Developing a Rigorous Aquatic Ecological Monitoring Program at a Central Queensland Mine

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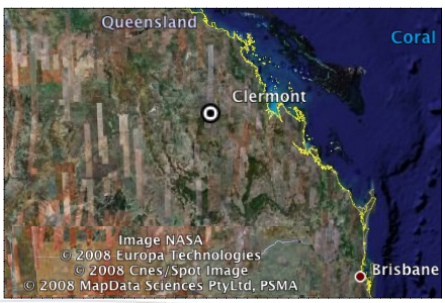
Introduction

- Clermont Coal Mine
  - Construction activities (e.g. building mine camp, roads etc.)
- Being developed by Rio Tinto Coal Australia Pty Ltd (RTCA), on behalf of the members of the Clermont Joint Venture
- Required an Aquatic Ecology Monitoring Program to determine impacts
  - Condition of Environmental Authority
  - Inform environmental management
- No time for pilot studies

Study Area

- Clermont, Central Queensland



Study Area

- Number of creeks run through the Mining Lease
- Theresa Creek Sub-catchment, flows to the Nogoa River (Fitzroy Basin)
- Intermittent or ephemeral waterways

Aquatic Ecology Monitoring Program

- Potential impacts to aquatic ecology (including creek diversion and discharge to creeks)
- Monitoring supports the Mine's Environmental Management Plan
- Aims to enable the early detection of impacts on aquatic ecology

Aquatic Ecology Monitoring Program

- Environmental Authority issued by the EPA requires the use of:
  1. River Bioassessment scores to monitor habitat
  2. Australian River Assessment System (AusRivAS) models to monitor macro-invertebrates

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Monitoring Program Design

- Exceeds EPA requirement to use AusRivAS
  - AusRivAS is a rapid assessment tool for assessing stream condition
  - Difficult to sample in prescribed AusRivAS seasons
- Reflects RTCA's desire to accurately detect impacts of the Mine

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Monitoring Program Design

- Ten sites monitored
  - Five 'impact' sites
  - Five 'control' sites
- Three replicate AusRivAS macro-invertebrate samples collected per site
- A range of univariate and multivariate data analyses used

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Monitoring Program Design

- Bed and edge habitats sampled
- Two survey events per year (early wet season and late wet season) to account for temporal variability
- Three events completed so far:
  1. Autumn 2007
  2. Summer 2008
  3. Autumn 2008

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Flooding in the Catchment January 2008

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Physical Habitat Assessment

- Descriptions based on AusRivAS physical habitat assessment protocols
- Comparison of River Bioassessment scores between control and impact sites for each monitoring event
  - ANOVA for differences in total scores among sites
  - PCA for relative contribution of each variable factor to differences in scores among sites

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Physical Habitat Assessment

- Impact sites had higher habitat scores than control sites
  - banks were more stable
  - greater abundance of stable physical habitat e.g. fallen trees, branches
  - Reduced scouring, erosion and sediment deposition

Steep, eroding banks at control Site 4

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Macro-invertebrate Communities

- Range of taxonomic groups sampled, common taxa included:
  - beetles (e.g. diving beetles)
  - water bugs (e.g. small water striders & water boatmen)
  - non-biting midge larvae (sub-families Chironominae and Tanypodinae)

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Macro-invertebrate Communities

- Greater availability of edge of habitat in summer
  - higher water levels

Summer 2008

Autumn 2008

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Macro-invertebrate Communities: Edge Habitat

- Differences in communities between sites for edge habitats
- Differences not due to a reduced number of pollution-sensitive taxa at impact sites (SIMPER analysis)
- Differences do not indicate an impact from mine construction

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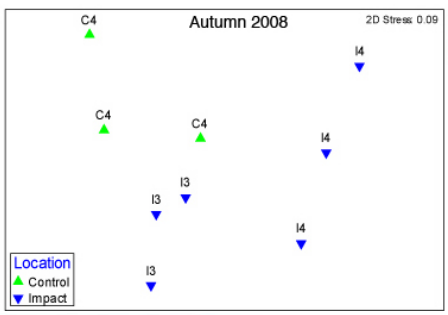
Edge Communities



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Macro-invertebrate Communities: Bed Habitat

- Bed habitats – generally no differences between control & impact locations over time
- Site differences do not indicate an impact from mine construction

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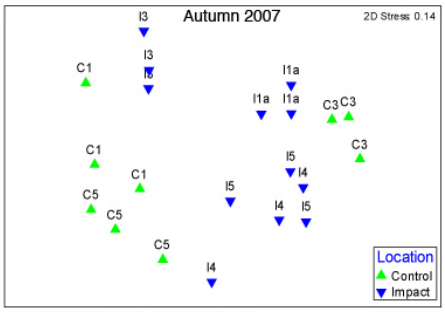
Bed Communities



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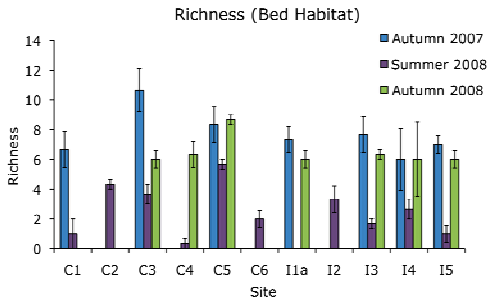
Macro-invertebrate Communities: Bed



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Conclusions

- Aquatic habitat in study area degraded
  - generally better at 'impact' sites
- Macro-invertebrate communities variable between replicates and sites, and over time
  - no impacts of mine construction detected
  - difficult to detect seasonal trends

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Conclusions

- Flooding affected macro-invertebrate communities in the short-term
  - increased availability of edge habitat
  - decreased diversity in bed habitats
- Increased magnitude of flows did not affect communities in the longer-term
  - no major differences between autumn 2007 and autumn 2008
- Longer-term, adequately replicated data set required

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Recommendations

- No diversions or discharge of water to creeks at this stage
  - continue monitoring so we are able to detect any impacts of these activities
  - critical to informing effective environmental management

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Recommendations

- Difficulties in maintaining a balanced sampling design in ephemeral creeks
- Increase number of replicate samples collected at each site
  - increase statistical power
  - collect more quantitative samples
  - move away from the use of the AusRivAS system

Acknowledgments

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