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Social benchmarking as a basis for communication programs to improve river health

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ABSTRACT
To complement physical measures or indices of river health a social benchmarking instrument has been developed to measure community dispositions and behaviour regarding river health. This instrument seeks to achieve three outcomes. First, to provide a benchmark of the social condition of communities' attitudes, values, understanding and behaviours in relation to river health; second, to provide information for developing management and educational priorities; and third, to provide the basis for assessment of the long-term effectiveness of community communication and education activities in achieving changes in attitudes, understanding and behaviours in relation to river health. In this paper the development of the social benchmarking instrument is described and results are presented from the first state-wide benchmark study in Victoria, Australia, in which the social dimensions of river health, community behaviours related to rivers, and community understanding of human impacts on rivers were assessed.

INTRODUCTION
Australian benchmarking of the environmental condition of waterways has been conducted in Victoria in 1999 and 2004 through an index of stream condition (ISC) which has been used to monitor the biophysical condition of rivers and waterways. A benchmark is simply a standard by which something can be measured or judged and change over time assessed. The ISC provides an assessment of the health of Victoria's rivers by measuring change in five bio-physical sub-indices and there have been many other indices of river health developed elsewhere (Gordon et al., 2004). Elsewhere, European projects for integrated risk-based management of rivers and river basins have developed approaches such as RISKBASE, based on the premise that river basins are complex and dynamic social/ecological systems where the central objective is the sustaining of ecosystem services rather than ecological status (van der Meulen and Brils, 2008). The emphasis on broader conceptions of ecosystems services has developed since the Millennium Ecosystem Assessment (Alcamo and Bennett, 2003).

Many researchers have investigated relationships associated with community and human dispositions and behaviour towards natural resources (Curtis and Byron, 2002; Parkins et al., 2001; Po et al., 2005; Effendi, 2004). More recently, a social benchmarking instrument has been developed specifically to measure community dispositions and behaviour related to river health. Social dispositions and behaviour regarding rivers and waterways are important because of the major impact of humans on river health. Such dispositions towards rivers have not previously been measured in a formal way. The most satisfactory way to compare such social dispositions and behaviours over time is to describe them in terms of a scale that allows for comparative measurement (Rossi and Gilmartin, 1980). Being able to assess such trends supports the role of these 'indicators' as warning signals for unsustainable resource use (Azar et al. 1996).

The social benchmarking instrument was developed to provide a tool to achieve three outcomes for managers of rivers and waterways. First, to provide an understanding of community expectations, attitudes and behaviours towards waterway management specifically, and water resource management more broadly; second, to provide waterway managers with critical information for developing priorities (both social and environmental) for action and for guiding the evaluation of community engagement activities; and third, to evaluate the longer-term effectiveness of river health community education and engagement activities.

There were two foci of interest for establishing social benchmarks: the dispositions and general waterway health behaviour of all members of the population; and, more specifically the dispositions and behaviour of respondents who live beside, work or manage property with waterway frontage. The findings regarding this latter group of respondents are the principal focus of this paper.

CONSTRUCTING THE SOCIAL BENCHMARK INSTRUMENT

The identification and development of potential indicators and component items incorporated into the survey instrument for developing the social benchmark measure was based on a literature review, the use of a panel of expert reviewers, a review of documents relevant to social aspects of river health provided by regional catchment management agencies (CMAs), and interviews and focus groups with other people involved in waterway management (Riedlinger et al., 2007). Social indicators were related to the biophysical aspects of river health in order to be useful in program management and were designed to capture changes over time in community river use and values regarding river health (Table 1). Multiple item statements were used to operationalise the indicators (typically 4 to 8 items for each indicator) and a survey instrument was constructed (Pisarski et al., *2*008).

Table 1 Indicators comprising the social benchmarking instrument

Indicator	Description	Management relevance
1. Waterway use	Level of use and what is gained from that use	Level and nature of use can affect impact of human behaviour on rivers.
2. Knowledge and literacy	Awareness of what makes a river healthy	Understanding of the biophysical basis of river health can affect people's river health attitudes and behaviours.
3. Aspirations and values	Includes attitudes to river health and who is considered responsible for river health	Useful to compare community values to those implicit in the biophysical indices scientific and management values about what leads to river health.
4. Adoption of and trust in recommended practices	Participation in river health activities, trust in CMA's recommended practices, behaviours that improve or protect river health	Targets for improving or protecting biophysical aspects of rivers are achieved by implementing best management practices recommended by CMAs. Levels of trust and adoption impact on achieving such targets.

A pilot study comprising 908 telephone interviews and 130 web administered interviews was undertaken in three CMA areas in Victoria in 2008. Completed interviews represented 22 percent of respondents' contacted (Pisarski et al., *2*008). The pilot study established the validity of the indicators and most of the component items. Small refinements were made to some component items.

Figure 1 shows the structure of the indicators and their components that comprise the social benchmark instrument. The validity of the groups of items comprising each of the multiple-item indicator components was confirmed by principal components factor analysis of the data derived in the pilot study (Nunnally and Bernstein, 1994; Pisarski et al. 2007).

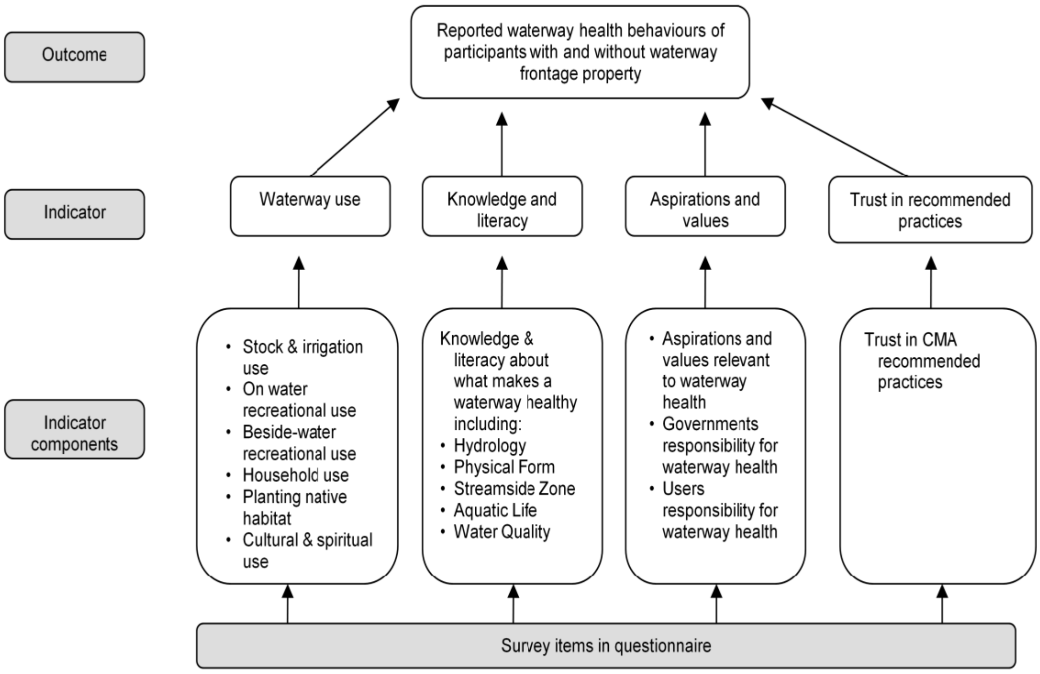

Figure 1 Components of indicators contributing to river health social benchmark.

Two outcomes were identified in the benchmarking process (Figure 1). First, the general waterway health behaviour of all respondents, including respondents' stated behaviours that should lead to improved waterway health such as actively seeking information, attending events about waterways; active involvement in Landcare, Waterwatch, Bushcare, Coastcare or similar organisations, participation in local projects or encouraging others to change their behaviour – activities that can be considered 'engagement'. Second, we were interested in the specific behaviour of respondents who live, work or manage waterway frontage property (riparian respondents) and specific behaviours that improve waterway health such as preventing stock from accessing waterways, removing weeds, seeking advice on managing their section of waterway or reach and removing willow trees.

Indices of river health, such as the ISC measuring physical conditions, are often reduced to an overall index score. The social condition benchmarking is a more complex set of data reflecting the complexity of community social responses and the pilot project confirmed that it was not productive to reduce the four indicators to a single overall score. The four indicator groups were considered to contribute independently to the social benchmark with scores potentially calculated for each indicator (Figure 1). The indicators comprising the benchmark thus have two valuable characteristics – a time-dependent measure of community dispositions and predictors of outcome behaviours.

A state-wide study of all Victorian CMA areas and metropolitan Melbourne was undertaken in 2009. Sampling of respondents was purposive and aimed to capture 300 riparian landholders and 300 non-riparian members of the general public in each of 10 catchment management areas and a larger number of respondents from metropolitan Melbourne. In total, 7140 respondents completed useable questionnaires, of which 3046 were respondents who lived beside, worked or managed property with waterway frontage (riparian respondents) and 4094 were non-riparian respondents. For riparian respondents the population of all Crown frontage license holders and Crown land riparian license holders was surveyed. From a population of 15,981 potential riparian respondents 3046 respondents (19% response rate) completed useable questionnaires.

The survey was administered as a paper-based questionnaire for riparian respondents and completed electronically via a web-based questionnaire for non-riparian respondents. This paper examines the responses of the riparian respondents.

RESULTS AND DISCUSSION

Waterway frontage behaviours that improved waterway health included actively restoring waterway health, preventing stock from accessing waterways, removing weeds, seeking advice on managing a waterway or reach, removing willow trees and maintaining on the ground works done in partnership with CMAs. Table 2 shows 34% of riparian respondents reported that they did not actively restore waterway health on their properties, however two thirds (66%) reported that they consistently (often or very often) tried to restore waterway health. Sixty three percent of waterway frontage holders reported that they prevented stock from accessing the banks of waterways. Overall, 18% of respondents had unacceptable behaviour, 34% had some appropriate behaviour, 36% good behaviour and 12% excellent behaviour.

Perception of financial capacity was a factor in the reported behaviours of riparian respondents: 35% of respondents stated they never have the financial capacity to do the right thing for waterways, 39% sometimes have the capacity, and 26% consistently have this capacity. While most respondents reported that they had the resources, time, energy and willingness to maintain on ground works that have been undertaken on their property, 36% of respondents never, seldom, or sometimes have the resources, time, energy or commitment to maintain on ground works. This lack of stated capacity can be expected to have an impact on respondent’s behaviour.

Table 2 Reported behaviours of waterway frontage holders: response percentages (N=3046)

	Never	Seldom	Sometimes	Often	Very Often
Restore waterway health on property	5	6	23	40	26
Prevent stock accessing waterways	13	7	17	27	36
Remove weeds and pests from waterways	5	5	16	37	37
Seek advice on managing waterways	16	21	34	18	11
Removed willows from waterways	43	23	11	11	12
Remove dead branches and logs in waterways (reversed/negative item)	50	27	16	4	3
Maintain the on-ground works done in partnership with my local CMA	26	7	30	21	16

Factor analysis of the items used in the state-wide survey instrument confirmed the indicators identified in Figure 1. To determine the relationships between indicators, indicator components and river health behaviours structural equation modelling, using maximum likelihood procedure, was employed (Kline, 1998). Details of model development are presented in Pisarski et al. (2008). The results reported here are for riparian respondents where the dependent variable was an index reflecting reported improved river health behaviours (riparian behaviour).

The structural equation model, excluding path coefficients, is presented in Figure 2. The model revealed a good fit ($\chi^2$745.21, *df* 63, $P > .59$, CFI=.91, IFI=.92, NFI=.91, TLI (NNFI) =.89, RMSEA=.061, AASR=.04) explaining 48% of riparian holders waterway health behaviour (n=3046). The distribution of residuals was symmetrical and approached zero, and the standardised off diagonal residuals were low. The standardised path coefficients for all direct and indirect pathways in the model were significant.

A complex set of interrelationships between the indicators and riparian respondents' river health behaviour were evident in the structural equation model (Figure 2). Some indicators had a direct influence on the behaviour of riparian respondents; however, some other non-indicator variables were also important. The most important direct pathways were between general waterway behaviour (such as actively seeking information about waterway health, and other activities that can be considered engagement in waterway health), using waterways for the rehabilitation of native habitat, respondents' contact with their CMA and membership of a community natural resource management (NRM) group, in particular Landcare.

As general waterway behaviour increased there was a corresponding increase in healthy riparian behaviour ($\beta = .319$, $p < .001$). The financial capacity to do the right thing for waterways also had a direct influence on riparian behaviour ($\beta = .147$, $p < .05$). Those respondents who had contacted their CMA most recently had better riparian behaviour. Contact with a CMA had a direct influence on riparian behaviour ($\beta = .147$, $p < .05$) but also operated indirectly on riparian behaviour through general waterway behaviour ($\beta = .227$, $p < .001$). Membership in community based NRM groups had a stronger influence on healthy riparian behaviour indirectly through general waterway behaviour ($\beta = .386$, $p < .001$), CMA contact ($\beta = .210$, $p < .001$) and waterway knowledge ($\beta = .107$, $p < .05$). As general waterway behaviour improved and contact with CMAs and knowledge increased so did healthy riparian behaviour.

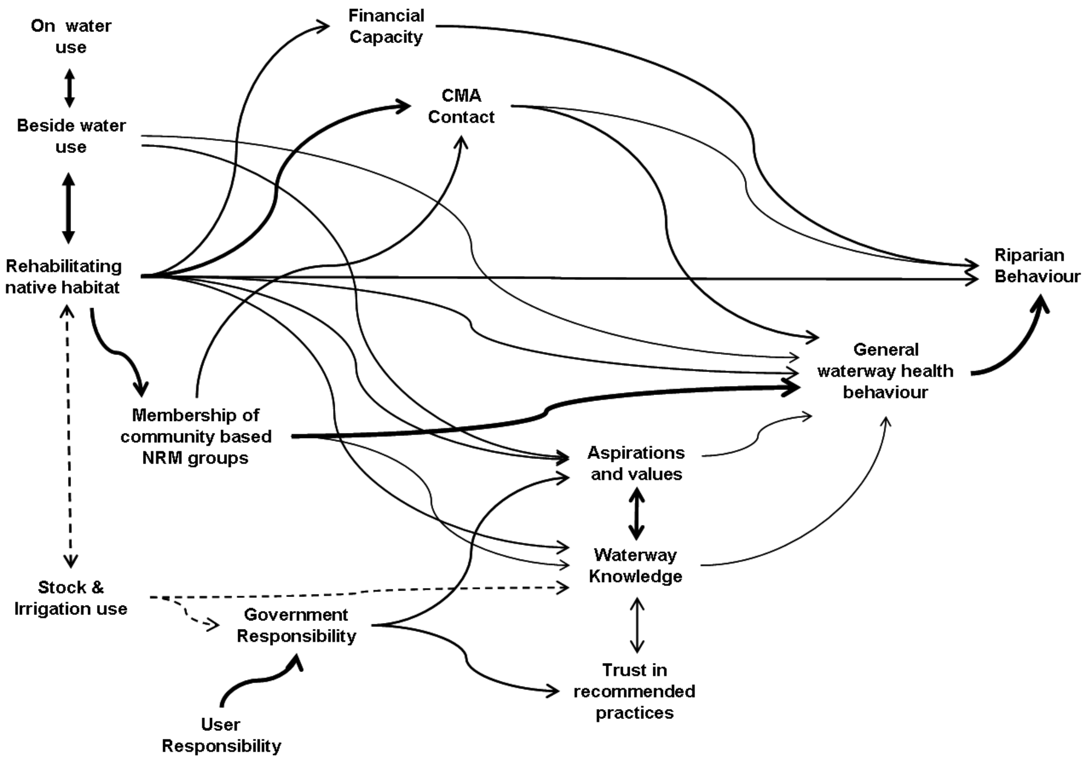

Figure 2 Model of reported river health behaviour for riparian respondents (N=3046) [Thickness of line represents strength of relationship; dashed lines indicate negative relationships]

Riparian respondents' waterway knowledge, trust in recommended practice, aspirations, use of waterways for stock and irrigation, beside and on-water recreational use and who they saw as responsible for waterway health did not influence riparian behaviour directly but operated indirectly through general waterway behaviour. As waterway knowledge ($\beta = .044$, $p < .05$), and aspirations for waterway health ($\beta = .107$, $p < .05$), increased general waterway behaviour also increased which, in turn, led to healthier riparian behaviour.

Trust in recommended practices was related to better waterway knowledge held by riparian respondents ($\beta = .196$, $p < .001$). There was a strong relationship between how much responsibility respondents thought government and waterways users should have for waterway health ($\beta = .374$, $p < .001$). The more riparian respondents saw this as a partnership between government and users the more they tended to trust recommended practice ($\beta = .216$, $p < .001$) and have positive aspirations ($\beta = .220$, $p < .001$).

Respondents who reported on-water use were often beside water users ($\beta = .282$, $p < .001$). Those respondents who reported higher beside water use had higher general waterway behaviour ($\beta = .082$, $p < .05$) and higher aspirations relevant to waterway health ($\beta = .180$, $p < .001$) which, in turn, was linked to better riparian behaviour.

There was a negative relationship between respondents who used waterways for stock and irrigation and those who planted native habitat (β = -.231, p < .001), as respondents who accessed waterways for stock and irrigation were less likely to be engaged in planting native habitat beside waterways. This indicates two distinctively different stories in relation to waterway uses. First, respondents who used waterways for stock and irrigation and did not plant native habitat had poorer waterway knowledge (β = -.163, p < .001) and did not think government should have much responsibility for waterway health (β = - .191, p < .001). This led to poorer general waterway behaviour and poorer riparian behaviour.

Second, those engaged in rehabilitating native habitat tended to have other healthy riparian behaviours (β = .252, p < .001), better general waterway behaviour (β = .195, p < .001), better knowledge (β = .191, p < .001) and aspirations (β = .180, p < .001) for waterway health. Riparian respondents engaged in planting native habitat also had higher membership in community based NRM groups (β = .275, p < .001) reported greater financial capacity to do the right thing for waterways (β = .228, p < .001) and increased contact with their CMA (β = .298, p < .001).

Those accessing waterways for stock and irrigation purposes had markedly poorer waterway frontage behaviour than those engaged in rehabilitating native habitat. There were markedly different levels of trust in CMA recommended practice and waterway knowledge. Involvement in activities likely to enhance trust and knowledge were also significantly different, with those more actively involved in events, activities and groups such as Landcare having better trust and knowledge. Encouraging membership in community based NRM groups and attendance at events and activities, while useful, may be difficult to achieve for those with the poorest behaviour.

Perceptions of financial capacity and resources to do the right thing by waterways were low or non-existent for those using waterways for stock and irrigation. Their expectations as to whether they should be expected to maintain on-ground works done in partnership with CMAs were also negative, raising the question as to whether there is a real difference in capacity or a difference in expectations. This requires investigation as, if the deficits in capacity are real, these respondents may need to be targeted with grants; but if not, offers of grants are unlikely to change the behaviour of this group.

The characteristics of riparian respondents with sound knowledge and best practice suggest effective strategies for improving behaviour include inviting people to see best practice, rewarding those who comply with best practice and to continue with on-ground works based on sound science. The results suggest that government bodies need to more actively engage in targeted local collaborative activities with community based NRM organisations, riparian holders and members of the general public. This will encourage trust in recommended practice, improve better knowledge transfer and foster a partnership of responsibility leading to better general waterway behaviour, which in turn will lead to improved waterway health.

CONCLUSIONS

This study has provided evidence validating the indicators comprising a social benchmark of river health. Better understanding of social variables influencing river health will help develop better policies to engage communities to improve the health of rivers. Benchmarking of the social conditions with respect to river health provided:

- a framework for assessing social conditions related to waterway use, waterway health knowledge and literacy, aspirations and values, trust in recommended practice and waterway health behaviour;
- indicator measures which can be used to predict likely waterway health behaviours and to identify reasons for current waterway health behaviours; and
- a tool for planning engagement and communication activities and, subsequently, assessing the effectiveness of communication programs.

In the analysis presented all indicators had direct or indirect influence on reported waterway health behaviours for riparian respondents; however, some other non-indicator variables were also important. The most important direct pathways for most indicators were linked to general waterway behaviour, reflecting community engagement, which in turn predicted desirable riparian behaviour.

The social benchmarking instrument has provided a means for better understanding of the complexity of the social conditions underlying waterway health and has provided a baseline of information for government and community organisations to identify where current targeted resources have been effective and to develop plans and strategies to better target resources to enhance waterway health. Future monitoring of benchmark indicators will allow assessment and evaluation of the effectiveness of river health community education and communication activities.

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