



Aquatic Fauna Biodiversity Assessment

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Wungong Catchment Environment and Water Management Project: Aquatic Fauna Biodiversity Assessment

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KPI

Changes in stream invertebrates.

Objectives

To assess the effects of the Wungong Catchment Environment and Water Management (WCEWM) project on the biodiversity of aquatic fauna (principally aquatic macroinvertebrates) in tributary streams of the Wungong catchment. The expectation is that faunal assemblages will change in response to changes in flow regime associated with the WCEWM project. Streams which used to flow all year, but which now flow seasonally due to reduced rainfall and catchment vegetation characteristics, may once again become perennial, and streams that are currently drying may have more secure flows. Perennial streams tend to support greater biodiversity than seasonal streams.

Methods

- The assessment compares macroinvertebrates and fish communities of streams in sub-catchments to be manipulated to streams of sub-catchments that will remain untouched. Quantitative sampling of aquatic macroinvertebrates is conducted in riffle habitat using a Surber sampler (25 x 25 cm metal quadrat with 250 µm mesh), with six replicate samples taken at each site. Qualitative sampling for fish is conducted using a back-pack electrofisher over a standardised 40 m at each site. *In-situ* measurement of a range of physical and water quality parameters is made in conjunction with the fauna sampling.
- The approach is based on a Before-After-Control-Impact (BACI) design. Univariate (ANOVA) and multivariate analysis (PRIMER) of quantitative replicate samples is used to determine change in macroinvertebrate community structure. Historic data (1984-1990) collected at control (reference) sites in the Canning and North Dandalup catchments are included in analyses to compare how reference sites change over time relative to their historic condition.
- Pairwise percentage similarity (PRIMER Bray-Curtis matrices), which provides a measure of statistical 'distance', is used to compare:
 - i). how impact (exposed) sites change over time relative to control (reference) sites, and
 - ii). how control (reference) sites change over time relative to their historic condition.

Sites

Table 1 provides a list of all sites sampled. Included are:

- Three exposed to thinning (Treatment Area 1, Treatment Area 2 and Vardi Road) and three reference sites (Waterfall Gully, 31 Mile Brook and Foster Brook). These were all sampled in December 2005, October 2006, October 2007, September 2008 and October 2009.
- In 2007, a new control was established on Wilson Brook (as control 31 Mile Brook is now to be treated), and 39 Mile Brook (Jack Rocks) was also added.
- In 2008, an exposed site was established on More Seldom Seen Brook to begin gathering baseline data prior to commencement of thinning operations in Treatment Area #5.

Results / Status

The 2009 data has yet to be analysed. Major results and trends from previous years' sampling are summarised as follows:

- No significant changes in water chemistry from previous sampling occasions at either exposed sites or reference sites (Figure 1).
- In 2008, macroinvertebrate species abundance and richness showed varying degrees of recovery following significant declines in spring 2007 (Figure 2).
- Low annual rainfall in 2006 and a dry winter in 2007 were considered major causal factors in the decline in spring fauna in 2007. It is likely that the late onset of flows in 2007, and the relatively short flow duration prevented some species completing their life cycles, resulting in their loss from some sites.
- TA2 (downstream of Cobiac sub-catchment) recorded smaller annual fluctuations in species richness and abundance than other exposed sites. However, there was insufficient baseline data to differentiate affects of thinning operations in coupes TA1.3 and TA2.1 from stochastic variation.
- At Vardi Road, macroinvertebrate species richness and abundance continued to decline, though not as steeply as observed between 2006 and 2007. This was in contrast to other exposed sites TA1 and TA2. Vardi Road dried for the first time on record in summer 2007 and macroinvertebrate communities now appear to be more similar to those at reference sites (Figure 3). Evidence for this was an average increase of 14% in pairwise percentage similarity between replicate samples taken at Vardi Road and those of reference sites. Increased similarity was primarily due to a reduction in the number of high-flow taxa and an increase in seasonal fauna at Vardi Road.
- Reference sites have shown a shift away from the historic condition, but this shift has not increased over the period 2006-2008. Communities at 31 Mile Brook, which may now be treated (CSIRO trial thinning), also showed a small but steady increase in similarity (8%) to other reference sites over the monitoring period 2005 - 2008. This can also be attributed to antecedent rainfall and the loss (likely temporary) of taxa more sensitive to change in annual flow regime.
- Fauna of note included stygal paramelitid amphipods. These are obligate groundwater species that require permanent water. Between 2005 and 2008 there has been a trend toward declining abundance of these amphipods at TA1, Vardi Road and Waterfall Gully, but a slight increase at 31 Mile Brook. Change in their abundance may reflect frequency and/or duration of connectivity between ground and surface waters. Where there is strong connectivity between ground and surface waters they will frequent surface waters in search of food, particularly during wetter months.
- It has proved difficult to standardise fishing effort due to the physical nature of stream habitats, *i.e.* large number of snags and densely fringing vegetation. Data has therefore been tabulated as relative abundance categories. To date there have been no obvious changes in distribution or abundance of native fish and crayfish.

Recommendations:

1. As previously recommended by ARL, it is critical that collection of pre-treatment baseline data and post-treatment monitoring data be continued over a period of years in order to separate short-term stochastic fluctuations from effects of treatment. Reference and exposed sites should be sampled for at least three years prior to commencement of treatments in each sub-catchment to quantify within and between site similarity in species diversity and assemblage structure.
2. Continued monitoring of reference sites is critical to distinguish effects of climate change from that of thinning trials.
3. If glyphosate (or other herbicide) is to be used in thinning operations, then levels in downstream receiving environments must be monitored to determine possible effects on stream biota. Analyses of water quality conducted by external laboratories must provide detection limits that meet current ANZECC/ARMCANZ trigger values for the protection of slightly - moderately disturbed aquatic ecosystems, *e.g.* 0.37 mg glyphosate

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Table 1. Aquatic fauna sampling sites.

Site Name	Catchment	Site Type	Treatment Area 'Exposure'	Treatment Indicative Status	Sampling Years	Sampling Location	UTM (zone 50) WGS84	
Waterfall Gully (WF)	Wungong	Reference	Control	No treatment required	2005, 2006, 2007, 2008	Upstream from road culvert 400m above gauging station.	413201 E	6436061 N
Treatment Area 1 (TA1)	Wungong	Exposed	WCTP TA1	TA 1.1 (native only) thinned in 2006 and again in 2008 TA 1.2 (native) thinned in 2007 & 2008 (post-88) TA 1.3 (native) – thinned in 2007,2008 & 2008 (post-88)	2005, 2006, 2007, 2008	Along Chandler Rd, immediately down-stream of Coronation Rd intersection.	417987 E	6428604 N
Treatment Area 2 (TA2)	Wungong	Exposed	WCTP TA2 & 3	TA 2.1 (native) commercial harvest in 2007 TA 2.1 Cobiac subcatchment (native) commercial harvest in summer 2008 and follow non-comm in winter 2008	2005, 2006, 2007, 2008	Pumping Station Rd 300 m upstream of the Coronation Rd bridge.	419389 E	6428254 N
Vardi Road (VR)	Wungong	Exposed	WCTP TA1, 2 & 3	As for TA1 & TA2	2005, 2006, 2007, 2008	Immediately downstream from gauging station and near 'flying fox'.	416382 E	6431737 N
More Seldom Seen Brook (MSS)	Wungong	Exposed	WCTP TA5	Not yet treated	2008	Immediately upstream from gauging station 616022 on More Seldom Seen Brook.	413350 E	6431007 N
31 Mile Brook (31MB)	Canning	Reference/ Exposed	CSIRO trial thinning (proposed)	Proposed for 2 transects only (20-30 ha) in winter 2009, not yet approved or implemented	2005, 2006, 2007, 2008	Off 31 Mile Road; immediately upstream from gauging station. Originally a reference site but will now be impacted by CSIRO thinning trials.	420806 E	6434022 N
Jack Rocks 39 Mile Brook (JR)	Serpentine	Reference/ Exposed	DEC trial burns	Not yet treated	2007, 2008	Jack Rocks. Off Kennedia Rd (via Balmoral Rd), immediately upstream from gauging station. Not strictly part of WCTP monitoring - first sampled in 2007 to assess impact of DEC fine-scale mosaic burns.	420689 E	6417649 N
Foster Brook (FB)	Nth Dandalup	Reference	Control	No treatment required	2005, 2006, 2007, 2008	Immediately upstream of Sharp Rd culvert, above Nth Dandalup reservoir.	410324 E	6403239 N
Wilson Brook (WB)	Nth Dandalup	Reference	Control	No treatment required	2007, 2008	Off North Road, above Nth Dandalup reservoir. First sampled in 2007 as replacement for 31MB which will be impacted by CSIRO thinning trials.	410084 E	6399053 N

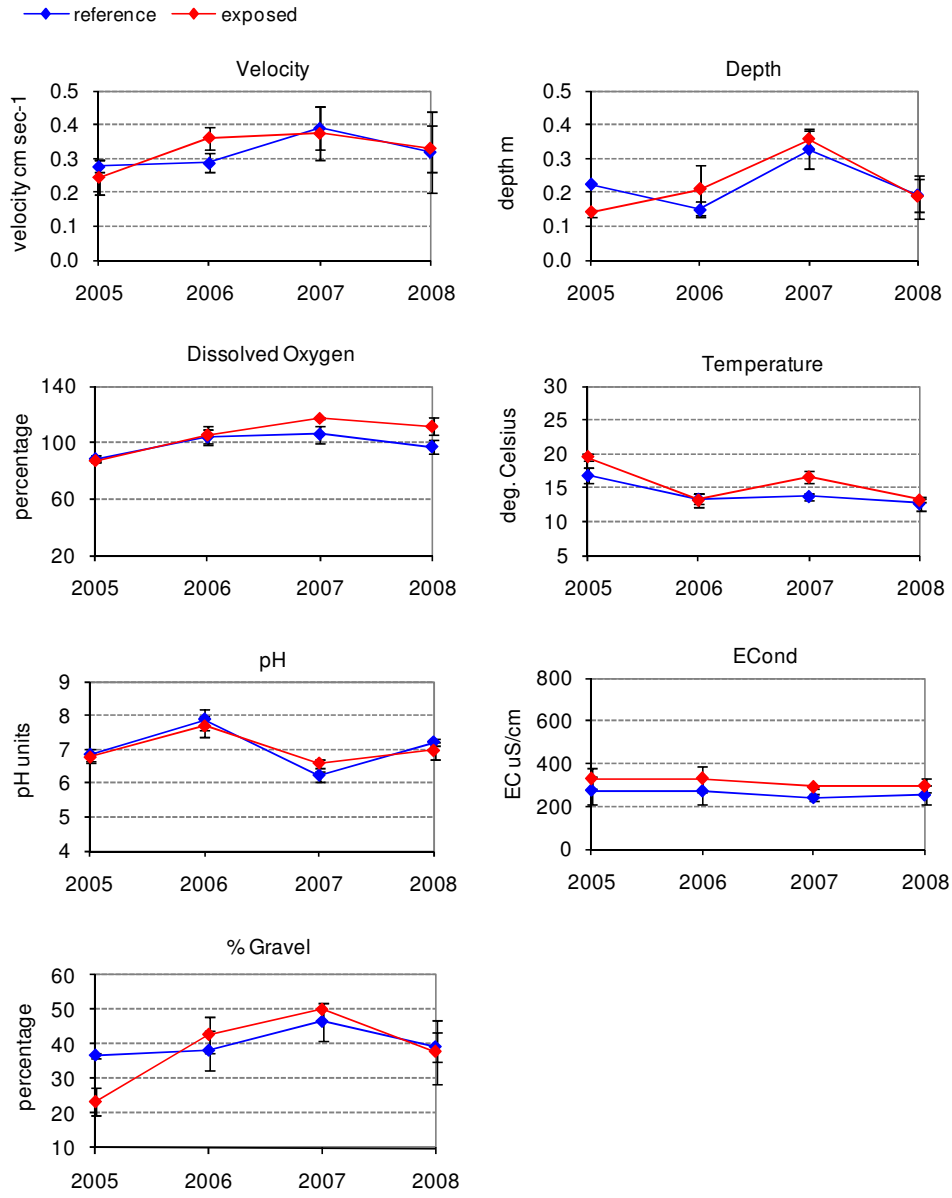


Figure 1. Annual variability in selected physico-chemical parameters (means \pm SE) at reference and exposed sites.

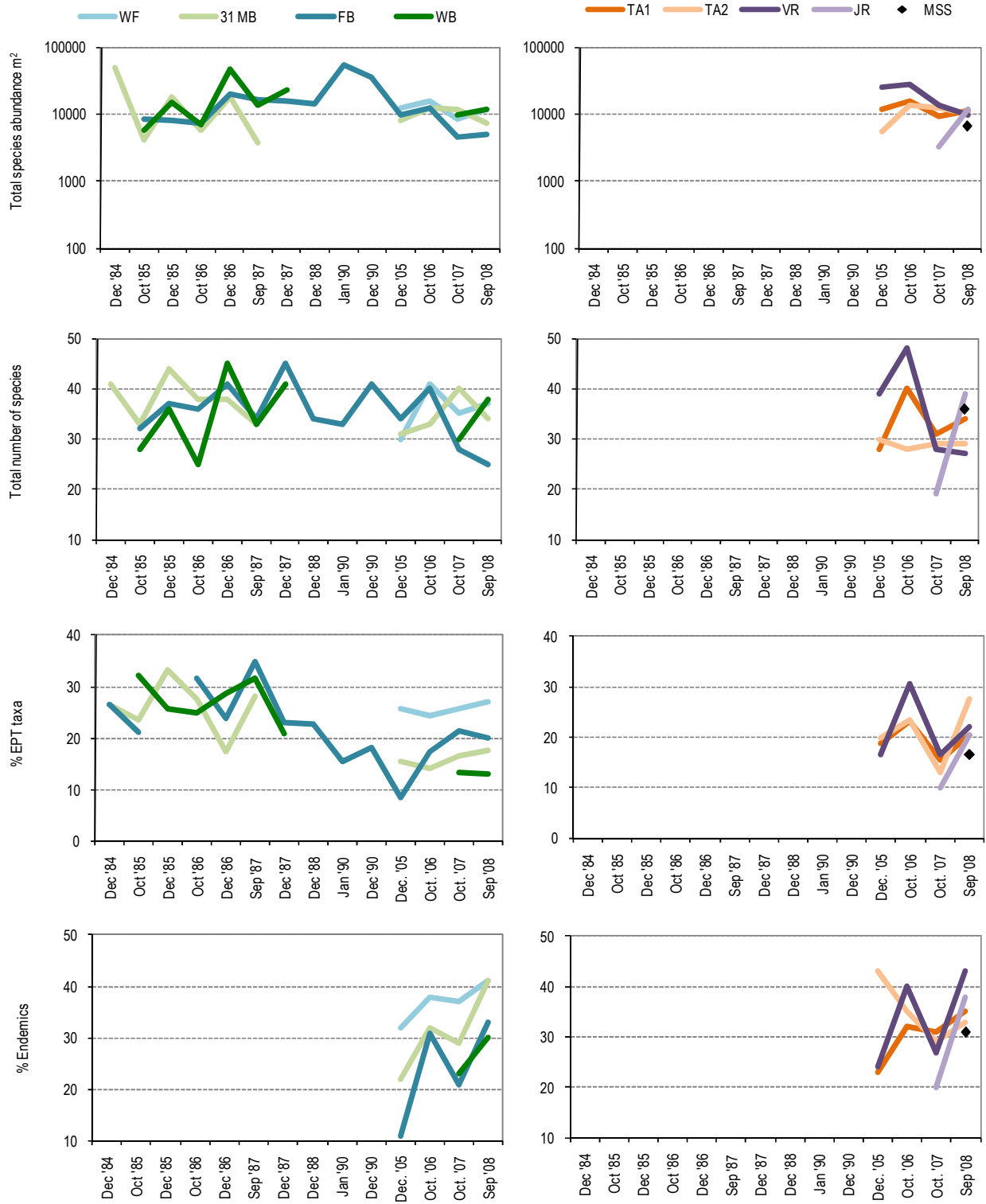


Figure 2. Temporal changes in total number of macroinvertebrate species (richness), abundance, % EPT taxa and % south-west endemics at each site. Refer Table 1 for site codes. Historic (1984-90) data for reference sites 31 Mile Brook, Foster Brook and Wilson Brook is included for comparison with recent data (2005-08). Note: taxonomy has been standardised between recent and historic sampling periods.

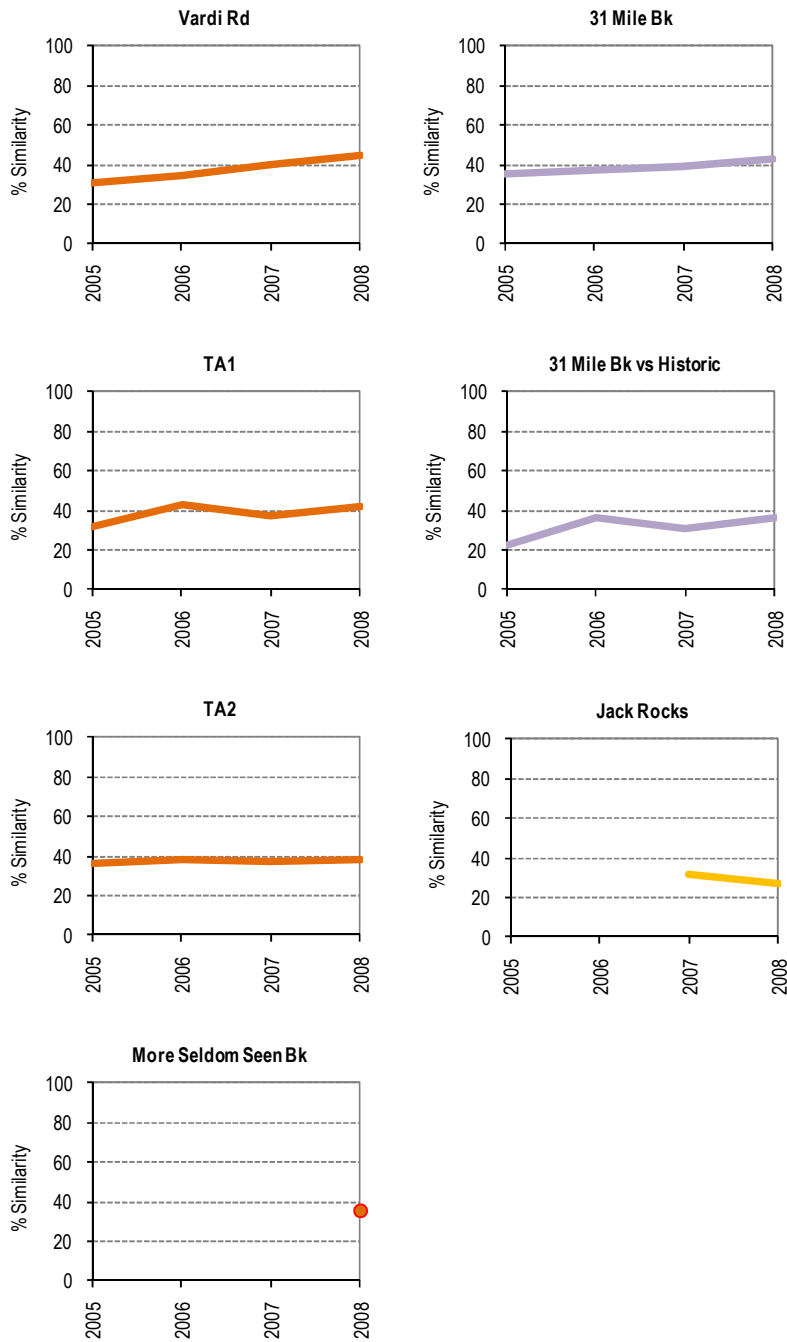


Figure 3. Change in similarity (%) of macroinvertebrate assemblages at exposed sites to those at reference sites. Reference site 31 Mile Brook has been included to illustrate change relative to other reference sites and change from historic condition. Similarity determined from Bray-Curtis pairwise percentage similarity matrices (PRIMER) for abundance data.