

## STYGOFAUNA AND MINING (WESTERN AUSTRALIA)

### KEY TERMS

#### Stygofauna:

Animals that live in groundwater. Habitats range from spaces between sand grains to pools and streams in caves.

#### In situ:

Has not moved from its place of origin.

#### Endemic:

Exclusive to a particular location.

### Why is this case study interesting?

One would not expect microscopic groundwater animals to be impacting operations of large companies in outback Australia.

This case study explains why mining companies in Western Australia are helping to drive research into stygofauna (Figure 1), particularly in the Pilbara area.



FIGURE 1 EXAMPLES OF STYGOFAUNA

### Why are stygofauna important ?

Groundwater is a definitive feature of Australia's ecosystems. Australia's climate, geological age, and distribution and security of groundwater resources are all indicative of an environment that favours groundwater as a habitat.

Many stygofauna species have origins dating back to before Australia broke away from Gondwana. This means stygofauna are natural indicators of the pace and way Australian groundwater conditions have changed. They are also an in situ measure of the environmental impact of human activities. Stygofauna are also believed help maintain groundwater quality by eating nutrients and matter, and contributing to the movement of groundwater.



FIGURE 2 GEOGRAPHIC LOCATION OF NEWMAN (SOURCE MAP NEWMAN.PDF)

The focal area of this case study is a mining site known as OreBody23. This is located near Newman in the Pilbara, central north-west WA (see Figure 2).

Public confidence in modern resource management decisions is damaged if such a significant component of endemic groundwater biodiversity is overlooked by environmental accounting practices.

### Threats to stygofauna

As you would expect, stygofauna are subject to activities affecting groundwater. Impacts with potential to threaten stygofauna include:

- Water abstraction,
- artificial filling
- contamination of aquifers
- clogging of pore spaces by compaction (including subsidence due to pressure changes, or fine sediment mobilisation activated by vibration)
- Changes to recharge
- Rate and extend of change (which would influence the capacity of stygofauna to relocate or adapt)
- Changes to pressure or temperature



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#### Dewatering:

Drain; remove water from.

#### Subterranean:

Underground.

### How did subterranean fauna come to feature in WA mining?

The Ethel Gorge aquifer has been subject to substantial fluctuations and interferences over the past few decades. This is largely due to the intensity of mining activity in the area. There is evidence that some stygofauna species within the aquifer are capable of withstanding considerable disturbance and change (Humphreys and Armstrong, 2001).

In 1997, BHP Iron Ore Pty Ltd submitted to the Western Australian Government a proposal to mine OreBody 23 below the watertable of the Ethel Gorge aquifer.

Dewatering required for the proposal was to have an estimated drawdown impact of about a 5.5km radius. The intent was to leave the mine pit open at the conclusion of operations. Models estimated associated evaporation would increase the salinity of the surrounding aquifer from 900mg/L to 1700mg/L over the next 40 years.

The submission was referred to the WA Environmental Protection Agency, through which attention came to stygofauna recently recorded by the Museum of Western Australia at the site, some of which were yet to be identified.

The OreBody23 proposal was subsequently approved by the WA Minister for Environment subject to BHP working with the Museum of Western Australia to:

1. identify the stygofauna species collected in the vicinity of OreBody23;
2. assess the conservation significance of the species found;
3. map the local distribution of the species sampled; and
4. undertake sampling in the Ophthalmia region if species distribution was found to be a significant conservation issue.

Completion of points 1 to 3 found the distribution of relevant stygofauna species to be a significant conservation issue, and BHP carried out additional sampling of the specified region. Evidence suggests this sampling was unable to conclude the relevant stygofauna species could be found in locations other than the Ethel Gorge aquifer or OreBody23 site.

This put BHP in an odd position. Having undertaken the required sampling they appeared to have Ministerial approval to proceed with the mining operation. However, there was potential for some species occurring at Orebody 23 to be endemic to that site.

If operations went ahead and lead to species extinction, both the Minister and BHP would have inadvertently contravened the WA Wildlife Conservation Act (which prevents lawful extinction of a native fauna species),

Adding to this was suggestion that the species occurring at Orebody 23 may qualify as a Threatened Ecological Community under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999. Were this the case, the proposal would need to be referred to the Federal Minister for the Environment, potentially precipitating further requirement of inconclusive sampling and analysis.

The challenge was inadequate information on Australia's stygofauna to assess likely distributions, endemism, adaptability, resilience and sensitivities to habitat disturbances or changes of the relevant species.

### Going further

**What would you do if you were an environmentally aware mining company with employees waiting to get on with the job?**

**What would you do if you were a Government, and responsible for both environmental protection and employment?**

**Prepare the respective positions and consider how the debate would progress.**



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The OreBody23 quandary generated a common interest in improving knowledge about stygofauna distribution. Recommendations included establishing a collaborative subterranean sampling and research effort.

The OreBody23 submission was not the first time stygofauna had been raised in context of mining practices. However, it is regarded as the submission that precipitated the inclusion of stygofauna as a regular (if not standard) component of mining environmental impact assessments in WA. The WA EPA has since preparing two documents to guide assessments of stygofauna:

- Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessments in Western Australia. Guideline No. 54 (released in 2003)
- Sampling Methods and Survey considerations for Subterranean Fauna in Western Australia. Guideline No. 54a – Technical appendix to Guidance Statement No. 54 (released in 2007)

### Going further

Drilling bores in remote parts of the country is a very expensive exercise. How would you go about designing a stygofauna sampling exercise across remote parts of Australia?

Stygofauna research in the Pilbara

Two extensive investigations of stygofauna in the Pilbara precipitated as a result of the OreBody 23 dilemma. These were:

- the Pilbara Region Biological Survey, and
- the BHP Billiton Pilbara Regional Subterranean Fauna Survey.

The Pilbara Region Biological Survey was undertaken between 2002 and 2009. As part of this survey, stygofauna were sampled, counted and documented in over 500 bore sites and 20 wetland springs in the Pilbara region of Western Australia.

This survey increased the number of stygofauna species known to exist in the Pilbara from 40 to 350, with the total number of species estimated to be up to 550. The vast majority of these species were new to science and unrecorded.



FIGURE 3 EXAMPLES OF NEWLY DISCOVERED STYGOFAUNA FROM THE PILBARA

The Billiton Pilbara Regional Subterranean Fauna Survey was a BHP Billiton initiative to have comprehensive information about stygofauna across its northern Pilbara tenements. The survey collected more than 30,000 specimens from over 5 000 samples, and was completed in 2011.

This survey has provided a regional-scale context and understanding of species distributions. The survey found a majority of species have distribution ranges greater than the impact area of most mine sites, however a proportion of species appear to have short-range endemism.

### Going further

Taxonomy of stygofauna sounds highly specialized, but the job also requires a diverse range of skills.

How would you know if a species new or previously discovered?



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While the general conclusions of the respective State and BHP surveys are not wholly consistent, they do both indicate that better information will help resolve future uncertainties. There is now general confidence in the broad nature and diversity of regional stygofauna.

Results from both surveys confirm stygofauna are an important component of the Pilbara's biodiversity. Indeed, the Pilbara is now recognised as a global stygofauna hotspot. The collaborative development of the knowledge base for stygofauna will continue to support more strategic approaches to future research and environmental impacts assessment surveys.

### References and further reading

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