



Ecological condition of streams in south-west forests

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Background

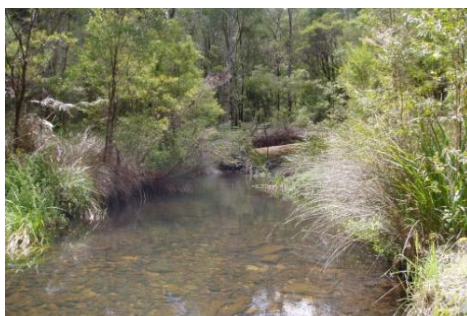
Disturbances associated with forest management modify landscapes and can alter stream water chemistry, hydrology, sediment processes and physical habitats, with consequences for stream biodiversity. Key performance indicator 20 of the *Forest Management Plan 2004-2013* addressed the need to manage Western Australian forests to protect aquatic biodiversity. Science Division's Forest Stream Biodiversity Monitoring Project was designed to assess the effects of forest management activities, particularly prescribed burning and timber harvesting, on aquatic macroinvertebrate diversity and stream water quality.

This study used a biomonitoring tool developed during the 1990s as part of the Australian Government funded Australian River Assessment Scheme (AusRivAS). The AusRivAS model predicts richness of aquatic invertebrate families using data from minimally disturbed streams and so provides a benchmark against which to judge the degree of stream disturbance. The AusRivAS O/E score is the ratio of the number of macroinvertebrate families observed in a sample to the number expected based on the AusRivAS model. The O/E scores are assigned to bands that reflect different ranges of biological condition, ranging from 'richer than reference' condition (Band X) to 'extremely impaired', containing very few of the expected families (Band D). These bands are used to provide a summary of the overall condition of sites over several years.

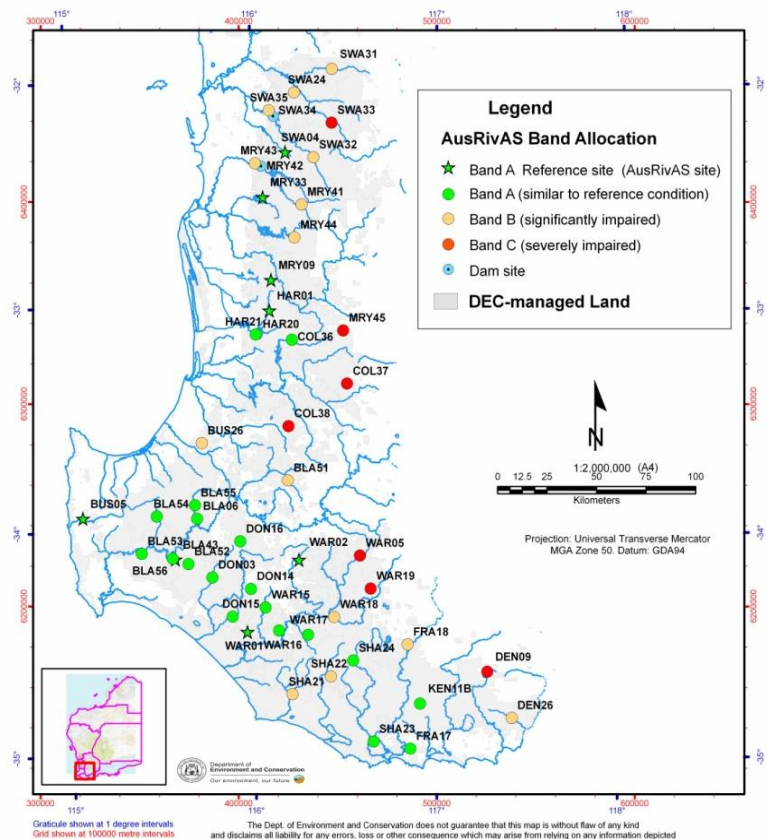


Above: example of macroinvertebrates collected

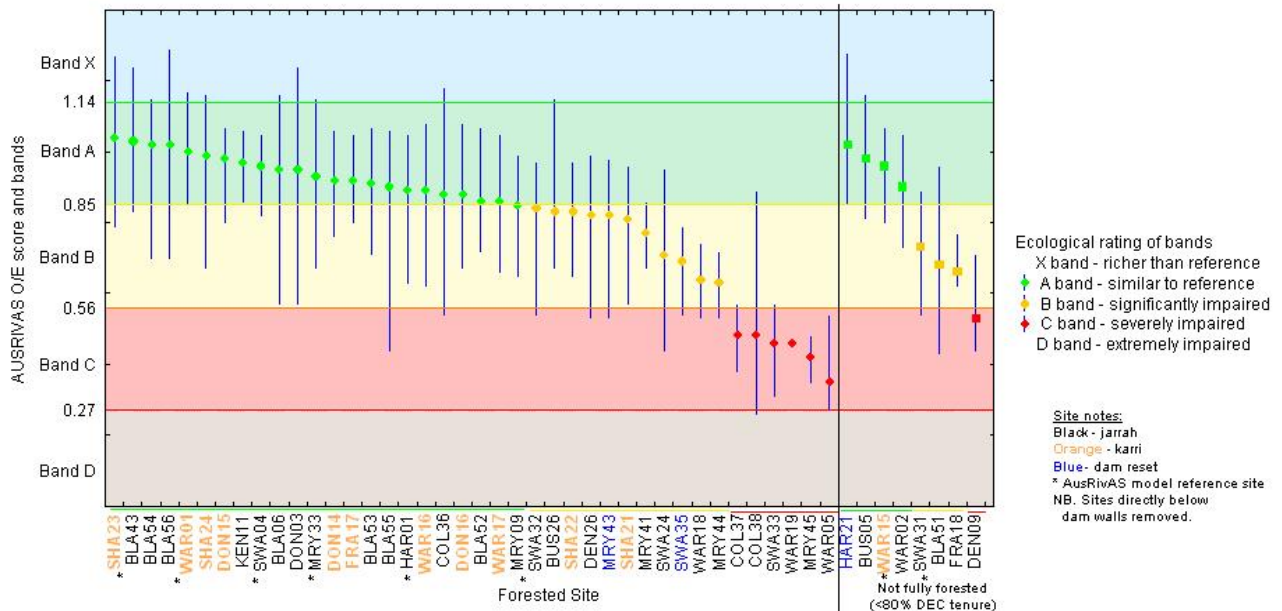
Fifty one sites were monitored throughout the south-west forests in spring each year (2005 to 2011). Eight of these are reference sites that were used to build the AusRivAS model. Sites were selected to have a wide geographic spread and to include streams in catchments subject to a range of existing and planned forest management activities. Generally, these sites are downstream of, rather than within, areas subject to timber harvesting and planned burns, as the aim was to monitor broader effectiveness of forest management rather than local impacts. Several sites were located in minimally disturbed catchments in conservation reserves.



Above: Sampling site on Lefroy Brook



Map showing ecological rating (derived from AusRivAS scores) for each site sampled over the 2005 – 2010 period



Average (2005-2010) AusRivAS band allocation and O/E score for each site. Blue lines show range.

Findings

- The ecological rating for a site varied annually and was attributable to a combination of annual events (rainfall and stream flow) and local disturbance. No site, including reference sites, had the same ecological rating for all six years (2005-2010).
- Declining rainfall has resulted in some streams experiencing more frequent drying or shorter hydroperiods, which can affect survival of aquatic macroinvertebrate populations. In 2010, a particularly dry year, 18 of the 51 sites were dry and only three received an A band rating (similar to reference condition).
- Of the 51 sites, 16 had an average rating of significantly impaired (B band) and eight were classed as severely impaired (C band). A few sites were rated as extremely impaired (D band) in some years but no site received an average D banding. All of the severely impaired sites were in jarrah forest and were either saline, had reduced flows or local disturbance. Sites with an overall rating of significantly or severely impaired were mostly in the northern Jarrah forest (north of Dwellingup) and in the drier eastern forests.
- While almost half of the sites appeared to be impaired, based on the O/E scores, the level of impairment was not directly related to the percentage of the catchment subject to timber harvesting or burning. Most cases of impairment could be attributed to low rainfall or limitations of the AusRivAS model.
- While the AusRivAS model provides a good benchmark against which to judge the degree of disturbance in the streams, the model has some shortcomings. Very few reference sites are located on small seasonal streams or in the south east lower rainfall areas, so sites in these areas may be rated incorrectly. Further, several naturally saline or acidic sites with low O/E scores were probably under-rated as the model is based on reference sites with more benign water quality.
- Seven sites in fully forested higher rainfall areas, which were neither saline nor acidic, were classified as band B. Three of these sites oscillated between A and B band so may be only marginally impaired and one site is downstream of a dam. Further investigation is required to determine reasons for the lower than expected diversity at the remaining impaired sites.

Management Implications

Local effects of forestry practices (such as control burns and harvesting) on aquatic ecosystems are well documented. However, this research suggests that there is minimal impact of current practices on downstream aquatic invertebrate communities in south-western Australian forests. Reduced stream flow, associated with the drying climate, appears to be a stronger influence on stream invertebrate communities. Silvicultural practices could ameliorate or exacerbate this threat and the downstream influence of forestry practices on stream biodiversity under conditions of reduced stream flow requires further investigation. The research also suggests that if reduced flows are associated with elevated salinity or acidification then this would further threaten stream biodiversity.