

**A PRELIMINARY INVERTEBRATE
SURVEY OF THE ENDURANCE
MINE SITE
North Eastern Tasmania**



CARABIDAE

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Abstract

The purpose of this study was to obtain and identify a sub-sample of the aquatic and terrestrial invertebrate population of the Endurance Mine Site in north-east Tasmania prior to rehabilitation. The area involved in the study was subject to extensive alluvial tin mining up until the early 1970's, when the mine sites were abandoned. Appropriate rehabilitation activities were not conducted at the time, resulting in extensive disturbance of large tracts of land. Invertebrate samples were collected from sites varying in levels of contamination and identified to species level where possible. Overall patterns reflected a low abundance in both aquatic and terrestrial fauna, with one Family, Dysticidae, displaying dominance in all aquatic sites sampled. Terrestrial fauna was more diverse, with a dominant presence of the ant *Iridomyrmex sp.* and small flying insects, however abundance ratings remained low. All invertebrate fauna identified are considered hardy species and tolerant of harsh environmental conditions. At the conclusion of this study there were no key indicator species that indicate a sensitive environment, and none that are listed on the Threatened Species Protection Act 1995. While Ruby Lagoon and adjoining creeks have provided a habitat for several species of aquatic invertebrates, the effects of heavy metals and pollutants have undoubtedly made this site inhospitable for invertebrate species that would otherwise flourish in wetland habitats.

1.0 INTRODUCTION

The study on the diversity and abundance of macro-invertebrates in the Endurance Wetland is initiated by SEMF Holdings Pty Ltd (SEMF), as part of a rehabilitation concept plan for abandoned tin mines in north-east Tasmania. The Endurance wetland is a mine site that is considered a priority for rehabilitation by Mineral Resources Tasmania (MRT), following the establishment of the Rehabilitation of Mining Lands Trust Fund. As part of the rehabilitation process it is necessary to ascertain the extent of invertebrate fauna within and surrounding the wetland prior to rehabilitation activities. If the aquatic and terrestrial fauna are highly diverse, abundant and contain species that are considered sensitive to environmental pollutants, it could jeopardise the validity of the rehabilitation management program intended for the area.

Macro-invertebrates are highly sensitive to varying chemical and physical conditions (Williams 1980), are recognised as the major non-microbial component of bio-diversity, and are considered important in ecosystem processes (Oliver & Beattie 1996). Aquatic invertebrates fulfill three (3) basic functions.

1. They form part of the food chain by consuming smaller food items such as bacteria and microalgae, and in turn provide a food source for larger organisms, such as frogs and fish.
2. They assist decomposition of organic matter, which contributes in accelerating the cycling of nutrients and other materials.
3. They influence the structure of aquatic communities such as the abundance and species composition of algae and other benthos (Barmuta 1989).

The survival of these animals is closely linked to the condition of the water environment. Hence particular macro-invertebrates collected and identified from the Endurance wetland can be used as indicators of the water's health, based on diversity and number. Other surveys suggest that abandoned mine sites may adversely affect the ecological health of streams and waterways, resulting from heavy loadings of acidity and heavy metals from abandoned mine and acid drainage (Besser *et al* 1998).

An analysis on the diversity and abundance of macro-invertebrates in the Endurance wetland has not been conducted thus far. However studies have been completed on additional physical parameters such as water quality, vegetation cover, erosion, sedimentation, drainage and the net acid generation potential (NAG). Based on the findings of this study, correlations may be drawn between water quality and the tolerance of certain invertebrate species to high levels of contaminants. This report will be useful as baseline data for future studies that may be undertaken on the ecology of abandoned tin mining sites in Tasmania.

2.0 METHODOLOGY

2.1 Study Sites

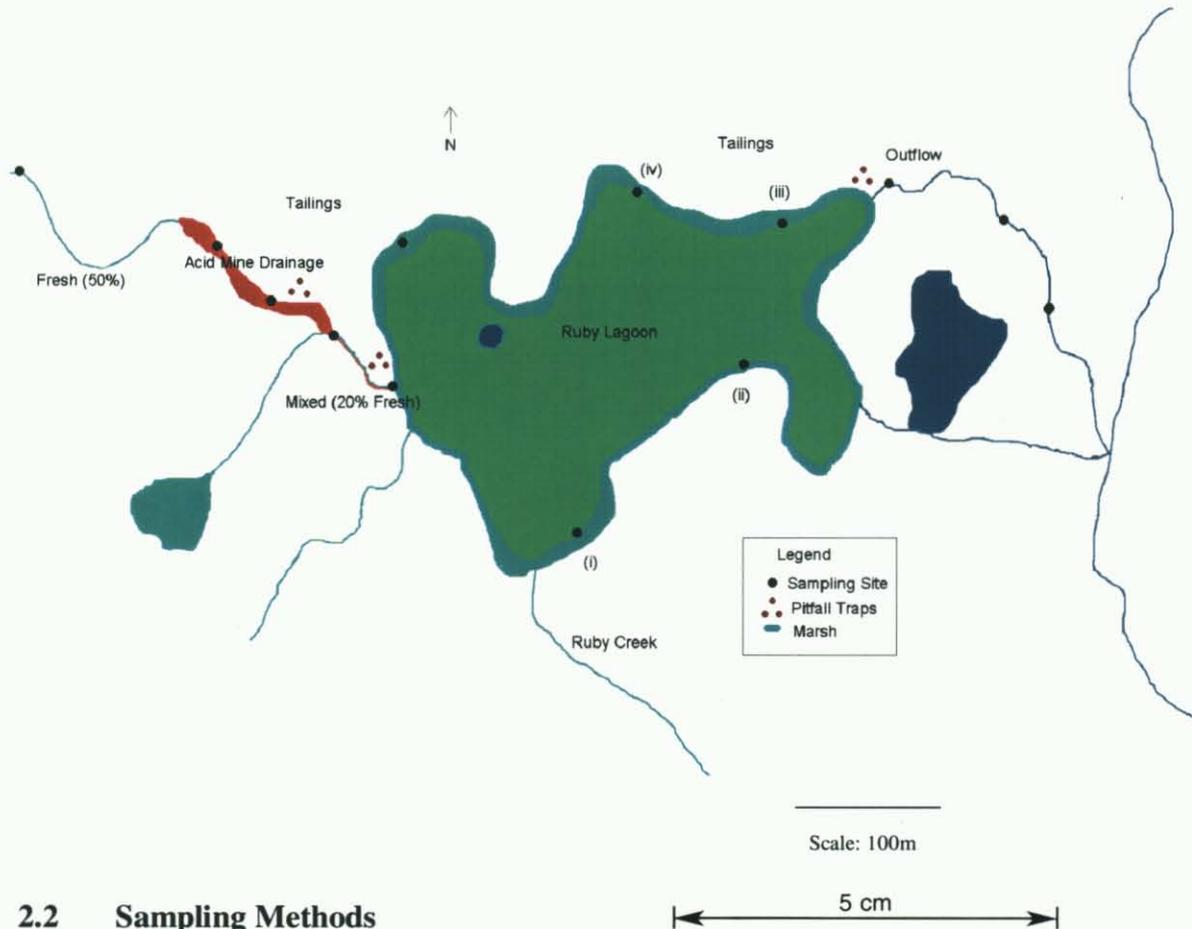
The study sites selected are located in the north-east of Tasmania at the Endurance wetland, located 5 kilometres south of Gladstone (5450585N 560786E Tasmapi). The wetland site spans approximately 400 hectares and has been exposed to considerable rehabilitation activities thus far (SEMF 1998), including the revegetation of mine tailings. A review by Environment Tasmania suggested that further rehabilitation of the Endurance wetland mine site was necessary in order to become self-sustaining. The area is currently used by local residents and tourists for recreational pursuits such as four-wheel driving, motorbike riding, swimming, hunting, gem fossicking and camping (SEMF 1997).

Five locations surrounding the Endurance wetland were selected for invertebrate sampling. These included four aquatic locations and one terrestrial. The four sites were:

- (i) Ruby Lagoon;
- (ii) the Ruby Creek Acid drainage stream;
- (iii) the Ruby creek fresh water streams (50% fresh and 50% contaminated);
- (iv) the Ruby Lagoon outflow stream; and
- (iv) the Endurance Tailings fans.

The five sites were named in reference to their location and habitat type. These being, Lagoon (L), Acid Mine Drainage (AMD), Fresh (F), Outflow (O) and Tailings (T) (Figure 2.1).

Figure 2.1 Location Map of Sampling Sites



2.2 Sampling Methods

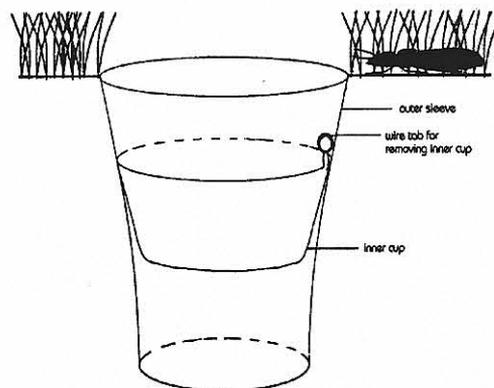
2.2.1 Aquatic Sampling

Moving rocks, along with sediment, and searching amongst aquatic vegetation initially disturbed aquatic macro-invertebrates. Water samples, along with sediment were collected by means of a net and transferred to a tray so that species could be collected. The sampling method was replicated twice at each site, and four times at the fresh (50%) site, due to an obvious increase in species diversity. Species were then transferred with syringes to small plastic vials containing alcohol, for transportation and subsequent identification. Identification of fauna was achieved using a binocular microscope in conjunction with aquatic invertebrate taxonomic keys (Anderson 1991, Lawrence & Britton 1991, Williams 1980).

2.2.2 Pitfall Traps

Pitfall traps were used to collect surface-active terrestrial species within the tailings fans. Each pitfall trap consisted of one plastic drinking cup (85 mm top diameter) which was placed inside a section of PVC pipe and buried into the soil (Fig.2.2). The rim of the drinking cup rested on top of the PVC pipe so that the edge of the trap lay flush with the ground surface. Each trap was filled with a preservative made up of approximately 30 ml of antifreeze/ 10 ml water solution. Nine pitfall traps were assembled and placed in clusters of three at random intervals along the tailings fans. The traps were assembled on February 2nd, 1999 and left in place over 24 hours. The positions were randomly selected and aimed to maximise species representation within the designated area, and provide a standard sample size. Species collection involved checking each trap systematically. Every pitfall trap was emptied into a screw top container and labelled correspondingly for subsequent identification. Traps were dismantled on day 2, February 3rd, 1999 and trap holes were filled in with existing soil.

Figure 2.2 Pitfall Trap



Source: After *Canadian Entomologist*, 1994.

2.2.3 Hand Sampling

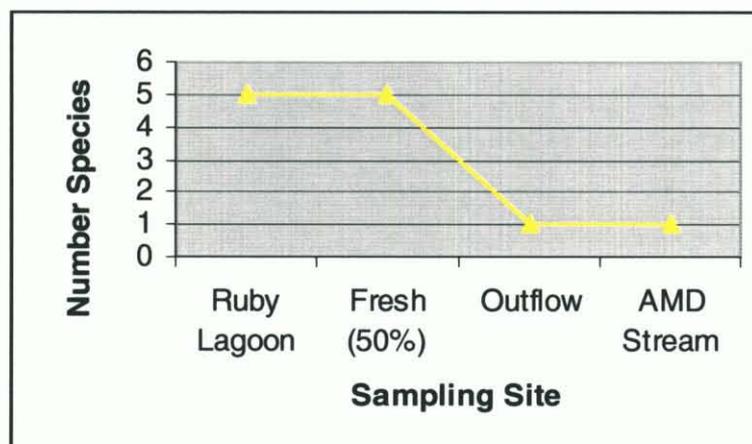
Terrestrial microfauna that were not active on the surface of the tailings are collected by hand by using fine forceps or by encouraging the insect into a collection cup. This was performed while setting the pitfall traps, and again when collecting the samples. Samples were protected from desiccation by placing in an esky for transportation. Fauna was examined and identified using a binocular microscope to Family or species level where possible.

3.0 Results

3.1 Aquatic Invertebrates

A total of ten species were identified from the range of aquatic sampling sites (Appendix 1). Ruby Lagoon (L) and the Fresh (50%) water creek (F) indicated the greatest diversity of species among all sites with each site having a total of five species (Figure 3.1). Within this group of species, two invertebrates were represented at each site. These were from the Families Ptilodactylidae and Dysticidae. Both species are within the Order Coleoptera.

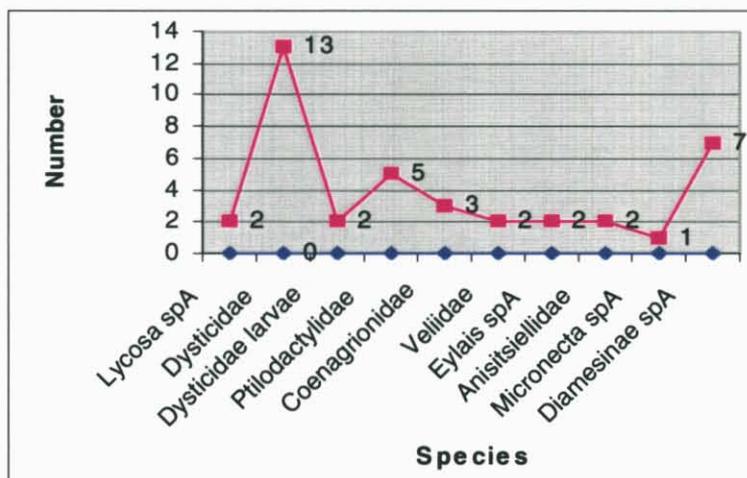
Figure 3.1 Species Diversity within Sampling Sites



The Outflow site (O) and the Acid Mine Drainage stream (AMD) displayed the lowest diversity among all sampling sites. At these sites one species only was represented in each location. Site O was dominated by Dysticidae, and appeared to be the only species that was present throughout the wetland system (excluding the AMD site). Site AMD was dominated by *Diamesinae sp* (bloodworm), and was located throughout the AMD stream, reducing in number in sites with increasing fresh water.

Results reflect an overall low abundance in invertebrate fauna, with species registering as tolerant and very tolerant to pollutants (Van Dort *et al* 1998). Species from the Order Coleoptera are the dominant representatives of aquatic fauna, dominating in all sites except the Acid Mine Drainage Stream (Figure 3.2).

Figure 3.2 Abundance of Aquatic Invertebrates



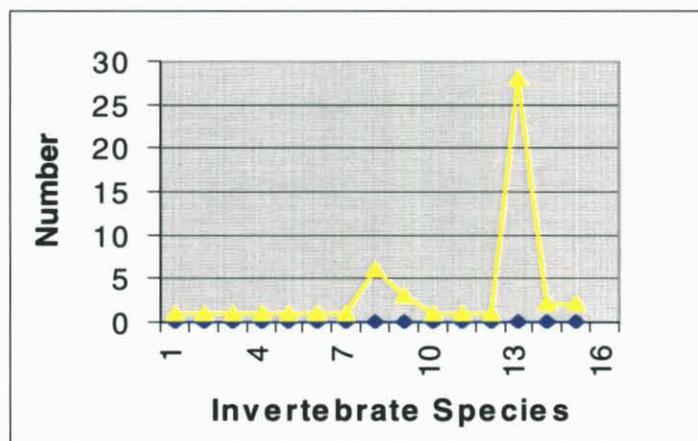
3.2 Terrestrial Invertebrates

A total of fifteen invertebrate species were collected and identified from the pitfall traps within the tailings (Appendix 2). Diversity of species was greater than the aquatic invertebrates, however abundance of species was poor in all

sites. The highest number of invertebrates was found nearest Site O, where vegetation was moderate and traps were closely spaced. Species abundance and diversity was lowest in traps located adjacent to the AMD stream, where only four species were collected. Vegetation at this site was significantly reduced and dominated by aquatic grasses.

In the pitfall traps located nearest the Outflow, the ant species (Formicidae) displayed dominance, particularly *Iridomyrmex sp.*, which appeared in the three traps set at Site O (Figure 3.3). Throughout all other traps, ant species were absent, but contained a diverse assemblage of species from a range of Families (Appendix 2). The second most dominant species overall was a small flying insect, from the Family Chironomidae, but was not widespread and only found in the traps nearest the lagoon edge. No species were found that are sensitive to pollutants, thus indicating an environment where only hardy species can exist.

Figure 3.3 Terrestrial Invertebrate Abundance in Tailings Fan



4.0 Discussion

4.1 Coleoptera at Endurance Mine Site

Coleopterans were the dominant Family found in both the aquatic and terrestrial sites. In accordance with Williams (1980) this is anticipated, as the Order Coleoptera is one of immense size with over one quarter of a million species Australia wide. Adults and larvae are found in a range of inland aquatic habitats, and therefore illustrates their hardiness and adaptability to environmental conditions.

The terrestrial Coleopteran species were represented by the Carabid beetle (Carabidae) and the Scarab beetle (Scarabidae). For beetles alone, species richness within these families is significantly correlated with richness in all other families (Oliver & Beattie 1996). The Endurance Mine site was poor in species richness, particularly in the beetle population. Thus an increase in the abundance of Coleopterans would parallel an increase in overall species diversity. For this to occur, the overall health of the ecosystem would need to improve considerably.

4.3 Formicidae at Endurance Mine Site

Ants perform a number of important functions within ecosystems. They accelerate nutrient recycling, are important predators and competitors, are prey to other species, and have a major impact on plant growth and reproduction. Ants prefer warm sunny areas and have broad omnivorous diets (Anderson 1991).

Throughout the tailings, *Iridomyrmex sp.* was the dominant species and most abundant. *Iridomyrmex sp.* is known for its aggressive behaviour and domination over other ant species. *Iridomyrmex sp.* were also found to be dominant in those sites that were exposed to sunlight for the majority of the day, ie pitfall traps adjacent to the Site O. The remaining two ant species, *Camponotus consobrinus* and *Rhytidoponera sp.* were also found in the traps

located at Site O, however were extremely low in abundance, thus supporting Anderson's (1991) claim that *Iridomyrmex sp.* displays dominant behaviour over other ants.

5.0 Conclusion

The identification of invertebrates found at Ruby Lagoon and associated creeks, has provided some useful baseline data from which subsequent studies can be continued. The aquatic Families or species identified are recognised as invertebrates that are highly tolerant of polluted and contaminated sites, and are capable of surviving under harsh environmental conditions. Sampling aquatic invertebrates alone cannot produce the data necessary to determine the health of a water body. However, when invertebrate sampling methods are used in conjunction with biological, physical and chemical parameters, a more comprehensive assessment of water quality can be ascertained. Studies pertaining to these parameters have been conducted at Endurance Mine Site.

The terrestrial invertebrate populations were typical of species found in heathland/grassland habitats, and in particular, disturbed sites. However, all species displayed considerable reductions in abundance, and below what would be considered as "healthy" population levels. This is undoubtedly attributed to the presence of heavy metals in the wetland system. The most common source of heavy metals are linked to mining activities, resulting in a decrease in the abundance and diversity of invertebrate organisms (Norris *et al.*, 1982). Abandoned mine tailings often continue to add metals to surface and ground waters for decades after active mining has ceased, despite remedial landscaping and site rehabilitation (Barmuta 1989). If constructed wetland management goals include wildlife habitat, pH must be greater than 3.5-4.0, and the concentrations of heavy metals in the water and sediments must not be toxic (Lacki *et al.*, 1992). At present the pH of the Endurance Wetland has been recorded as approximately 3.5 (Talbot pers.comm.1999).

Although there were no key environmental indicator species identified, ie species that are considered sensitive to pollutants, the small range of species found have the potential to be used in future environmental assessment programs. The relative abundance of different species is indicative of disturbance levels, and overall health of the ecosystem. This investigation into the invertebrate fauna of the Endurance Mine Site highlights the importance of wetland ecology, and emphasises the necessity for ongoing monitoring of these habitats.

In reference to future studies, it is recommended that subsequent invertebrate surveys are conducted in the area post excavation and rehabilitation, to determine whether environmental condition has improved. This should be done on seasonal basis, as invertebrate fauna varies considerably from season to season. In reference to the results of this study, the rehabilitation management program designed for Endurance Mine Site will have little impact on the present invertebrate fauna. Species that currently live in the environment are highly tolerant species, capable of adaptation and survival in extreme habitats.

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APPENDIX 1

**Aquatic Invertebrates
Of
Ruby Lagoon**

Ruby Lagoon

Order	Family	Genus	Species	Common Name	Number
Aranae	Lycosidae	<i>Lycosa</i>	spA	Wolf Spider	2
Coleoptera	Dysticidae			Diving Beetle	3
Coleoptera	Dysticidae	larvae		Diving Beetle	2
Coleoptera	Ptilodactylidae				2
Odonata	Coenagrionidae			Damselfly Nymph	3
Hemiptera	Veliidae				2

Fresh Water Creek (50%)

Order	Family	Genus	Species	Common Name	Number
Acarina	Eylaidae	Eylais	spA	Fresh water mite	2
Acarina	Anisitsiellidae			Fresh water mite	2
Coleoptera	Dysticidae			Diving Beetle	2
Coleoptera	Ptilodactylidae				1
Hemiptera	Corixidae	<i>Micronecta</i>	spA	Water-boatmen	1

Outflow

Order	Family	Genus	Species	Common Name	Number
Coleoptera	Dysticidae			Diving Beetle	8

Acid Mine Drainage Stream

Order	Family	Sub-Family	Genus	Species	Common Name	Number
Diptera	Chironomidae	Diamesinae	Diamesinae	spA	Blood worm	7
			spA			

APPENDIX 2
Terrestrial Invertebrates
Of
Endurance Mine Site

**Tailings Terrestrial
Invertebrates**

Order	Family	Genus	Common Name	Number
Aranae	Lycosidae	unknown	Wolf spider	1
Aranae	unknown	unknown		1
Aranae	Graphosidae	spA		1
Coleoptera	Carabidae	Promecoderus	Beetle	1
Coleoptera	Scarabaeidae	Aphodius tasmanii	Beetle	1
Dermoptera	Labiduridae	Labiduridia riparia	Earwig	1
Diplopoda	Julidae	Julidae spA	Centipede	1
Diptera	Chironomidae	spA		6
Diptera	Chloropidae	spA	Fly	3
Diptera	Chloropidae	spB	Fly	1
Diptera	Ephydriidae	spA	Fly	1
Hymenoptera	Formicidae	Camponotus consobrinus	Red Ant	1
Hymenoptera	Formicidae	Iridomyrmex spA	Ant	28
Hymenoptera	Formicidae	Rhytidoponera	Sugar Ant	2
Orthoptera	Gryllidae	Babilla spA	Cricket	2