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A CONSERVATION ASSESSMENT OF THE AQUATIC MACROINVERTEBRATE FAUNA IN THE GRAMPIANS NATIONAL PARK

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Abstract

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A total of 236 aquatic macroinvertebrate taxa were identified at 32 riverine sites in the Grampians National Park. At least 23 of the taxa may represent species restricted to the park. The genus *Austrophlebioides* (Ephemeroptera, Leptophlebiidae) was missing from all sites surveyed, despite suitable habitat. Ordination indicated three distinct groups of sites within the park, primarily based on the stream-bed substrate type. Standard conservation measures were attempted (diversity, uniqueness, rarity, etc) with limited success. Twenty sites showed some characteristics of conservation significance. One site was shown to be more diverse than all others, six sites had more than three endemic species present, seven sites had the only record of an endemic species, the Mackenzie River was shown to be a unique area in the park (with an associated distinct fauna) and other sites scored highly on statistical conservation indices. None of the conservation measures used could, by themselves, identify all the significant sites within the park.

Introduction

Traditional methods of assessing the conservation status of riverine sites revolve primarily around the lack of human disturbance at a particular site or within a catchment (Mitchell, 1990) or are based on the presence of species with high conservation status (e.g., CNR, 1995). However, assessments of the 'naturalness' of individual sites or catchments do not necessarily translate immediately to the equivalent significance for the invertebrate community. Meredith et al. (1989) evaluated stream segments in East Gippsland according to the presence of impoundments, in-stream works, pollution sources, roading, and the percentage of timber harvesting and non-native vegetation. However, the impact of these disturbances is site dependant and such a simplistic evaluation may not reflect the impact on the fauna. In fact, patterns in the aquatic macroinvertebrate fauna of the area (derived from multivariate groupings) do not correspond to the on-ground patterns derived from 'naturalness' evaluation (T. Doeg, Freshwater Ecology Section, unpublished data).

Where individual species are used to identify sites of significance, the identification of the species of conservation significance is often based on a well established knowledge of both the taxonomy and distribution of certain groups of flora and fauna (e.g., fish). However, knowledge of the taxonomy and distribution of aquatic macroinvertebrates is not sufficiently detailed in Victoria to allow correct assignment of a conservation status (e.g., Doeg and Reed, 1995). Yen and Butcher (1994) suggest that single species conservation may be inappropriate for the majority of invertebrates and that other techniques or criteria should be applied. These include habitat-based or community-based approaches.

A number of alternative methods have been suggested for these other approaches. This paper evaluates some of these methods, using data collected as part of a National Estate survey of streams in the Grampians National Park.

Methods

A total of 60 sites was sampled (Fig. 1) throughout the Grampians National Park from all major drainage areas. Sites ranged from wide vegetation-choked channels, small slow-flowing silty tributaries, faster flowing sand to cobble bed streams to steep boulder dominated rivers. At each site, standardised kick samples were collected from the main channel using an FBA net (150 µm mesh net). Macroinvertebrates were picked from a one-tenth subsample and identified. The funding provided for this project allowed only 32 sites to be completed (Fig. 1). Samples from the remaining sites are currently being processed and a full analysis of the results,

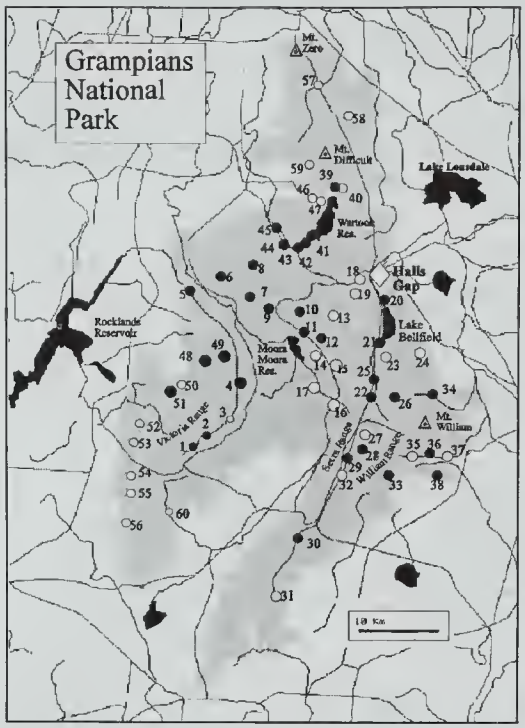

Figure 1. Map of the study area showing the location of sampling sites. l — sites processed during this study; m — sites sampled but not processed during this study.

including the species collected will be presented elsewhere.

Conservation analysis

The traditional conservation analysis of using land use characteristics to identify significant sites (Meredith et al., 1989) should, in fact, eliminate much of the Grampians National Park from a high conservation rating. The presence of major reservoirs (Lake Wartook and Moora Moora Reservoir), the extensive networks of roads and tracks, historical grazing and timber harvesting would automatically reduce the value of most park streams. Despite this, the LCC identified the Victoria Range, Serra Range and the Major Mitchell Plateau as having Remote and Natural attributes worthy of note (LCC, 1991).

No previous attempt has been made to assess the conservation status of the Grampians in terms of the aquatic macroinvertebrate fauna. Suggested methods of using freshwater macroinvertebrates in conservation analysis fall into five main types — diversity, presence of rare and endangered species, presence of local endemic species, groupings of sites with distinct community compositions, and proposed statistical tests of rarity.

Diversity patterns

Generally, sites are considered to be of significance based on diversity measures if they have a large number of species present, or more correctly, a higher number of species present than would be expected. There are insufficient data on the Victorian fauna to establish (in a formal sense) the expected number of species at any particular site. Current work elsewhere under the River Health Initiative is attempting to produce a predictive model, where the likely composition and diversity of a site can be estimated from a series of environmental variables.

However, diversity measures alone may not always indicate the true nature of the site. Numerous examples exist where clearly disturbed sites are not distinguished from undisturbed sites, based simply on the number of taxa present (e.g., Doeg, 1985).

In an overall sense, the 236 taxa of freshwater macroinvertebrates recorded at the 32 sites compares favourably with other intensive surveys in Victoria. For example, in East Gippsland, similar kick samples collected at 48 sites resulted in 269 taxa (T. Doeg, unpublished data) while similar orders of total diversity have been recorded in the upper Goulburn River (Doeg 1985), the Thomson River (Doeg et al., 1987), the Yarra River (Pettigrove 1989) and the Latrobe River (Metzeling et al., 1984). Care should be taken in comparing regional diversity between surveys due to differences in the distribution of site characteristics, sampling methods and taxonomic discrimination, but there is no reason to suspect that the total fauna collected was any more or less diverse than other aquatic sites sampled throughout Victoria.

The number of taxa found at each site (from 8 to 72) was broad (Fig. 2). The site with the highest number of taxa was at Site 21 on Fyans Creek on the Grampians Tourist Road (72 taxa). This was substantially higher than any of the other sites, the site with the nearest diversity, also on Fyans Creek, having only 56 taxa.

Rare, endangered and endemic species

The presence of rare and endangered species is a valid determinant of high conservation status. However, the lack of adequate taxonomic and

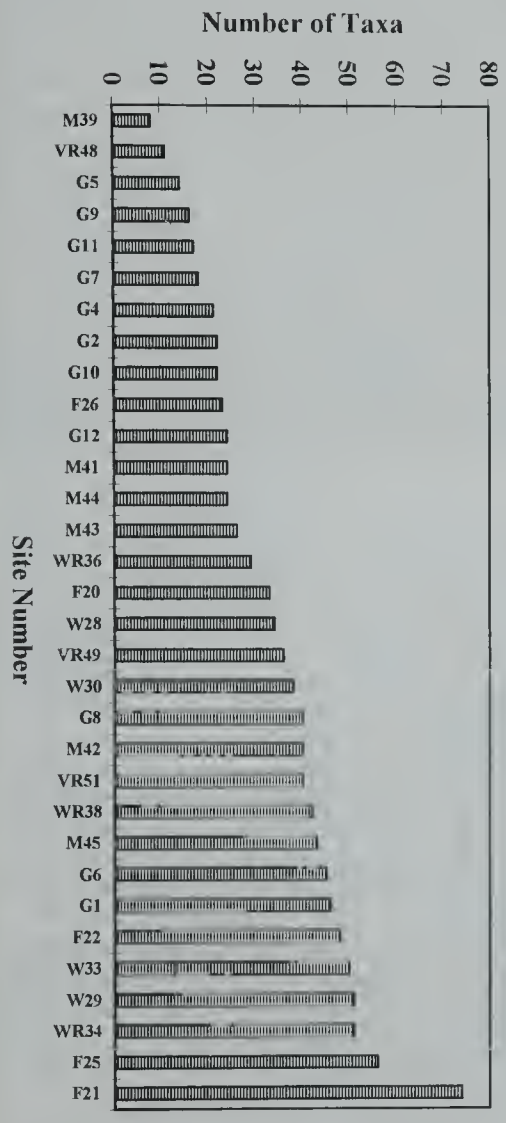

Figure 2. Number of taxa recorded at each site, sorted from lowest to highest. Numbers from Fig. 1 with referenee to the following eatchments: G — Glenelg; F — Fyans Creek; W — Wannon River; WR — Mt William Range; M — MeKenzie River; VR — Victoria Range.

distributional knowledge restricts our ability to identify species that are truly rare or restricted (Butcher and Doeg, 1995). However, no taxon present on the official lists of rare and endangered species (CNR, 1995) was located in this survey. Given the paucity of sampling conducted previously in the Grampians, it is not surprising that rare or endangered species described from elsewhere in the state were not located there.

The majority of species collected have been recorded in other work in other places in Victoria. Significantly, 23 of the taxa (10% of the fauna) were identified as either unrecorded in recognised voucher collections, or as distinct from a known or described species, and may be new species restricted to the Grampians (herein called 'endemic' taxa). As such, they fall into the category of having limited distributions and could possibly qualify for inclusion in lists of rare species. The unique nature of the Grampians biota revealed in both flora and vertebrate surveys is therefore also reflected in the presence of a large proportion of new and possibly endemic freshwater taxa.

Twenty seven of the 32 sites processed contained at least one endemic taxon. The most number of such taxa at a single site was 6, at Site 6, an un-named tributary of the Glenelg River on Hines Track. Nine of the potential endemic taxa were located at single sites within the park.

Of particular interest, the major genus of mayfly, *Austrophlebioides*, was absent from any of the sites sampled. *Austrophlebioides* is common on rocks in stony upland streams but 'are not commonly found at lowland sites or sandy sites' (Marchant et al., 1994), and are often reduced in abundance due to the impact of human disturbance (Doeg, 1985, Doeg and Koehn 1994). However, members of the genus are known throughout Victoria at almost all altitudes, and often form a significant component of the freshwater fauna. Even in some of the more disturbed streams, such as the Mitta Mitta River in north-east Victoria (Blyth et al., 1984), *Austrophlebioides* were still located, albeit in reduced numbers. While it is not unreasonable for the genus to be absent from the silt or sand-based sites, many other sites had conditions suitable for the taxon (particularly at cobble sites). Given the number of sites sampled, the genus should have been located if it was present. Either it has never been present in the Grampians, or some (possibly natural or cyclical) event in the past has lead to its elimination.

Site groupings

The use of multivariate analyses can enable the identification of distinct groupings of sites that have a distinctive fauna within a small geographic area, like the Grampians. Classification by TWINSPAN indicated the formation of 4 distinct groups of sites (Fig. 3). The first division, indicating the most distinct group (Group 1), separated a group of 7 sites on the Glenelg River and one site on the McKenzie River upstream of Wartook Reservoir. Seven of the Group 1 sites were those with predominantly silt and/or vegetation substrata. Unusually, Site 12 (Moora Creek) has a substrate of cobbles and boulders, but a nearby parallel road, suggesting a sedimentation impact.

Even though the majority of Group 1 sites were located in the Glenelg River catchment, other sites (that have not been processed yet) with similar substrates can be found in other catchments in the park. Hence, the separation of the Group 1 probably reflects the distribution of a habitat-type and not a particular area of significance.

The second major division separated the sites on the McKenzie River downstream of the Wartook Reservoir from all of the other sites (Group 2). These sites were in a high gradient, high flow stream, generally with the highest proportion of larger particle sizes (cobbles through to boulders). This division is of more significance, as while this may also be substrate based, there are no similar habitats within the park, and similar faunal compositions at sites outside the McKenzie River catchment are unlikely to be found. Thus, the McKenzie River downstream of Lake Wartook may be seen as an area of some local conservation significance (despite the presence of the reservoir upstream).

Group 3 contained sites on Fyans Creek and the Wannon River (substrates composed primarily of cobbles), with Group 4 comprised of all the remaining sites primarily with a sand or pebble component (mainly the Glenelg River, and William and Victoria Range sites). Such sites are widespread throughout the park.

In general, ordination by Reciprocal Averaging (Fig. 4) reflected the major groupings outlined by the classification, but with little discrimination between the mixed substrata sites. Significantly, the ordination indicated that the community composition at Site 43 (located immediately below a popular tourist complex with a defective sewage system) was distinct from the remaining Mackenzie River sites, which showed a higher degree of similarity. Site 43 was not clearly distinct from the other sites on the basis of diversity measures alone (a total of 26 taxa compared to 24–43 at the other sites in the group), but had a distinctly disturbed fauna dominated by oligochaetes and chironomids.

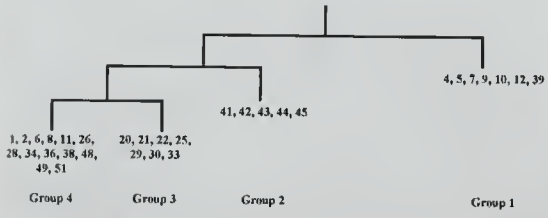

Figure 3. TWINSPAN dendrogram showing the relationship between sites and site groupings. Numbers as for Fig. 1.

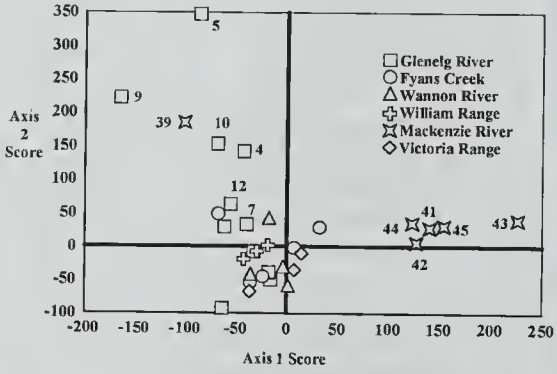

Figure 4. Reciprocal Averaging (RA) plot showing the relationship between sites. Only site numbers for Groups 1 and 2 from the TWINSPAN analysis are shown.

Rarity measures

While the techniques or measurements employed to evaluate conservation significance above are relatively widespread and accepted, the evaluation of freshwater macroinvertebrate communities using statistical indices does not appear to have been used for freshwater macroinvertebrates in Victoria or Australia. Such indices were developed to enable an objective assessment of site values, free from the drawbacks of more subjective value judgements.

Objective tests on conservation criteria were based on the methods described in Eyre and

Rushton (1989). Each of the 236 taxa was assigned a score on a geometric scale (1–16) based on the number of sites out of the 32 at which it was collected, awarding higher scores to species occurring at fewer sites. The highest score (16) was assigned to species occurring at only one of the sites sampled, with 8 points to species occurring at 2–4 sites, 4 to species at 4–7 sites, 2 to species at 8–15 sites and 1 to species at 16–32 sites.

A site score (termed the Species Rarity Total — SRT) was calculated as the simple sum of all the scores of all the species present at the site. Each of the SRT indices were divided by the number of species at each site to obtain a second site score, the Species Quality Factor (SQF). The SRT and SQF were graphed and analysed by eye to detect sites of outlying low or high rarity values.

While such indices have some appeal as a simple estimate of site significance, it is important to understand exactly what the indices reflect. The SRT is a simple sum of the individual species score, so that a site with many rare species scores higher than a site with fewer rare species.

However, the SRT score will also be affected by the total number of taxa, so that a site with many taxa will score higher than a site with fewer taxa, even if they have the same number of rare or restricted species. This is demonstrated in the present case. Site 21 clearly had the highest values for SRT (Fig. 5) of all the sites examined. This site also had the highest number of taxa of any site. But that site did not have the highest number, or proportion, of taxa unique to that site. There were 6 taxa found only at Site 21 (8.3% of the total at the site), the same number as Site 8 (6 out of 40 taxa, 15% of the total), but this is compared with 9 at Sites 6 (44 taxa, 20%) and 30 (38 taxa, 23%). Site 9 had 5 unique taxa (representing 31% of the 16 taxa collected, the highest proportion of all sites).

While Sites 6 and 30 had the second and third highest SRT respectively, Site 8 was ranked sixth, and 9 was ranked 15th among all the sites. Hence, the calculation of SRT values does not seem to reflect all the possible criteria that could be used to determine the rarity of a site.

The Species Quality Factor (the SRT divided by the number of taxa) overcomes many of the problems of using the raw score. By standardising the score, the SQF more reflects the proportion of taxa at a site that are rare. Hence, Sites 9, 30, 5 and 6 all score highest, in that order (Fig. 6), in this calculation reflecting the proportion of unique taxa (31%, 23%, 21% and 20% respectively — the four highest proportions of all sites). This provides a more intuitively satisfying solution to the use of indices, downplaying the presence of common taxa and identifying sites with the largest proportion of the fauna composed of restricted taxa.

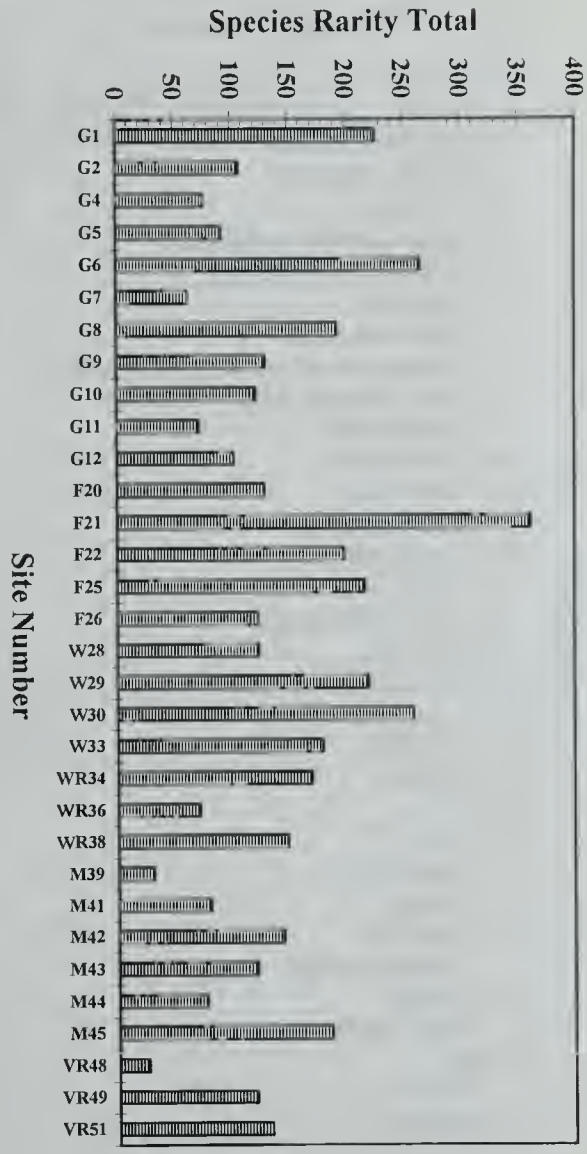

Figure 5. Species Rarity Total for each site.

Conclusions

Depending on the type of measure used, twenty sites with some significance status could be identified (Table 1). One site was shown to be more diverse than all others, six sites had more

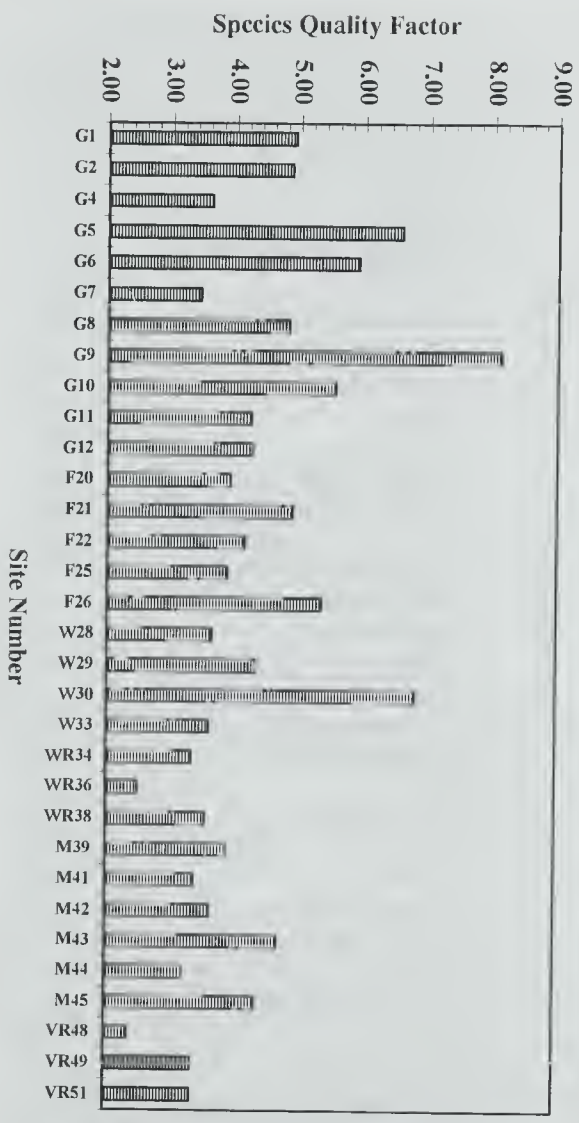

Figure 6. Species Quality Factor for each site.

than 3 endemic species present, seven sites had the only record of an endemic species, the Mackenzie River was shown to be a unique area in the park (with an associated distinct fauna) and other sites scored highly on statistical indices. None of the conservation measures used could, by themselves, identify all of the sites within the park with characteristics of conservation significance. It is clear that for aquatic macroinvertebrates to be used to identify areas or sites of conservation significance, far more information on the characteristics of natural undisturbed communities needs to be collected.

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Table 1. Summary of sites displaying some degree of uniqueness based on each of the types of analysis used in this report.

Site	Diversity	Endemic species present	Only site for endemic species	Members of distinct group	SRT	SQF
1					4	
2			1			
5						3
6		6	2		2	4
8			1			
9			2			1
10			1			
11						
21	+	4	1		1	
25		5				
30					3	2
33		4				
34			1			
36		4				
41–45				+		
49		4				

Explanation of codes: *Diversity* — The site with the highest number of taxa; *Endemic species present* — More than 3 possible endemic species present; *Only site for endemic species* — Number of local taxa restricted to only that site; *Members of distinct group* — Mckenzie River sites; *Rarity SRT* — Top four ranked scores for Species Rarity Total; *Rarity SQF* — Top four ranked scores for Species Quality Factor.