the late 70's when the borehole drilling programme was substantially scaled down.

Since 1984 the standard operating procedure for the drilling of boreholes has included capping them with a plastic disk, however there is also a process of natural capping occurring. Natural capping occurs when processes such as litter accumulation and collapse of the walls

lead to borehole filling. Uncapped boreholes are also eliminated through the mining process, which from 1969 to the present day has been at a consistent rate of about 250ha per year (Leggate, 1976; P. Warren, pers. comm.).

While prior studies have reported that fauna are collected by boreholes (Muir, 1985; Chapman, 1988) this paper is the first attempt to quantify their rate of harvest of a faunal assemblage.

METHODS

The estimation process consisted of four parts: compiling existing field trapping and direct observation data, equating capture rates of pitfence traps and boreholes, estimating the population of uncapped boreholes over the life of the mine, and estimating the likely number of individuals trapped.

Pitfence trapping was undertaken as part of a survey into habitat preference of terrestrial vertebrates and invertebrates, between November 1991 and July 1993. Pitfence trapping involved the construction of an L-shaped fence with 7m arms, buried at their bases, with a bucket sunk at the free end of each arm.

Each pitfence trapping system was treated as a length of trap boundary. The fencing length includes both sides of each 7m arm - a total of 28m - to which the circumference of the 30cm diameter buckets were added, bringing the total trapping boundary per system to 29.8m. Similarly, the circumference of a borehole was treated as a length of trap boundary, with each 19cm diameter borehole having a trapping boundary of 0.9m.

Using the number of boreholes drilled in each year, the annual accumulation of metre nights of borehole trapping boundary over the life of the mine was estimated for each year. Essentially, the number of uncapped boreholes at the end of a year was the number at the end of the previus year, plus the number of uncapped boreholes which were created minus the number eliminated during that year.

The number of uncapped boreholes created in each year was estimated as the number of boreholes drilled, mutiplied by the proportion capped, plus the number of the prior year's capped boreholes which had experienced a capping failure. A capping failure is where the plastic disk in the collar of the borehole becomes dislodged, tilts to one side and permits the passage of an animal. The rate of cap failure was assumed to be 5% per annum.

Uncapped boreholes were eliminated by natural capping and by extension of the mine. The rate of natural capping was assumed to be 5% per annum. Under the assumption of a rate of mining of 250ha/year, and a borehole spacing of 250 feet (81m), about 441 boreholes were eliminated each year.

To estimate the cost of remediating the uncapped boreholes I manually counted the number of boreholes within the conservation corridors of Andoom, and used a per borehole cost obtained from Western Mining Corporation (Woolard, 1991).

RESULTS

A total of 512 individuals of 28 taxa were recorded over 960 pitfence trap nights (28,608 metre nights) from the woodland habitat. Their total combined weight is estimated to be at least 2.574kg. No mammals or birds were trapped by the pitfence systems.

The total number of boreholes drilled in the Andoom region between 1950 and 1979 was 29,228, of which 4,044 were located in conservation corridor habitat.

The cumulative effort of the pitfence trapping totalled 28,608 metre nights, while the borehole trapping totalled 98,709,000 metre nights - a ratio of 1:3,450.

The estimated mass of fauna to have fallen down uncapped boreholes over the life of the mine was 19±9.4 (95%CI) tones, or 3.65±1.08 (95%CI) million individuals.

DISCUSSION

There are five strands to the following discussion: supporting evidence, the sources of strengths and weaknesses of the projection, the ecological implications of the effect of uncapped boreholes, the action the situation requires, and the opportunity the situation presents.

In addition to pitfence trapping, direct inspection of abut twenty boreholes resulted in observations of an unidentified black snake (most likely the Black Whip Snake, *Demansia atra*), a single Burton's Legless-Lizard (*Lialis burtonis*), at least twenty Rocket Frogs (*Litoria nasuta*) and one other native frog (*Cyclorana novaehollandiae*). Not all species fail to negotiate the vertical surface and opening of the borehole. For example, I have observed two individuals of the Pelagic Gekko (*Nactus pelagicus*) traversing the walls of, and sheltering within, the collar of a borehole. Taxa with an ability to negotiate vertical surfaces were excluded from the actual trapping data.

In an extracted sample of three boreholes the foreleg of a Tommy Roundhead (*Diporiphora* sp.) was recovered, along with the remains of about fifteen Cane Toads (*Bufo mrinus*).

The projection has a number of strengths and weaknesses. The strengths include: equating each metre of the pitfence trap to a metre of borehole and projecting using depleted populations. The weaknesses include: inclusion of re-trapped individuals, an unknown rate of natural capping, an unknown rate of capping failure, an unknown number of boreholes drilled in the Weipa region.

The strength of the projection by virtue of equating each metre of trap to each metre of borehole is that when an animal encounters the trap boundary it can escape, whereas if it encounters a borehole the outcome is a trap. The effect of this is that the projection is an underestimate. Likewise, if the effect of uncapped boreholes on fauna populations is real then the projection is based on depleted populations, and the loss over the life of the mine would have been much larger.

I handled the projections weaknesses in the following way, and for the following reasons. I have persisted in including re-trapped individuals because I feel that the adjustment would not greatly alter the story, and that the overestimate it results in is compensated for by the

underestimating effect of the two factors raised in the prior paragraph. Rates of natural capping and capping failure were made equivalent, and I simply doubled the estimates to account for not having information on borehole drilling for the Weipa region.

From an ecological perspective uncapped boreholes present to members of the terrestrial faunal assemblage a negligable to extreme risk. This is because the fauna consists of organisms with a range of body sizes and home ranges, and individuals of each species will have a greater or lesser probability of having a detrimental encounter with an uncapped borehole. Aside from small taxa falling into an uncapped borehole, it can also be imagined that larger organisms may have detrimental, but not immediately fatal, encounters. For example, a macropod or an emu may damage its limb by failing to negotiate a borehole.

That uncapped boreholes may serve as permanently open traps for a segment of the vertebrate fauna is cause for concern. Thi is because harvesting of what are possibly substantial numbers of some species may disrupt the normal functioning of the populations and biological communities in the affected areas, as the proportion of sink to source habitat within the landscape has increased (Dunning *et al.*, 1992).

A compounding factor is the spatial patterning of the landscape following mining operations, in particularl the role of linear and patch remnant habitats as part of the fauna conservation strategy. The conservation strategy depends upon the integrity of remnant tall open woodland habitat fringing mesic landscape elements associated with streams, swamps and coastal dune systems. It can be supposed that these remnant woodland habitats will sustain increased traffic by individuals, which would increase the probability that individuals will encounter uncapped boreholes.

In addition, the magnitude of a borehole effect would be larger for populations of organisms which have dispersing young, or respond to seasonal conditions by dispersing or conglomerating between mesic and woodland habitats, and the effect may be borne disproportionately by key age classes within the population.

The situation requires action, in that at a minimum the integrity of the conservation corridors should be restored by remediating their uncapped boreholes. Remedial capping operations conducted by the Western Mining Corporation Ltd's Kambalda Nickel Operations minesites were costed at $38-63 per borehole in 1990 dollars, so the cost of a remediation programme at Weipa is estimated to be about $3-500,000.

The situation may also present an opportunity to study the distribution and abundance of a woodland fauna undergoing change. This is because the boreholes could be excavated and their stratification investigated.

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