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Community Macroinvertebrate Sampling Contributing to Localised Assessment of River Health Condition and Trend

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ABSTRACT: With the increasing desire of community groups to contribute to monitoring the condition and trend of riverine ecosystem health, Waterwatch Queensland procedures have been revised for use in an integrated catchment monitoring program. Procedures were reviewed and historic macroinvertebrate data and the 2006 river health survey data was analysed for the Border Rivers and the Maranoa Balonne catchments. A number of anomalies were identified and amendments to taxa groupings have been made in an amended record sheet.

Using the groupings from the amended record sheet, historic data collected by scientists and community groups alike has been retro analysed to obtain average SIGNAL index scores. In this way data from 2006 and 2007 community monitoring and ongoing monitoring by scientists has been used to provide an indicative condition and trend assessment of individual river catchments.

This project has built on the historic Waterwatch development of a robust macroinvertebrate monitoring system. It has allowed the development of draft local water quality guidelines to include macroinvertebrate guidelines at a finer scale than previously obtained through more rigorous scientific monitoring programs. Community monitoring is not likely to replace rigorous scientific studies, but continued improvement has allowed community monitoring results to contribute to river health assessment. It is anticipated that community monitoring results will help to identify local areas of success or of concern that warrant further investigation or on-ground action.

ACKNOWLEDGEMENTS

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INTRODUCTION

Community capacity and enthusiasm to be involved in river health monitoring indicates a desire, and even an imperative, to ensure monitoring is a part of engaging the community in river health management. Chin *et al*, highlighted this in the 2005 National Waterwatch Conference when they outlined that:

“Community monitoring programs have generated increased awareness and understanding of catchment and water quality issues and instilled a sense of trust and ownership in the information collected and promoted wider community stewardship and responsibility for the future health of our waterways and catchments. ... However the usefulness of community generated data ... is often called into question... [with] concerns over the reliability and integrity of the data. ...In contrast state agency and regional monitoring programs have usually been developed with a focus on scientific rigor ... [but] the capacity of this information to influence on-ground change and improvement in water quality has often been called into question. ...Clearly, there are opportunities to integrate these characteristics...” [1]

Chin *et al* went on to tabulate attributes of a monitoring program with respect to the program’s capacity to contribute to natural resource management (NRM). This table (Figure 1) presents the different monitoring programs as pieces of a pie. To integrate – the word means to make whole – these waterway monitoring programs would create a greater capacity to influence change. It should be noted that the spatial and temporal capacity of community monitoring has not yet been realized in most areas due to data confidence and analyses limitations. Consequently, whilst the community ownership is strong, the trust and subsequent capacity to influence change has been limited.



 Community monitoring	 Strategic State and Regional monitoring
Attributes:	
<ul style="list-style-type: none"> ✓ Community trust ✓ Ownership ✓ Capacity to influence change ✓ Spatial and temporal capacity ? Data confidence 	<ul style="list-style-type: none"> ✓ Scientifically rigorous ✓ Established infrastructure ? Access to information ? Capacity to influence on-ground change

Figure 1 Attributes of independent community and agency monitoring programs [1]

Table 1 lists the key attributes from Chin *et al* and gives them a nominal rating for historic monitoring programs and for the potential of an integrated monitoring programs in the QMDC region. Acknowledging that these ratings are subjective, it is hoped they can highlight the potential benefits of an integrated approach to waterway monitoring. Capacity to influence changes is presented as the sum of the other attributes.

Attribute	(Historic) Community Monitoring	Regional (Scientist's) Monitoring	Integrated Monitoring (Potential)
Community Trust	1	1	2
Ownership	2	0	2
Spatial Capacity	0	1	2
Temporal Capacity	0	0	2
Data Confidence (rigorous)	0	2	2
Capacity to influence change	3	4	10

Table 1 Provisional Monitoring program attributes in the QMDC region (Ratings: 0 – poor; 1 – fair; 2 –good)

The Queensland Murray Darling Committee (QMDC) is making a concerted effort to realise the potential of integrated waterway monitoring. As a part of ongoing encouragement and support for landholders moving towards environmentally responsible land management, over 50 landholders have received training in waterway monitoring. Monitoring is intended to engage participants in assessing the level of achievement of regional Natural Resource Management Plan (NRM Plan) targets that:

“By 2020, river health at representative sites of the Maranoa-Balonne and Border Rivers catchments is maintained or improved relative to baseline conditions to be set by 2010. ... Specific Resource Condition Targets are to be developed by 2010, for macroinvertebrates ...” [2]

The light green shaded areas in Figure 2 show the Maranoa-Balonne and Border Rivers catchments. QMDC is working with many landholders and industries in these catchments to achieve the above mention, and other NRM Plan targets. The darker green and brown shaded areas show the properties whose owners or managers are currently working with QMDC to reduce

environmental threats and enhance production. A significant challenge now lies in engaging these stakeholders in monitoring programs that will maintain the “stewardship and sense of responsibility” whilst building “reliability and integrity.”

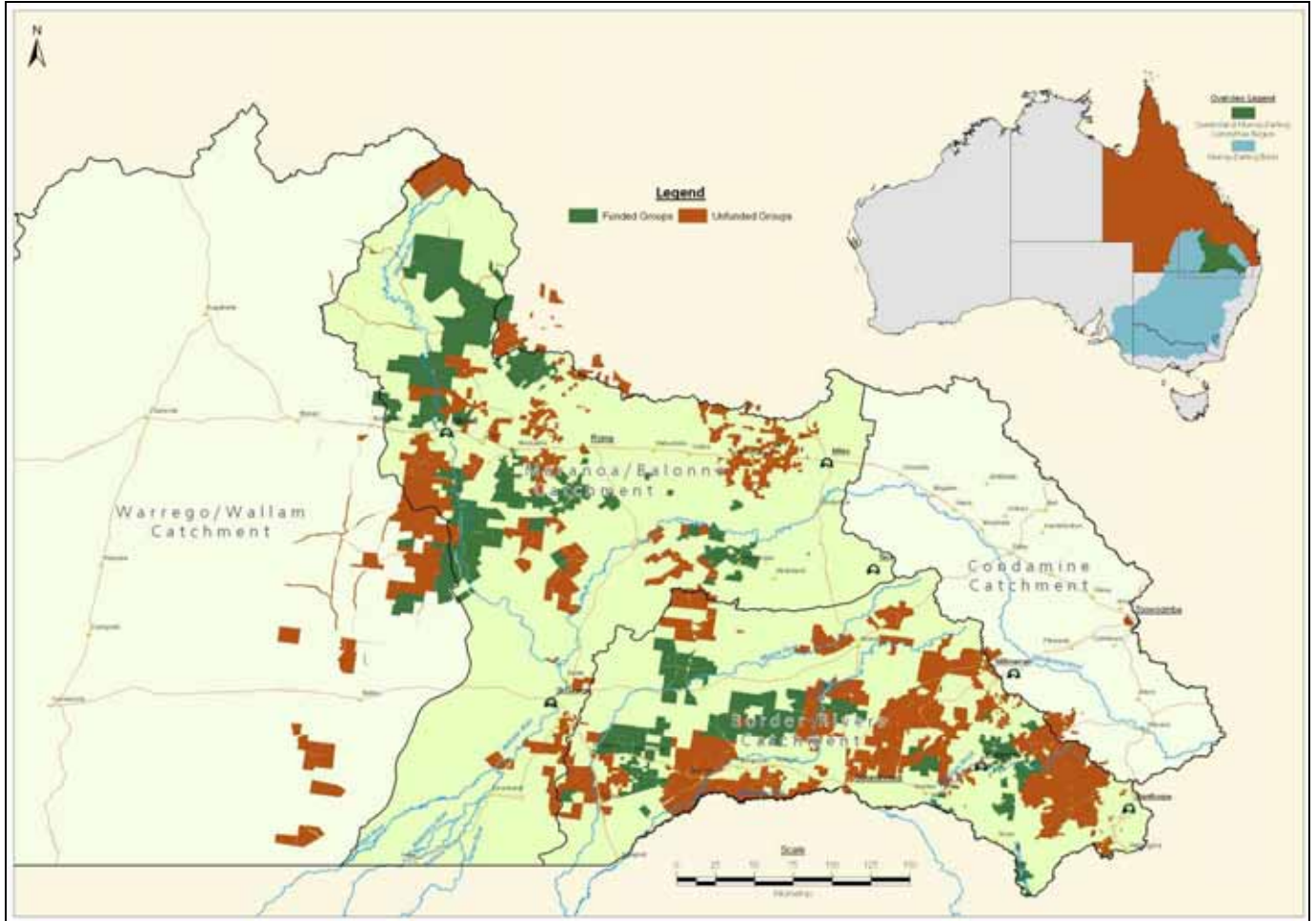


Figure 2 Maranoa-Balonne and Border Rivers catchments within the Queensland Murray Darling Basin

To test and enhance the capacity of community monitoring data to assess achievement of the NRM Plan target for maintaining or improving river health, QMDC has co-ordinated community monitoring and has analysed data from September 2006 to September 2007. Historic and current data from other more rigorous scientific monitoring programs has also been used to establish nominal baseline conditions and to validate the results of community monitoring data.

Results indicate that community monitoring can be used in conjunction with more rigorous monitoring to assess whether river health is being maintained or improved in the Border Rivers and Maranoa-Balonne catchments. However, more work is required to enable community monitoring data to be used alongside other data for monitoring condition and trend. More work is also required to determine whether climate (expressed in stream flow) or land management practices are driving changes in river health.

Water quality and riparian function have also been included in river health assessments but only macroinvertebrates are reported in this paper.

METHODS

Chessman [3] outlines the international acceptance of macroinvertebrates as a measure of river condition. He also outlines how a SIGNAL score can be used to give an indication of stream condition from a given sample.

“There are many different types of macroinvertebrates. Each type requires particular environmental conditions in order to survive, grow and reproduce. Some types are tolerant of water pollution whereas others are very sensitive. So biologists can tell a lot about the environmental conditions in a water body from the types of macroinvertebrates present and their abundances.” [3]

Chessman outlines that it is desirable to identify macroinvertebrates down to family level but that a coarse measure of stream condition is possible using order or higher level identification. The coarser order-class-phylum identification is often adopted as the best attainable level of identification onsite by samplers with limited training. (Queensland) Waterwatch, 2005 [4] outlines sampling methods and scoring that includes mostly order-class-phylum but with some orders broken down to families or groups of families.

The Waterwatch 2005 methods and scoring were adopted as the provisional standard for QMDC community monitoring. However, some alterations were made during the planning and in subsequent sampling to simplify or better explain sampling methods and to incorporate QMDC data sheets. Samples from the first round of sampling performed in September 2006 as a “rapid river health survey” were preserved and identified by an independent experienced Waterwatch coordinator. 10% of samples were also re-identified by an AUSRIVAS accredited scientist as a Quality Assurance (QA) check on the identification process. After the 2006 samples and historic samples from State Government and Murray Darling Basin monitoring programs were analysed, the Waterwatch 2005 score sheet was revised. Some order groupings were merged and others added or deleted according to what was, or was not found in the collated data for the region.

Revised procedures and scoring were incorporated into the QMDC Monitoring Guide (2007) which is the recommended standard for community monitoring in the Border Rivers and Maranoa-Balonne catchments. Extracts from this guide are included as Appendix 1. Neighbouring Murray Darling Basin catchments to the West are also likely to adopt this standard. Catchments to the East are currently using the aforementioned, and similar, Waterwatch 2005 scoring system.

Sampling methods are similar to the AUSRIVAS methods used in the more rigorous monitoring programs, with a significant difference being that the QMDC 2007 surveys sampled all available habitats (composite) whilst Queensland AUSRIVAS currently only samples edge habitats. Historic samples were a mixture of composite and individual habitat samples but were dominated by edge samples. Composite samples are seen as the most practical for community monitoring as they allow the ongoing education value of identifying different habitats and the maximum variety in taxa found.

An attempt was made in the 2006 River Health Survey to take edge samples at 10% of sites. This was hoped to help correlate results with the Sustainable Rivers Audit (SRA) samples taken by scientists using Queensland AUSRIVAS procedures. However, due to the drought conditions, edge samples were difficult to obtain with confidence in many streams. The very low water levels meant that there was very little variation between edge and bed samples. Separate edge samples were only taken at two of the 60 sites and both of these sites were in apparently healthy streams

benefiting from supplemented flows. The samples were deemed to be insufficient in number and non representative so they were not used in comparisons with SRA data.

Due to the variation in habitats sampled little confidence was held that taxa richness results would be comparable but it was hoped the average SIGNAL Grade scores would be comparable. Validation of these expectations was attempted by the use of recent AUSRIVAS sample data from the Murray Darling Basin's Sustainable Rivers Audit (SRA).

Results were rationalised against available hydrological data which showed that the dry conditions are possibly the dominant cause for 2006/07 results being poorer than historic results.

RESULTS

Analyses Method

For provisional analyses, 2006/07 results were compared with 1990s results. That is, the community monitoring data was compared with the historic AUSRIVAS data. Recent AUSRIVAS data was withheld for comparison with the 2006/07 community monitoring results for validation purposes. The 1990s data was adopted as the reference data set. The median of the 2006/07 test data is expected to fall within the 25th to 75th percentile "box" of the reference data set if no (statistically) significant change has occurred. If median signal grades were below the reference box, it indicates a decline in river health. Conversely, if median SIGNAL Grades were above the box, it indicates an improvement in river health. Results are categorised into 5 "scores" or condition ratings based on this analysis of a number of samples. No individual sample is used to determine river health. Samples must be grouped temporally or spatially to establish a reference and test dataset with preferably at least 20 and 5 sample results respectively. From Figure 3 below:

- 5 Excellent - a significant improvement in river health
- 4 Very Good - some improvement in river health
- 3 Good - no significant change in river health
- 2 Fair - slight decline in river health
- 1 Poor - a significant decline in river health

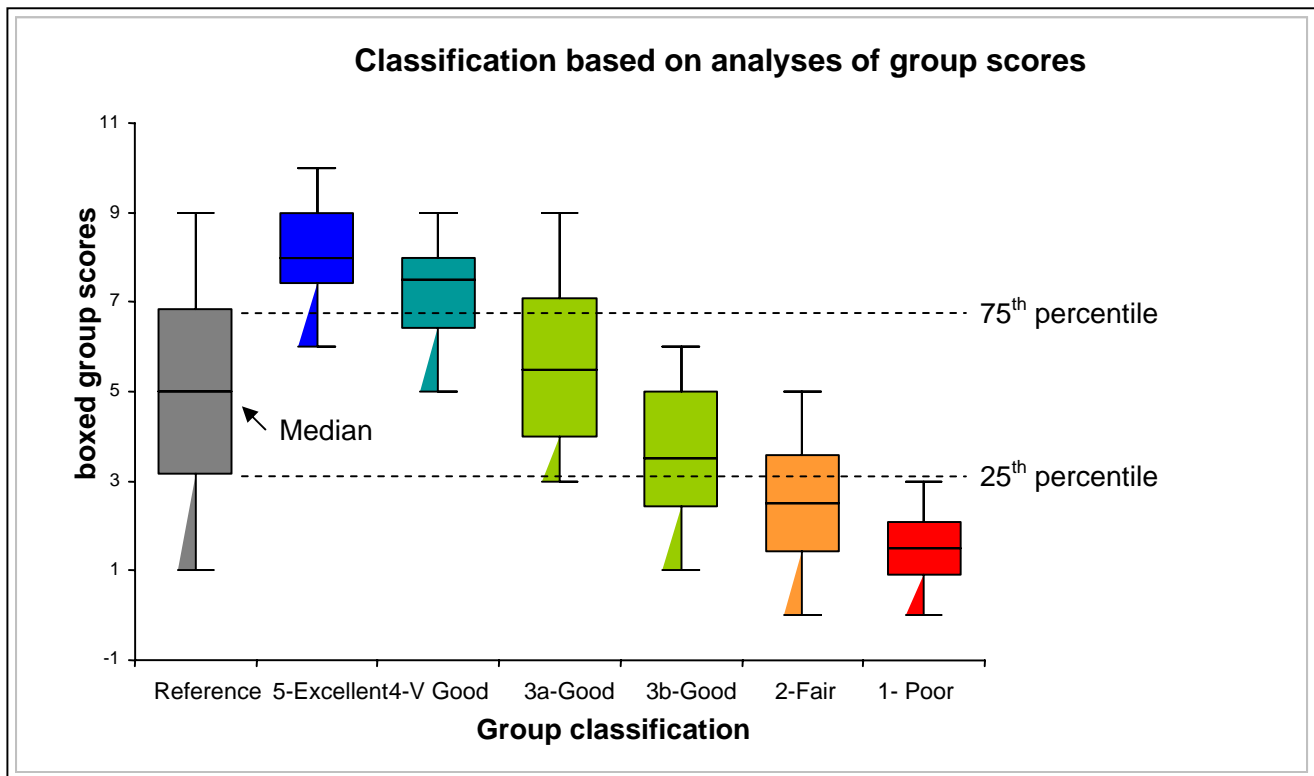


Figure 3 Nominal scoring and colour key for test results against a reference data set.

Regional Results, Checks and Validation

2006/07 results for the region sampled were bordering on slight decline in river health against the 1990s adopted standard. That is, the median for the test data set was the same as the 25th percentile for the (1990s) reference dataset (see Figure 4). Looking at the median values with 2000 to 2005 data also included there would appear to be a declining trend in the catchment river health.

This is of some concern to NRM advocates and landholders alike given that a lot of work has been done to improve land management practices in all industries throughout these catchments. Comparison with flow data shows some parallels between annual flows and SIGNAL Grade scores. This indicates any decline in river health from 2006/07 results is likely to be due, at least in part, to hydrological conditions and not necessarily poor catchment management. Due to the ephemeral nature of the streams, scoring of flows based on 25th and 75th percentile box plots is not appropriate. Even in the wetter period, the 25th percentile monthly average flow is close to zero. What can be noted in Figure 5 is that the frequency of high flows, as indicated by the tops of the boxes has been significantly lower in the 2000s and particularly in 2006/07. The diamond plots of 95% confidence limits of means are included on this plot to show this parametric measure of central tendency. Although very different to the non-parametric box plots, they confirm that 2006/07 had lower flows and that flow trends align with the indicative trends of river health obtained from SIGNAL Grade scores. Plots were prepared using Analyse-it, Excel addin software [6].

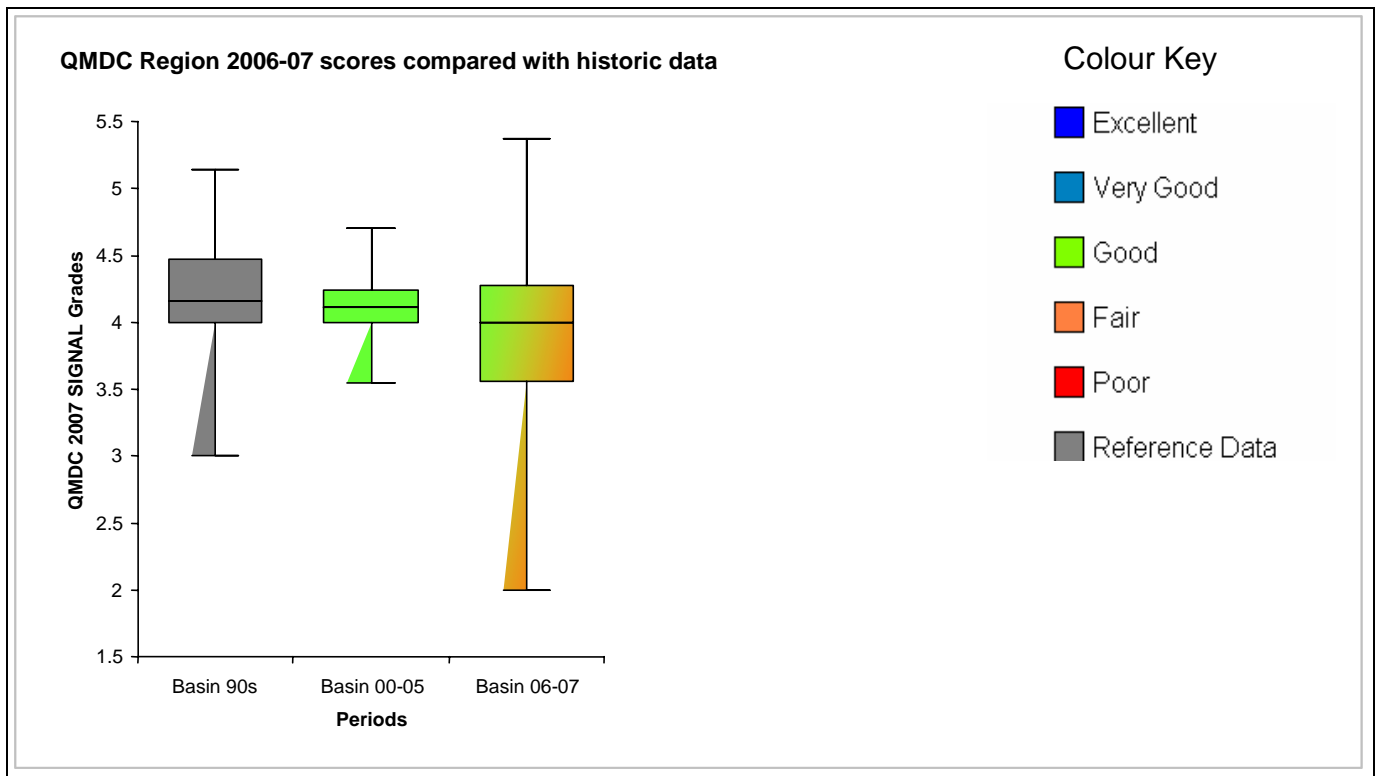


Figure 4 Average Signal Grades for all samples in QMDC region

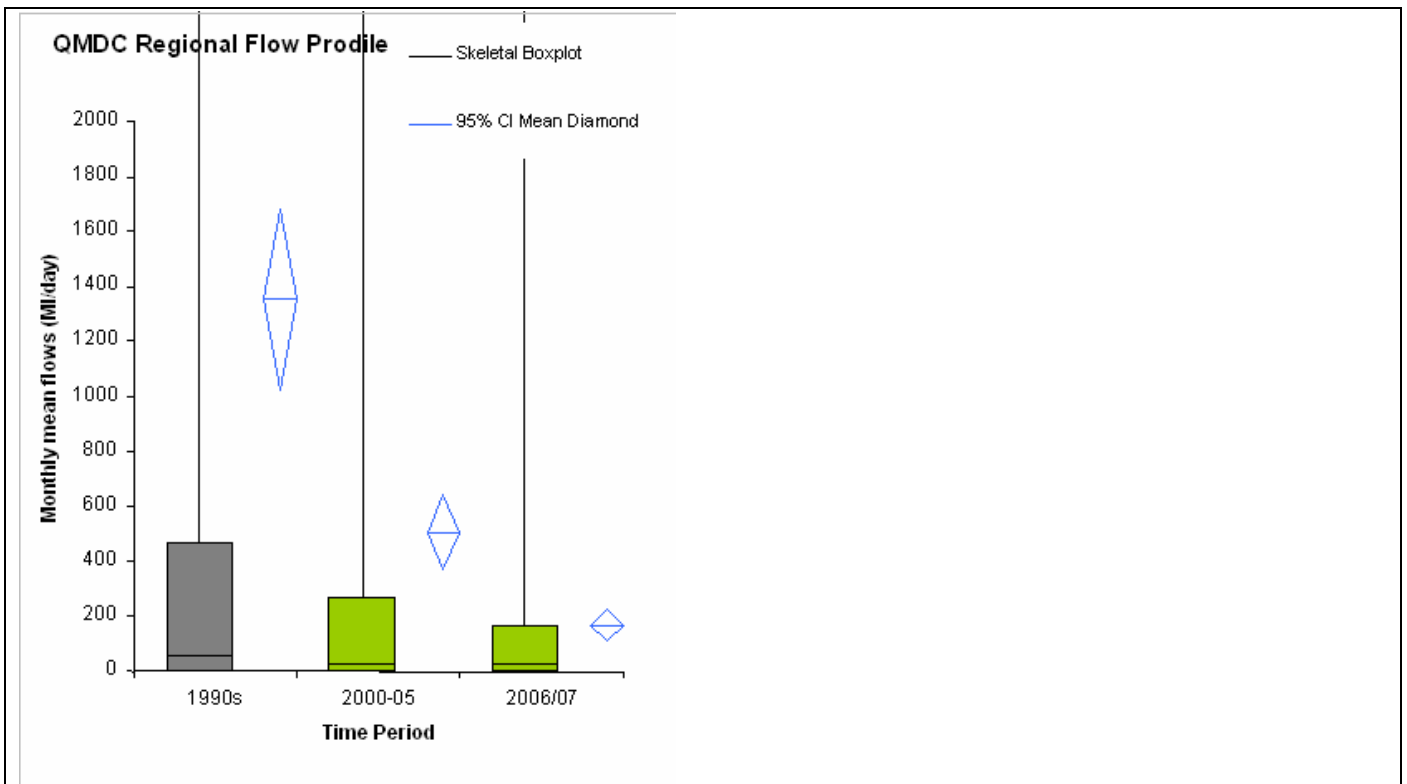


Figure 5 Average monthly flow volumes for representative sites

Some correlation between flows on the month of sampling and SIGNAL Grade scores was found (see Figure 6). However, this is a poor correlation and, although it confirms that flows influence scores, it does not provide scope to adjust scores to isolate the influence of flow. It is likely that the influence of flow is a combination of preceding months' flows which will improve river health and flows at the time of sampling which may result in a poor sample with corresponding low scores. Further investigation of the links between SIGNAL Grades and flow conditions would be enhanced if both data sets could be analysed on a shared platform with time series flow data analysis capability.

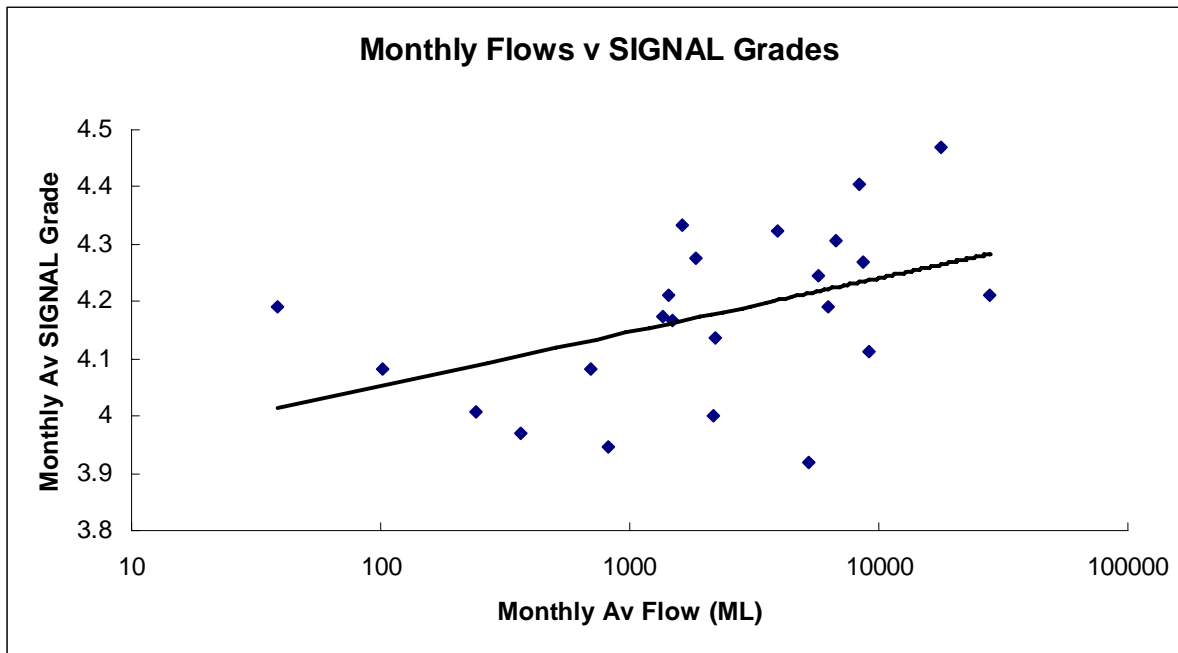


Figure 6 Monthly mean flow correlation with monthly mean of Signal Grades

A number of validation checks have been performed on the 2006/07 community monitoring data. A number of plots from the Draft QMDC River Health Survey Report are included as Appendix 3. Key findings only are discussed here.

SRA edge sample results were lower than community monitoring composite sample results (see edge 06-07 and comp 06-07 in Figure 7 below). However, the difference is not significant, being similar to 3b in Figure 3 above. This gives some confidence in the community sampling results and strengthens the indication of a decline in river health in 2006/07.

To determine whether the higher scores from 2006/07 community data were due to them being from composite (multiple habitat) samples and the SRA data being from edge samples, these results were plotted with historic samples having edge samples separated. It was found that the edge and the composite samples both showed a declining trend but that the edge samples seemed to decline more in the 2006/07 dry conditions (see Figure 7). This aligns with anecdotal information as the attempt to take edge samples at 10% of sites was thwarted by the difficulty in finding edge habitats in receding waterholes of ephemeral streams. It is assumed that the variation between community data and SRA data in 2006/07 is due to the edge habitat decline and that

trend analysis against all (combined) historic data is legitimate. However, future duplicate or shadow sampling at a number of representative sites is required to validate this assumption.

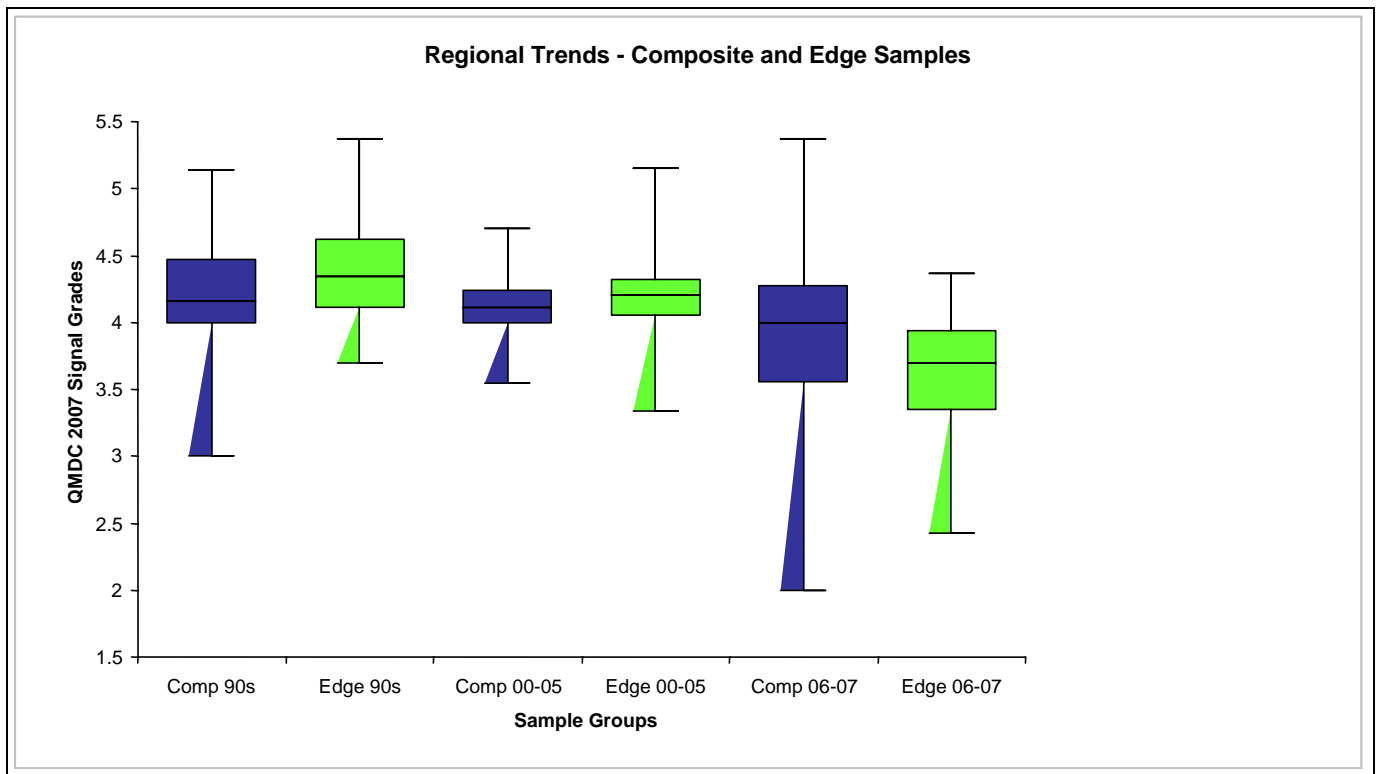


Figure 7 Trends in Signal Grades for edge (green) and composite/combined (blue) samples

Some other findings based on plots included in Appendix 3 include:

- Community monitoring samples re-evaluated by an AUSRIVAS accredited biologist showed community samplers found less taxa but that this did not seem to impact on average signal grade scores.
- Community monitoring generally seems to result in less taxa found than AUSRIVAS samples.
- The QMDC 2007 scoring generally results in higher scores than and broader spread of scores than the same data analysed to order-class-phylum.

River Catchment Results

Regional (indicative) trends were not replicated in each river catchment. Although most river catchments showed indications of 2006/07 scores being lower than the 1990s reference, one catchment had higher median scores. Figures 8 and 9 show how results can be broken down into smaller catchments to highlight areas of success or concern. The catchment shaded red in 2006/07 is of concern and warrants further investigation. Investigations will start with a check on data management and analyses and on relative decline in flows compared to neighbouring catchments. More support may be required for monitoring in this catchment to increase site density and thus identify areas in good condition and areas of concern within the river catchment.

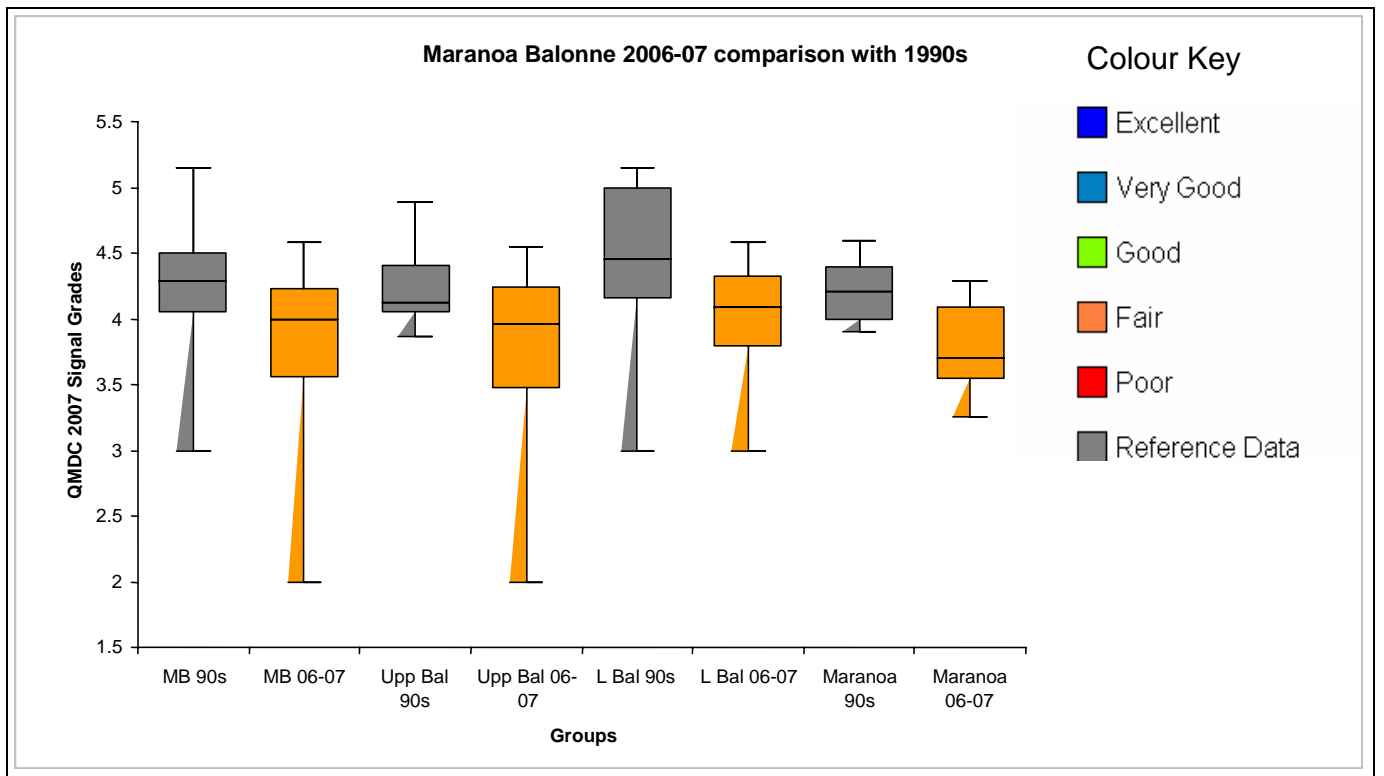


Figure 7 Average SIGNAL Grades of the Maranoa Balonne and Contributing River Catchments

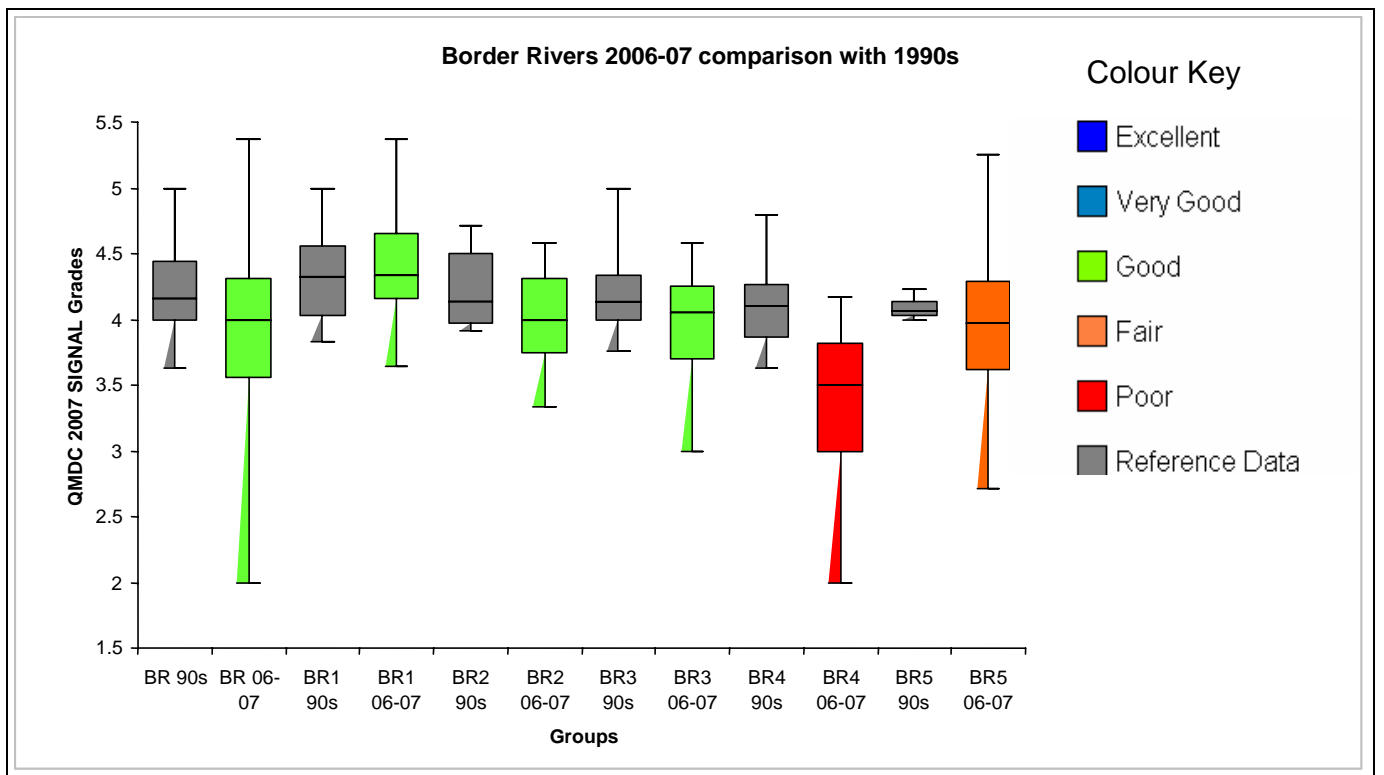


Figure 8 Average SIGNAL Grades of the Border Rivers and Contributing River Catchments (Catchments not named pending presentation to primary stakeholders)

DISCUSSION AND CONCLUSIONS

Community monitoring using SIGNAL grades can help with condition and trend reporting although results should be used with caution until ratified at catchment scale with results from AUSRIVAS accredited monitoring programs. Links with other monitoring programs is essential to validate results, to ensure continuous improvement, and, to enhance the acceptance of results in local and scientific forums.

Reviewing the attributes for a monitoring program's capacity to contribute to NRM, Table 2 below revisit this with a nominal status for community and scientific monitoring as it was applied in QMDC region in the 2006/07 assessment which integrated community and scientists' data.

Attribute	(Historic) Community Monitoring	Regional (Scientist's) Monitoring	QMDC 2006/07 assessment	Integrated Monitoring (Potential)
Community Trust	1	1	1	2
Ownership	2	0	1	2
Spatial Capacity	0	1	1	2
Temporal Capacity	0	0	1	2
Data Confidence (rigorous)	0	2	1	2
Capacity to influence change	3	4	5	10

Table 2 Review of Provisional Monitoring program attributes in the QMDC region

The trust and ownership of these results is at best fair as they have not yet been presented to stakeholders. Presentation of these results is the next essential if trust and ownership is to be secured. Ownership and trust in results will be better for those involved in monitoring.

Community monitoring results allow comparison of river catchments within a broader region. This enhanced spatial capacity should help to make results more meaningful for land managers. However, increased site density would allow finer resolution in assessments and should be encouraged, particularly in catchments where this assessment has raised concerns about the river health.

Integration of data from different sources has allowed indicative temporal assessments of the region and the river catchments. More work is required to isolate climate and flow impacts if we are to use results to determine impact of land use on river health. This Temporal capacity will be enhanced if data can be merged on a common platform and possibly analysed along with time series flow data.

Validation checks have given some confidence in the community data. However, more shadow testing is required with both edge and composite sample results compared. Comparisons should be between scientist's and community sample results and between result from edge and composite samples.

Ongoing support is required to further improve community monitoring networks that will integrate with more rigorous programs. This will allow community monitoring to contribute to localised assessment of river health condition and trend. Community involvement can then realise the potential for integrated monitoring to contribute to improvements in Natural Resource Management.

REFERENCES

1. C. Chinn, R. Cawley & N. Johnston, Regional Monitoring Partnerships for Waterway Health, p1-2, *Proc 2005 National Waterwatch Conference*, accessed online 18th October, 2007 at <http://www.waterwatch.org.au/publications/2005conference/pubs/chinn-cawley-johnston.pdf>
2. Queensland Murray Darling Committee *Regional Natural Resource Management Plan – target Review Report (2006)* p25, QMDC, Toowoomba, Queensland.
3. Chessman B, 2003, *SIGNAL 2 – A Scoring System for Macro-invertebrate ('Water Bugs') in Australian Rivers, Monitoring River Health Initiative*, p3-4, Technical Report no 31, Commonwealth of Australia, Canberra.
4. Waterwatch Queensland, 2005, *Waterbug & Riparian Vegetation Snapshot Parts A & C*, accessed online 18th October, 2007 at <http://www.qld.waterwatch.org.au/news/index.html>
5. Queensland Murray Darling Committee, 2007, *Queensland Murray Darling Basin Water Quality and River Health Monitoring Guide* p24,25 and 29, QMDC, Toowoomba, Queensland
6. *Analyse-it for Microsoft Excel (version 2.00)*, 2007, Analyse-it Software, Ltd. <http://www.analyse-it.com>

APPENDICES

Appendix 1 – Extracts from the Queensland Murray Darling Committee Water Quality and River Health Monitoring Guide [5]

Water Bugs (Macro-invertebrates)

Materials

- Dip nets – either commercially bought nets from aquarium suppliers (fine mesh) or home-made nets prepared prior to the field activity
- Small buckets (e.g. large yoghurt containers)
- Small paint brushes
- White ice cube trays
- Forceps
- Hand lens
- A large white shallow tray eg tote-box
- Camera, GPS unit and maps if available

Process

Sampling

- Use the net to collect a sample of water bugs from your local stream. To collect a sample of water bugs start downstream and work upwards, as the flow will carry animals and material into your net. If there is not enough flow to wash macro-invertebrates into your net, sweep it through the water as you walk upstream.
- Sweep the net for 5 minutes through the water, sweep around vegetation, near the banks and along the bottom.
- If you are sampling amongst water plants, beat gently and scrape your net against the base of the plants to dislodge any invertebrates clinging to the surface.
- If you are sampling in the sediment, shuffle and kick the ground vigorously with your boots to stir up the dirt, debris and material.
- Remember to turn over and scrub rocks and logs in the water; these provide homes for many animals.

Sorting

- Place a small amount of water into the white tray and empty the contents of your net into the sorting tray. Do not overfill the trays, instead divide the remaining material between a number of trays. This will enable you to view any macro-invertebrates that are 'hiding'. Wash down the sides of the net with some water to make sure you get your entire sample into the tray. Keep the bugs in a shady spot.
- If there is a lot of mud in your sample, let it settle for 10 minutes; this will make it easier for you to find the animals.
- Put some water in the ice cube trays and carefully remove the bugs from the net into the tray. Sort the captured bugs on the white tray into their various types using the paintbrush, tweezers or pipettes (BE CAREFUL NOT TO HARM THE BUGS). Pick and sort through the collected material for at least 20 minutes. Some bugs are great at camouflage and may take time to find.
- Put each type into a separate compartment in the ice cube tray.
- Return all duplicate bugs remaining in the large tray to the stream.

- Using the identification charts (Resource Sheet 4 – see your Waterwatch Coordinator for more detailed identification charts) identify your captured bugs. The water bug identification chart is divided into four groups according to how sensitive they are to pollution; very sensitive, sensitive, tolerant and very tolerant.
- List the name and number of each water bug species that you collected in the water bug survey table.

Recording

There are several versions of the recording sheet. QMDC has developed the attached 2007 sample sheet from the WaterWatch Queensland 2005 sheet adapted to accommodate bugs found in the Queensland Murray Darling Basin from the First National Assessment of River Health 1994 to 2004 and the QMDC 2006 River Health Survey.

Record the findings of your sampling on the relevant Aquatic Invertebrate Record Sheet and carefully return bugs to the waterway

Interpreting your Results

The results sheet provides basic interpretive information. The following provides further information about the sensitivity scores and the SIGNAL Index.

Pollution Sensitivity or SIGNAL Index

Although habitat condition can sometimes be the overriding factor in determining macro-invertebrate diversity, the presence or absence of certain species can be directly attributed to water quality. The sensitivity of different groups of macro-invertebrates to water pollution varies. Some species are extremely tolerant of pollution while others are extremely sensitive.

The impact of water pollution on a site can be assessed by determining if animals sensitive to pollution have been lost from the site using the SIGNAL Index (Stream Invertebrate Grade Number Average Level). The SIGNAL Index has been developed specifically for the macro-invertebrate fauna in Australian rivers.

Each family of macro-invertebrates has been allocated a pollution sensitivity grade number based on how sensitive each taxon is to various pollutants. Pollution sensitivity grade numbers range from 1 (most tolerant of pollution) to 10 (most sensitive to pollution). The SIGNAL Index value is calculated simply by averaging the pollution sensitivity grade numbers of the families of macro-invertebrates present at a site. The higher the SIGNAL value, the better the condition of a site.

QMDC is currently developing local water quality guidelines for the Border Rivers which will include the range of signal index scores expected in Border Rivers and Maranoa Balonne catchments.

Aquatic Macro-invertebrate Record Sheet QMDC 2007

Stream	Location	Site No.	Lat	Long	Datum
Date/time (yyyymmdd hhmm)	Water Level	Source	Sampler	IDed by	
Common Name	Scientific Order (unless indicated)	Signal grade	Seen	Signal Grade	
Mayfly nymph	Ephemeroptera	10			
Caddis fly larva	Trichoptera	10			
Stonefly nymph	Plecoptera	9			
Damselfly larva	Odonata	4			
Dragonfly larva	Odonata	4			
Lacewing	Neuroptera	6			
Toebiter/alderfly/dobsonfly	Megaloptera	6			
Riffle beetle adult/larva	Coleoptera	8			
Whirligig/other beetle adult/larva	Coleoptera	5			
Scavenger water beetle adult/larva	Coleoptera	3			
Diving/crawling w beetle adult/larva	Coleoptera	2			
Crane fly larva	Diptera	6			
Black fly larva	Diptera	5			
Biting midge larva	Diptera	4			
Soldier fly and other fly larva	Diptera	4			
Mosquito larva/pupa	Diptera	3			
Non-biting midge larva	Diptera	3			
Water mite	Acariformes	6			
Water flea	Cladocera (suborder)	5			
Copepod	Copepod (subclass)	4			
Seed shrimp	Ostracoda (class)	4			
Proboscis worm	Nemertea (phy)	7			
Flatworm	Turbellaria (class)	3			
Roundworm	Nematoda (phy)	3			
Segmented worm	Oligochaeta (cl)	1			
Water caterpillar (moth larva)	Lepidoptera	3			
Leech	Hirudinea (class)	2			
Water measurer	Hemiptera	4			
Water strider/water treader	Hemiptera	4			
Water scorpion/giant/other w bugs	Hemiptera	3			
Back swimmer	Hemiptera	2			
Water boatman/creeping w bugs	Hemiptera	1			
Scud	Amphipoda	4			
Isopod	Isopoda	3			
Freshwater yabby and crayfish	Decapoda	4			
Shrimp & prawns	Decapoda	4			
Freshwater crab	Decapoda	2			
Freshwater mussel	Bivalvia (class)	3			
Freshwater snail	Gastropoda (class)	2			
Hydra	Hydrozoa (class)	2			
Springtail	Collembola (class)	1			
	Totals		n=	Σ	
SIGNAL SCORE		QUALITY			
To be reviewed for QMDB		Healthy habitat			
To be reviewed for QMDB		Mild pollution			
To be reviewed for QMDB		Moderate pollution			
To be reviewed for QMDB		Severe pollution			

Habitat sampled %	
Edge	
Bed/pool	
Macrophyte	
Riffle	
Total	100

Site condition	
Taxa Richness	
0-5	Poor
6-10	Fair
11-15	Good
15-23	Excellent

Catchment condition	
Pollution Index	
To be reviewed	Poor
To be reviewed	Fair
To be reviewed	Good
To be reviewed	Excellent

Taxa Richness (n)	
PollutionIndex(ΣSG)	
Signal score(ΣSG/n)	

Appendix 2 - QMDC 2007 changes from Waterwatch 2005 bugs score sheet (from unpublished notes)

Notes from results of QMDC 2006 river health survey against WaterWatch Qld 2005 scoring
Based on these notes, some changes have been made to the MacroInvertebrate Field sheet
The new QMDC 2007 sheet is used for 2006 river health survey scoring and is the recommended
Field sheet for community based instream biota monitoring

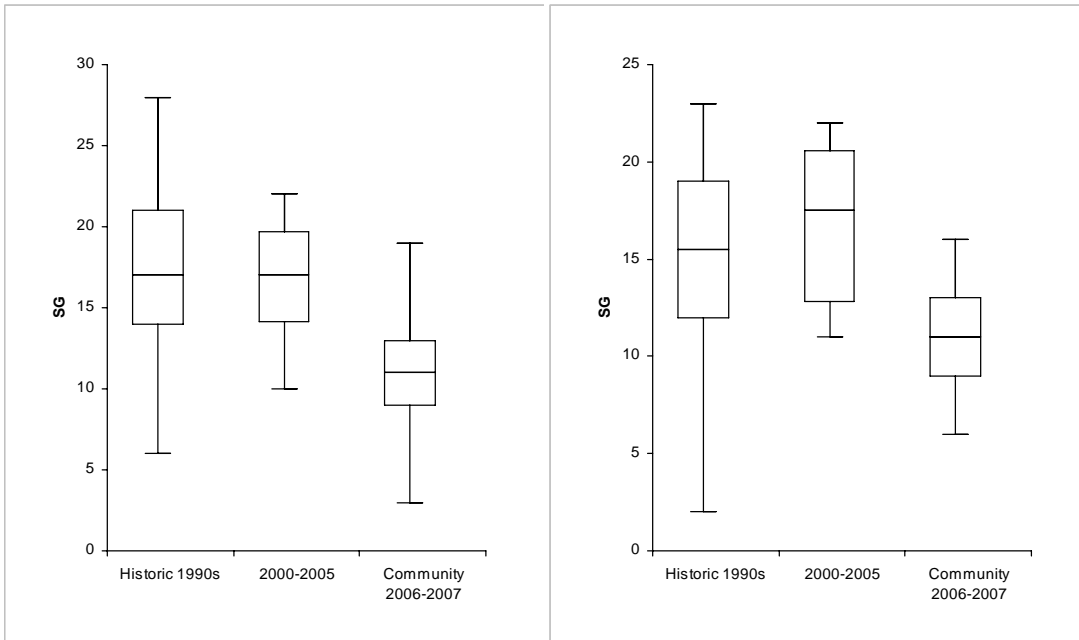
- Belostomatidae (Giant Water Bugs) Signal 1 - aligned with Water Scorpion
- Naucoridae (Creeping Water Bugs) Signal 2 - aligned with Water Boatman
- Veliidae (Small Water Striders and Mesoveliidae (Water Treaders) Signal 3 & 2 - aligned with Water Striders
- Notonectidae (Back Swimmers) and Pleidae (Pygmy Back Swimmers) - All as Back Swimmers
- Unidentified Fly Larvae - aligned with Soldier Fly Larvae
- Unidentified Beetle Larvae (eg Marsh Beetles) - aligned with Whirligig Larva
- Rove Beetles and various other beetles -not Diving or Scavenger Water Beetles - aligned with Whirligig adults
- Collembola (Springtails) ignored - No signal index for these - noticed onsite as multiple small blue on surface
- Moth Larvae (Water Caterpillar) Signal 3 - New classification added
- Roundworms not seen in any sample grouped with Segmented Worm to avoid excess classifications
- It was noted that finding and identifying water mites in a lab was difficult, especially with muddy samples

Further changes to QMDC 2007 sheet have been made to accommodate macroinvertebrates found in historic AUSRIVAS surveys.

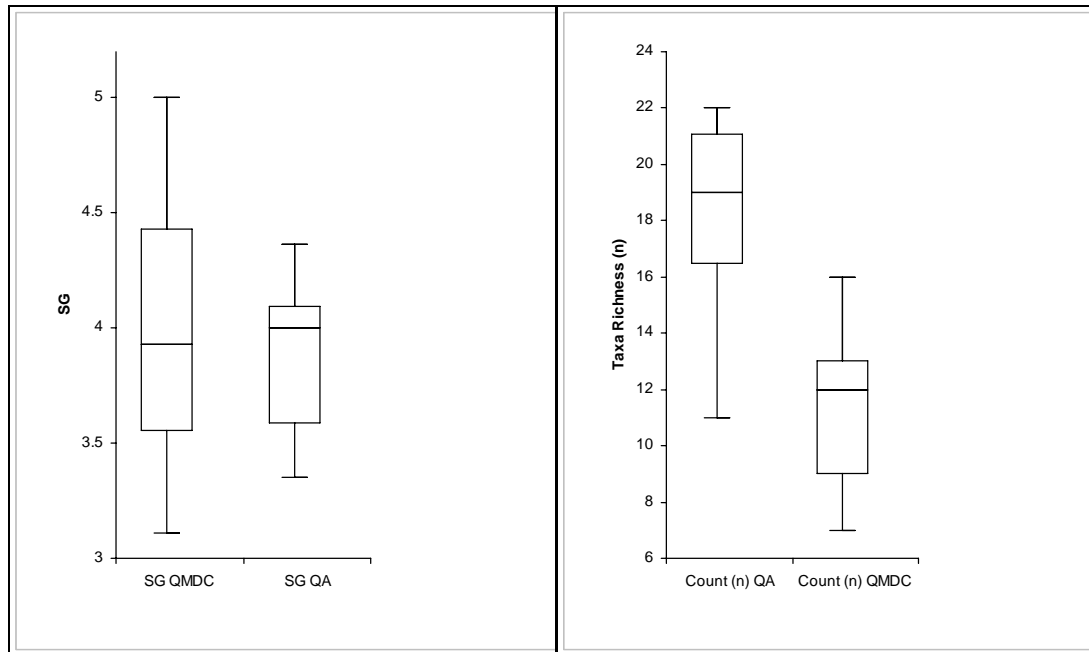
- Water treader aligned with water strider (Signal 4) and grouping name extended to Water strider/water treader
- Parastacidae (crayfish) Signal 4 - aligned with Freshwater yabby and grouping name extended to Freshwater yabby and crayfish
- Water scorpion/Giant water bugs (Signal 3) - name extended to Water scorpion/giant/other w bugs
- Predacious Diving Beetle adult grouped with Predacious Diving Beetle larvae and grouping name changed to Diving/crawling w beetle adult/larva
- Riffle beetle adult grouped with Riffle beetle larva
- Whirligig and other beetle adult grouped with Whirligig and other beetle larva
- Scavenger water beetle adult grouped with Scavenger water beetle larva
- Lacewing (order Neuroptera) - added to list as Signal 6 - based on the average SG of AusRiv scoring system
- Sisyridae (spongefly) Signal 6 - aligned with Lacewing
- Corallanidae, Oniscida (water slate/sow bug) - Signal 3, aligned with Isopoda
- Noteridae, Staphlinidae, Brentidae, Chrysomelidae, Limnichidae, Hydraenidae (minute rove beetle), Scirtidae (marsh beetle), Psephenidae (water penny) - Signal 5, aligned with Whirligig/other beetle adult/larva

- Tabanidae (horse fly), Empididae (dance fly), Dolichopodidae (dolly), Psychodidae (moth fly), Muscidae (muscid), Ephyridae (ephyrid), Sciomyzidae (marsh fly) - Signal 4, aligned with Soldier fly and other fly larva
- Curculionidae (aquatic weevil) - Signal 3, aligned with Scavenger water beetle adult/larva
- Haliplidae (crawling water beetle), Hygrobiidae (screech beetle), Heteroceridae - Signal 2, aligned with Diving/crawling w beetle adult/larva
- Chaoboridae (phantom midge), Dixidae (meniscous midge) - Signal 3, aligned with Non-biting midge larva
- Saldidae (shore bug), Gelastocoridae (toad bug), Ochteridae, Leptopodidae - Signal 3, aligned with Water scorpion/giant/other w bugs
- Hebridae (velvet water bug) - Signal 4, aligned with Water strider/water treader
- Nematoda (Roundworm) - Signal 3, separated from Segmented worm
- Oligochaeta (Segmented worm) - Signal 4, based on the average SG of AusRiv scoring system
- Collembola (Springtail) - Signal 1, no longer ignored as above due to presence in a number of samples
- Nemertea (proboscus worm) - added to list as Signal 7 based on AusRiv scoring system
- Lepidoptera [Water caterpillar (moth larva)] - added to list as Signal 3 based on AusRiv scoring system
- Megaloptera (Toebiter/alderfly/dobson fly) - added to list as Signal 6 based on the average SG of AusRiv scoring system
- Sialidae (alderfly larva) - Signal 6, aligned with Toebiter/alderfly/dobsonfly
- Conchostraca (clam shrimp) - Signal 4, aligned with Seed shrimp
- Corbiculidae (little basket shell), Sphaeriidae (pea shell) - Signal 3, aligned with Freshwater mussel based on the average of the AusRiv scoring system
- Ancylidae (freshwater limpet) - Signal 2, aligned with Freshwater snail
- Ptilodactylidae - Signal 8, aligned with Riffle beetle adult/larva
- Unidentified Crustacea - aligned with Shrimp and prawns based on average SG for all Crustacea

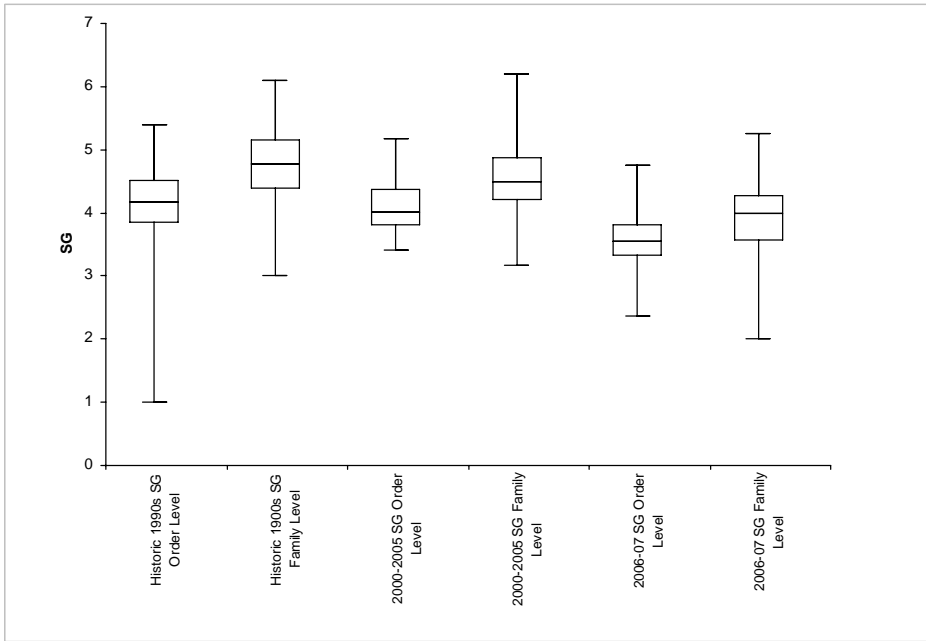
Appendix 3 – Extracts from Draft QMDC River Health Survey Report



Comparison of Taxa Richness (n) by Collection period in Border Rivers (left) and Maranoa Balonne (right)



Comparison of SIGNAL Grade (SG) and taxa count (n) for 10 QMDC samples checked by external Ecologist (QA)



Comparison of SIGNAL Grade (SG) identified to Order/class/phylum (Order) Level and QMDC 2007 (Family) Level for all catchments