Identifying and Testing Engagement and Public Literacy Indicators for River Health

JENNI METCALFE AND MICHELLE RIEDLINGER

Natural resource management (NRM) organisations in Australia are increasingly recognising the need for complement studies of biophysical condition of the environment with studies of social condition, such as values, understanding, and participation related to the environment. Relevant and reliable social indicators that can be scaled and measured on a regular basis are essential to meet this need. In this study, we identified four indicators to test the social condition of the public in the State of Victoria in Australia with regard to river health. These indicators were river use, river knowledge and literacy, values and aspirations, and river health behaviours.

We tested the four indicators through telephone and web-based surveys with over 1000 people in three areas of Victoria. We analysed the survey data statistically and gathered baseline data on the social condition of river health in the three regions. We made recommendations for how this data could be interpreted and used in community engagement and science communication programmes about river health. We also examined the limitations of the methodology and recommended modifications to the survey design and application for an anticipated roll-out of the survey across the entire State of Victoria. The Victorian Department of Sustainability and Environment (DSE) will use this survey instrument to test social indicators on a regular basis.

Acknowledgements: The authors would like to thank the Victorian Department of Sustainability and Environment for supporting this research. We also wish to acknowledge the work of Anne Pisarski from the University of Queensland and John Cary from the Victoria University of Technology who were part of a larger research project that guided this research.

Jenni Metcalfe is Director of Econnect Communication, PO Box 734, South Brisbane, Queensland, 4101, Australia. E-mail: jenni@econnect.com.au
Michelle Riedlinger is Senior Consultant of Econnect Communication, PO Box 734, South Brisbane, Queensland, 4101, Australia. E-mail: michelle@econnect.com.au

---

Science, Technology & Society 14:2 (2009): 241–267
SAGE Publications Los Angeles/London/New Delhi/Singapore/Washington DC
DOI: 10.1177/097172180901400203

Introduction

River health is a significant issue in Australia with regular droughts and floods, and a highly variable climate. Australia is divided into six states and two territories. These jurisdictions are responsible for managing waterways. Victoria was the first State to develop, test and institute a formal means for measuring the biophysical state of its waterways. They achieved this through an Index of Stream Condition (ISC) and accompanying data collection methods, with data being collected every five years. It started with benchmark data in 1999, ran again in 2004 and is due to be carried out again in 2009. It is administered by the Victorian Department of Sustainability and Environment (DSE) and carried out by Catchment Management Authorities (CMAs). The CMAs are regional organisations based around catchment areas that have specific responsibility for river health.

The ISC provides a statewide picture of the biophysical condition of rivers and stream, which assists the DSE and the CMAs to communicate about the health of Victoria's rivers, determine what needs to be done, and assess the long-term effectiveness of river rehabilitation programs.

The ISC measures changes in five key components of river health: hydrology, water quality, streamside zone (vegetation), physical form (bed and bank condition and instream habitat) and aquatic life. Each of these components has management actions associated with it. For example, restoring the streamside zone may involve planting native vegetation and improving water quality may involve reducing urban runoff of water.

Understanding Social Condition

The DSE also recognises the need to assess social conditions of community (values, understanding and participation) to complement the assessment of the biophysical aspects of river health. The Victorian River Health Strategy describes the community vision for Victoria's rivers as:

> Our communities will be confident and capable, appreciating the values of their rivers, understanding their dependency on healthy rivers and actively participating in decision making.

In 1997, DSE contracted Econnect Communication through the University of Queensland[1] to carry out a social benchmarking study to

produce a set of social indicators for river health that could be measured on a regular basis.

A survey to measure the social indicators would also be piloted in three of Victoria's CMA regions: Corangamite, North Central and North East. This would be the first comprehensive pilot study conducted in Australia of the social condition of communities with regard to river health.

The data gathered from the survey would give river managers:

- a better understanding of community expectations, attitudes and behaviours towards river management specifically, and water resource management more broadly
- information to help them develop priorities (both social and environmental) for action
- an assessment of the long-term (five to ten years) effectiveness of river health community education and engagement activities against defined targets over time

Developing Social Indicators for River Health

We started with Force's (1995) model for developing natural resource management (NRM) social indicators, which suggests that indicators should reflect an extensive review of the literature, a theoretical basis and relevance to NRM activities. We conducted a review of the relevant literature and interviewed river health managers and social researchers from each of Victoria's CMAs. We used this approach to gather information on the challenges associated with developing social indicators, social indicators suggested or in use and methods used to measure social indicators.

Literature Review

The literature review was essential for identifying what had already been researched and tested and provided the project with a theoretical basis to draw on. We examined the approaches used by researchers in Australia and internationally to develop indicators for river health and the health of other natural resources. We also investigated the challenges and opportunities associated with developing social indicators and measuring them.

The review identified that research specifically examining the social aspects of river health is limited. However, more social researchers are

engaged in studying general natural resource social indicators, and have identified some of the challenges and opportunities to developing cost-effective social indicators. We also identified some key criteria to consider when developing social indicators. Force's (1995) model for developing social indicators suggests that indicators should also be easy to understand and interpret and, when measured, should provide reliable quality data.

Stanley et al. (2006) highlight relevancy as the most important criteria for an NRM social indicator, given that it guides management action. Being simple enough to be understood and interpreted by resource managers and the community is essential for decision making.

In this article, we describe how the project applied these factors and others to developing and measuring social indicators for river health.

CMA Interviews

In parallel with the literature review, we conducted interviews with river health officers and social researchers from all eleven CMAs in Victoria. We asked them to identify social indicators that they were already using or would be useful for CMAs and to provide us with relevant social research they had conducted.

We discussed the results of the literature review and the CMA interviews with the Victorian Department of Sustainability and Environment and other social researchers to develop a set of agreed social indicators. All CMAs understood that social research was important to achieving their natural resource management targets, specifically for river health. They could see the intuitive links with biophysical research, including the Index of Stream Condition.

The CMAs saw relationships between social and biophysical condition where these were collectively producing outcomes such as sustaining the production of food and goods, supplying drinking water, able to be fished and swum in, having a biodiversity of fauna and flora, visual amenity and a preserved cultural heritage. Furthermore, some CMAs believed the interaction between healthy rivers and communities related to a 'sense of place', which could lead to greater social cohesion.

All of the CMAs stressed the importance of linking the social indicators to the ISC indicators. Typical questions raised in interviews with them were: 'What are the specific practices that influence river health? How can those practices be linked to the social?'

However, the collection and use of social data by CMAs is still in its infancy, and the work is most often being carried out by consultancies through telephone and mail surveys, and some interviews. CMAs identified a lack of skills and resources for researching and interpreting social information.

CMAs identified a need for social indicators that could:

1. assess social condition according to specific river reaches:

   > [If we knew the] issues by area … the issues relate to projects and how we manage projects; e.g. We've been working on re-snagging for three years and awareness has gone down. (Verbal communication)

2. provide project-level information:

   > The hardest thing to get a handle on is the project-level information. We are trialling some increased incentives to get activity on waterways. These are specific landholders that border the rivers…We've got increased incentives to do work, [but we need to know] do you want to take it up? If not, why not? (Verbal communication)

3. link to current recommended practices for river health, as relevant to the ISC:

   > There are gaps for understanding particular issues. [What are the] links to behaviours? Why is there no fence there? In that respect it would be interesting to know how [do social aspects] influence the ISC? (Verbal communication)

4. assess the capacity, particularly for farmers and landholders, to change their practices.

Challenges to Developing Indicators

We used the information we had gathered from the literature and from interviews with CMA staff to identify the challenges and opportunities for developing indicators.

A key point that both the CMA staff and the literature review emphasised was the need for social indicators to provide useful data. The CMAs

believed that it was also important for social indicators to be easy to understand and interpret. This is also reflected in the Simple, Measurable, Achievable, Realistic, Time-bound (SMART) filter process for assessing social indicators, which we used to assess the social indicators in this project (Lockie et al. 2005; Taylor et al. 2002). The SMART filter is recognised in the literature as providing the best criteria for assessing social indicators that work in NRM settings. The results of this exercise are provided in Table 1. The project's approach for meeting the SMART criteria and overcoming the challenges described by the literature and CMA staff is provided in the column titled 'Project's approach'.

Suggested Social Indicators for River Health

A total of seven social indicators were identified in the literature and CMA reviews. Table 2 provides details of the indicators identified, the indicators selected and reasons for our selection.

Indicators such as social networks and capacity to change were not included as they are not simple and scalable and can be difficult to measure. While they may be important for understanding social condition related to river health, we cannot measure these with current methods and understanding. In addition, these indicators would not provide management-focused data and, therefore, would not warrant the cost to river management organisations to measure them.

The Social Indicators

The social indicators we selected for this project sought to pass the SMART test referred to earlier and also meet the needs of DSE and the CMAs as much as possible. Table 3 describes the four indicators that we chose and summarises the relevance of these for managing rivers to protect or improve their health.

Measuring Social Indicators for River Health

A major consideration for choosing our social indicators was ensuring that they were measurable. Based on the literature review, previous social research conducted by the CMAs, and the discussions with the CMAs, we selected a largely quantitative survey as the tool for measuring the social indicators.

TABLE 1
Challenges to Developing Social Indicators for Each of the SMART Filter Criteria

SMART filter need	*CMA challenges*	*Literature review challenges*	*Project's approach*
Simple	Capturing community diversity	Comparing social indicators across regions, when communities have their own unique characteristics (Cavaye 2003) Measuring indicators cost-effectively by using a quantitative survey to collect social data to produce scalable indicators (Rossi and Gilmartin 1980; Cavaye 2005; Curtis et al. 2001; Curtis and Byron 2002; Curtis and DeLacy 1997; Parkins et al. 2001; Po et al. 2005; and Effendi 2004) The inability to compare current social condition with a previous 'pristine' condition, which can be done with biophysical indicators (Cavaye 2003)	Develop indicators that will provide data that will identify the unique social aspects of communities in regard to river health Use a survey tool that can gain data that can be interrogated at regional and local levels Benchmark current social condition statewide to provide a reference for comparing future assessments on a 5-yearly basis

(*Table 1 continued*)

(*Table 1 continued*)

SMART filter need	*CMA challenges*	*Literature review challenges*	*Project's approach*
Measurable	Quantifying social indicators Scale of data collection required	Establishing reliable methods for isolating and measuring the causes of social characteristics (Rossi and Gilmartin 1980) A lack of agreed measures for social indicators (Bulmer 2001), the need to have a mix of objective and subjective indicators (Stanley 2006), that are measured both quantitatively and qualitatively (Cavaye 2003) Measuring attitudes (Vaughan and Hogg 2005)	Develop a set of objective and subjective indicators Use statistics to identify relationships between indicators Use a survey tool that includes quantitative and qualitative questions Recommend further actions at the CMA level for interrogating the data
Accessible	Lack of resources and skills	A lack of adequate skills and resources for developing and applying indicators (Bulmer 2001)	Recommend developing user manuals for *(a)* CMAs to implement the tool and interpret the data, and *(b)* social scientists to sort, analyse and interpret the data from the tool Recommend contracting social scientists to support CMAs in implementing, analysing and interpreting the survey tool results

Relevant	Data with sufficient detail for regional and river reach analysis Need for local flexible use of generic indicators Tool being used to evaluate CMA's performance	Losing critical information when combining data into an indicator (Byron et al. 2006) The need for sub-catchment scale data rather than larger catchment scale data (Curtis et al. 2001) Indicators being seen as a threat if used as an accountability mechanism (Barrett and Pascoe 2003; Bellamy 2005)	Make raw data available for further investigation Include questions in the survey tool that can help identify specific river reaches within a CMA region Recommend further actions at the CMA level for interrogating the data Stress that indicators and tool for testing them cannot be used as an evaluation mechanism Recommend that the subindices, indicators and survey tool continue to be further tested and developed to better meet the needs of DSE and CMAs
Timely	Shifting NRM priorities Influence of current issues, like the drought	Comparing social indicators over a sufficient time period to be able to detect visible trends of change (Rossi and Gilmartin 1980) The unpredictable and fast changing nature of the environment and society (Wolfenden et al. 2006)	A five-year period was selected for the SISC to link in with ISC, and to allow enough time for detecting any changes Recommend further actions at the CMA level for interrogating the data according to current issues such as the drought and changing NRM priorities

Table 2
Social Indicators Suggested by CMAs and the Literature Review

Social indicator	*Literature suggestions*	*CMA expectation*	*Indicators chosen*	*Reasoning*
Behaviour	Adoption of current recommended practices Participation in NRM activities, especially related to river health Behaviours that support river health	Interested in adoption of and trust in recommended practices, including involvement and participation in relevant activities, uptake of incentives tenders and grants which implement best practices, and community satisfaction with NRM planning	Yes	Able to test for trust in recommended practices and stated behaviours—which includes farming and general practices to protect river health and support river health
Values	People's connection to place 'sense of place' Non-market values placed on rivers Amenity of rivers for access and recreation Visual pollution Natural appearance	Interested in community values and attitudes to river health. It was thought these values could indicate a 'wellbeing' that the community derives from rivers	Yes	Values could be tested by assessing attitudes towards the environment generally and river health specifically which included their general aspirations as well as who they think is responsible for looking after river health
Community capacity	Community readiness to engage or change practices (capacity to change; community capacity) Skills Membership of groups Willingness to pay Trust	Interested in the capacity for engaging in river health, which includes their capacity to change practices	No	Not specifically included as capacity and networks are difficult to measure and interpret. Included membership of groups as part of demographic information and trust in recommended practices as part of the adoption and trust social indicator

Social capital	Social networks Organisational credibility Relationships between institutions and community	Interested in networks for engaging in river health, including partnerships and social networks	No	A new area that is untested and difficult to measure. Looked at how people perceived institutions like the CMA in relationship to river health information and activities as part of the adoption and trust social indicator
Resilience/ community strength	Access to information Social networks	Interested in the ability of a community to engage in river health activities as part of the strength and resilience of a community to change	No	Looked at access to information only as part of assessing the trust in recommended practices as part of the adoption and trust social indicator
Waterway use	People's connection to place 'sense of place' Amenity of rivers for access and recreation Visual pollution	Interested in accessibility, visual appeal and amenity of rivers for recreational purposes, including community-initiated river events	Yes	Able to test for recreational and farming use of waterways
Wellbeing of the community	Sense of place Community involvement Social networks Human health (physical and mental)	Interested in 'sense of place' as it related to values and also community involvement and participation in river health events and activities	No	Looked at sense of place as it related to the use of waterways social indicator and participation in groups like Waterwatch and Bushcare as part of the adoption and trust social indicator
Knowledge and literacy	Knowledge and literacy	Interested in understanding what the community knew about what made a river healthy or not, and awareness of local conditions	Yes	Included social indicator as a test of awareness and knowledge

TABLE 3
Social Indicators Selected for the Social Index of Stream Condition

Social indicator	*Description*	*Management relevance*
A. Waterway use	Level of use and what is gained from that use	Level of use can affect potential impact of human behaviour on rivers. Visual amenity is a social aspect of river health that is relevant to biophysical river health indicators such as hydrology, physical form and streamside zone.
B. Knowledge and literacy	Awareness of what makes a river healthy	People's understanding of the biophysical basis of river health implicit in the ISC can affect their river health attitudes and behaviours.
C. Aspirations and values	Including attitudes to river health and who they think is responsible for looking after river health	The biophysical Index of Stream Condition (ISC) is based on scientific and natural resource management values about what makes a river healthy. It is useful to compare community values to those implicit in the ISC.
D. 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	The ISC leads to CMAs setting targets for improving or protecting biophysical aspects of rivers. These targets are achieved by implementing best management practices that are recommended by CMAs. Levels of trust and adoption will affect how these targets are achieved.

Rossi and Gilmartin (1980) argue that the only way to compare social conditions within and between regions over time is to describe them in terms of a scale that allows for comparative measurement. Being able to assess trends supports the role of indicators as warning signals for unsustainable use (Azar et al. 1996; Machlis et al. 1994). It also helps management evaluate responses and assign priorities to actions (Machlis et al. 1994). Quantitative survey instruments, such as telephone and mail questionnaires, are amenable to this scaling.

From the literature and interviews with CMA staff, we identified a number of benefits to using surveys to test for social indicators. First, surveys are relatively easy to conduct using a reputable telephone survey company and on the Internet. They would also produce:

- consistent, scalable results, which can be compared across a number of demographic variables
- Victoria-wide benchmark of river health attitudes, knowledge and behaviours
- results that can be used to predict likely river health behaviours and to identify reasons for current river health behaviours
- information which CMAs can further explore with their staff and communities to help plan river health engagement activities that further help achieve river health community targets
- a standard method for assessment and interpretation
- a common language to talk about social condition, based on four key areas: waterway use, river health knowledge and literacy, aspirations and values, and river health behaviour
- a method, which could be further tested and developed

Researchers have already successfully worked with Victoria's CMAs and Melbourne Water to survey landholders or communities (Curtis and Byron 2002; Curtis and DeLacy 1997; Effendi 2004; Parkins et al. 2001; Po et al. 2005). Indeed, Jackson et al. (2004) argue that this type of research tool may be the only useful and cost-effective method for measuring social condition with respect to natural resources.

This project aimed to test social indicators to produce data (mostly quantitative) that could be used to compare social conditions within and between regions, and over time. This required us to develop a statistical scale that could be used for comparative measurement. Surveys provide

data that can be used to develop such scales, and telephone surveys conducted by the same company provide a rigour and consistency that is difficult to achieve through other survey means. As such, this project chose a telephone survey to measure the social sub-indices. It also used a web-based survey with the same questions to test the efficacy of using a cheaper method for collecting data.

We recognised that a quantitative survey alone would not provide the depth of data or interpretation required to meet this project's objectives of informing strategic management or for making policy decisions. Therefore, the survey also included qualitative questions to collect data for more specific interpretation.

To provide the CMAs with specific waterway data and to include some qualitative information in the survey, respondents were asked specific questions about the waterways they were most familiar with, which promoted some rich qualitative data. We also included questions about any work respondents had seen done on these waterways.

The questions in the survey were developed to test the chosen social indicators. The survey was also designed to be scalable so that the indicators could predict the social dimensions of river health over time.

We conducted telephone surveys of 300 people and promoted a web-based survey in each of the three pilot catchments: Corangamite, North Central and North East. The pilot catchments were selected to represent a variety of geographic and social regions.

Survey Results

We received 1040 surveys, with 900 from telephone surveys and 140 from the web-based survey, ten of which were not useable. This represented a very high level of accuracy and consistency. Of the 130 usable web-based survey responses, thirty six were from outside the three pilot CMA regions, thrity five were from Corangamite, twenty eight from North Central and forty nine from North East.

The surveyed sample was representative of the Australian Bureau of Statistics population data for country Victoria. There was a good mix of urban (54.5 per cent) and rural (45.3 per cent) dwellers. Most people had completed either secondary education (45.5 per cent) or attained a diploma or a trade (22.2 per cent). There were almost equal numbers of

males (51.3 per cent) and females (48.7 per cent) responding, with most working full time (37 per cent), some working part-time (15 per cent) and some retired (24 per cent).

The data generated from all the surveys (three catchments and one web-based survey) were combined and screened for errors. This resulted in 1030 usable data records, which were then analysed using statistical tests such as factor analysis and analysis of variance. The scores for each of the social indicators on both the combined data and individual data sets were converted to scores, similar to that used by the biophysical ISC. The data analysis revealed ten sub-indicators contained within the four social indicators. Waterway use contained the sub-indicators of on-farm use, on-water recreational use and beside-water recreational use. Aspirations and values contained the sub-indicators of values relevant to river health, government responsibility for river health and user responsibility for river health. Adoption and trust in recommended practices contained the sub-indicators of trust in CMA recommended practices, stated general river health behaviours and stated on-farm behaviours affecting river health. The river knowledge and literacy social indicator examined people's knowledge about the scientific basis for river health.

Benchmarking Social Condition for River Health

We gathered a collective picture of the social condition of communities with regard to river health across the three pilot catchments, as shown in Table 4. We found no significant differences in the demographics between the three CMAs, except that there were slightly more farmers in the North East region.

The general public had similar social condition results across the three pilot catchments. This suggests that the general public in the three catchments have similar patterns of waterway use, knowledge and literacy, and values and behaviours related to river health.

When we compared farmers' and the general public's adoption of recommended practices, we found significant differences in scores. Farmers showed moderate levels of adoption of river health behaviours compared with the low adoption rates of the general public. About half of the farmers who responded to the survey engaged in positive on-farm

TABLE 4
Benchmark of Social Condition of Communities Across the Three Pilot CMA Regions

Indicator	*Sub-indicator*	*Description of social condition*
A. Waterway use	1. Farm use	Only a small percentage of respondents use water for farming (9–15 per cent sometimes, often or very often).
		More likely to live in extended families with several generations represented.
		More likely to have contact with CMAs.
		Most farmers are 45 years and older, with 34 per cent being 45–54, 29 per cent being 55–64 and 17 per cent being older than 65.
	2. Direct on-water recreational use (boating, fishing, and so on)	More common use than farming, but still low (between 48 and 76 per cent do not use it for these purposes).
		More likely to be men or couples with children.
		Tend to have diploma or trade qualifications.
		Fewer people over 65.
		Tend to belong to fishing or boating groups.
	3. Beside-water recreational use (picnics, walks, and so on)	Most common use of waterways (up to 80 per cent).
		More likely to be women.
		More likely to have a higher education.
		Tend to belong to conservation, Landcare or Waterwatch groups.

B. Knowledge and literacy	4. Literacy about what makes a river healthy	People's general literacy about river health is moderate, with most almost getting the right answers (according to experts); but there are causes for concern about their literacy with regard to the dangers of willows to river health (54 per cent got wrong answer or did not know), and the benefits of snags (45.8 per cent got wrong answer or did not know).
		Men tend to have greater knowledge.
		People less than 24 years old or greater than 64 had the least knowledge.
		Couples with children had greater knowledge than other types of families.
		Knowledge increases with education.
		People with greater knowledge tend to belong to conservation or Waterwatch groups.
		People who had greater contact with their CMA had greater knowledge.
		There was a significant relationship between people's perception of their knowledge and their actual knowledge.
C. Aspirations and values	5. Values relevant to river health	Most (>90 per cent) shared positive aspirations and values about river health that indicated that it was a critical issue for Victoria, that rivers needed to get enough water to stay healthy, that they had a personal responsibility to do the right thing by waterways, that water needed to be conserved, and that rivers lead to a better quality of life.
		Women had higher aspirations and values than men.
	6. Governments being responsible for river health	Most (>85 per cent) believe that all Victorians, the Victorian government and CMAs should do more to improve river health.
		Most think that government agencies should have a high responsibility for river health.
		Women are more likely than men to see users as responsible.

(*Table 4 continued*)

(*Table 4 continued*)

Indicator	*Sub-indicator*	*Description of social condition*
	7. Users being responsible for river health	Most think everyone should play a role in river health. 79 per cent thought users such as tourism, commercial fisheries, mining, farmers, and public landholders had a clear responsibility. People who use waterways for beside-water use, particularly women, see users as responsible. Those who belong to conservation groups are more likely to see users as responsible. People under 20 were less likely to see users as responsible.
D. Adoption of and trust in recommended practices	8. Trust in CMA recommended practices	People tended to think the CMAs (44–55 per cent) were doing the right thing and providing the necessary information OR they did not know (31–43 per cent). Women have higher levels of trust than men. Those who did not think their CMA provided good advice gave four major reasons: lack of information, insufficient media coverage, confusion over roles or because of conflicts when dealing with the CMA.
	9. Stated general river health behaviours	90 per cent consistently try to use less water. 59 per cent consistently attempt to reduce stormwater pollution. 17 per cent are involved in Landcare, Bushcare, etc. 42 per cent at least sometimes try and get river health information. 29 per cent have been involved in Waterwatch at least sometimes. 45 per cent have taken part in local river health projects at least sometimes. 28 per cent have tried to change people's river health practices. Less likely to engage in stated behaviours if below 24 or above 64 years in age. Increases with education, belonging to a conservation, Waterwatch or Landcare group, and by increased contact with their CMA.
	10. Stated on-farm behaviours affecting river health	17 per cent (176) of the total sample responded to these items. About one third of farmers don't engage in positive river health behaviours on their property, and about half consistently engage in positive behaviours. One third of farmers never seek river health advice and only about a quarter regularly attend a river health event to get advice. However, this could reflect the farmers without river frontage (this was not tested in the survey). Positive behaviours increase with education and membership of a conservation, Waterwatch or Landcare group. Those involved in fishing, sporting or no groups are least likely to engage in positive farming behaviour.

river health behaviours. However, only about a third of farmers captured in our survey sought river health advice and only about a quarter attended river health events.

Many members of the general public were trying to use less water and reducing their stormwater pollution, and a significant number (one-third to a half) sought river health information and participated in local river health activities or events. Our analysis, however, indicates low levels of river health behaviour overall.

Trust in CMA-recommended practices was high across all three CMA regions. The general public trusted that their CMA was doing the right thing for river health and providing good information. Surprisingly, many people did not know the CMA they belonged to and what the role of their CMA was, indicating more investigation is needed to understand the basis for this trust considering this lack of awareness.

On-water recreational use of waterways for boating, fishing and swimming was generally low across all CMAs. More people used waterways for activities that happen beside waterways—such as picnics or enjoying the scenery, native birds and animals—with this beside-water usage being moderate.

Overall knowledge and literacy was moderate across the three CMAs, indicating an area that needs improvement. Many people had an accurate perception of their knowledge or lack of knowledge in relation to river health and what makes for a healthy river, but a significant number had little or no understanding of the importance of recommended practices, such as removing willows and keeping fallen logs and branches in the river. Generally, in each CMA region people aspired to have healthy waterways and valued healthy rivers highly, but their overall knowledge of how to do this was low to moderate, translating to low general river health behaviours.

People in all CMAs perceived that all levels of government and users of waterways had a high level of responsibility to ensure the health of waterways. Most people believed everyone should do more to improve river health, including both government agencies and users of waterways, but, again, this was not generally reflected in either levels of knowledge or behaviour.

Implications for Engaging Communities

Actions by both the general public and farmers can improve river health. If the influences of such behaviour can be determined, it is also possible to prioritise engagement and communication activities to maximise positive river health actions.

Our survey tested respondents' stated responses to two types of river health behaviours:

1. General river health behaviours including involvement in landcare, Bushcare or Waterwatch, seeking information about river health, taking part in river health local projects or events, or trying to encourage someone else to change their behaviour for river health outcomes.
2. Farming river health behaviours including preventing stock from accessing waterways, planting native vegetation along waterways, removing weeds, or seeking advice on river health.

Both sets of behaviours improve river health. The strongest direct influences on general river health behaviours are (in order of strength from highest to lowest):

1. beside-water recreational use of water
2. farm use of water
3. river health knowledge and literacy
4. trust in recommended practices

Therefore, for example, CMAs trying to improve general river health behaviours as a high-priority target would look to maximise beside-water recreational use of its waterways through actions such as providing better picnic facilities, walking tracks and interpretative displays.

In the final phase of this project, we conducted interviews with each pilot catchment to discuss the process of the project, the interpretation of that data, likely uses they would have of the survey results, and other possible methods for testing and extending the data. The complexity and breadth of the data means that river managers will need to explore it in greater depth and according to their own needs and priorities.

For example, the Corangamite CMA wanted to improve river health literacy and positive behaviours among its urban populations, especially in the City of Geelong. We separated and analysed the survey data for Geelong from the other responses for the Corangamite region to get a more specific idea of their knowledge and literacy. We found that Geelong residents appear to have little knowledge about some river health aspects. They were mostly unaware of the benefits of dead branches and logs in a river, water flowing out to sea, and the natural drought and flood cycles that the wetland areas of a healthy river experience. These findings have helped shape the key messages in the CMA's river health communication strategy, which include the following:

1. Healthy rivers have native vegetation along their banks, a natural wetting and drying cycle, and have logs and branches as habitat for a diversity of fauna
2. Rivers are living systems that need water—water flowing to the sea is not wasted.

The Corangamite CMA also wanted to compare how their rural and urban residents perceived the health of waterways in the Corangamite catchment that they were most familiar with. We separated the data for the most commonly selected waterways and then compared their responses against the biophysical data collected by the ISC. The most common waterway selected by both urban and rural residents, by far, was the Barwon River. Most people did not identify a particular reach in this river, which made it difficult for us to compare respondents' perceived health of the reach against the actual biophysical reach-based data collected by the ISC. The ISC rates all Barwon River reaches as being in poor health, except for the entrance to the river and its length to Barwon Heads, where it is assessed as having moderate health. Most of this project's survey respondents, both rural (71 per cent) and urban (70 per cent), rated the Barwon River as being unhealthy or a little unhealthy, which appears to back up the ISC results. Survey respondents provided reasons for why they believed the Barwon was unhealthy, the most common being the presence of algal blooms. Some suggested that algae discouraged them from swimming in the river because they feared getting sick. The colour of the river was also a factor influencing the respondents' perceptions—a

muddy-looking or murky river was seen as an unhealthy river. Dead branches, algae, rubbish and pollution added to the unhealthy look of the river.

The Corangamite CMA's communication strategy aims to increase the involvement of residents in helping to restore and protect the rivers that residents feel most connected to. The Barwon River will be a particular focus of the Corangamite CMA's activities.

It is important that the survey results gathered from social indicators are further explored and interpreted with the communities involved in the engagement activities. This is considered essential by most of the researchers involved in social indicator work (Aitken 2000; Bellamy et al. 2001; Lockie et al. 2005; Parkins et al. 2001). Lockie et al. (2002) believe that participatory approaches to interpreting social indicators help overcome many of the problems associated with trying to understand continually changing social environments by taking into account:

1. the variable impact of environmental, economic and social changes on affected communities
2. the many and competing interpretations and responses to these changes
3. how these interpretations and responses change over time
4. the differing power relations that exist within a community

Indeed, many researchers believe that the communities under study should be involved in determining the social indicators to be studied to ensure these indicators reflect their values rather than those of the researchers (Cobb and Rixford 2003). This project relied on the inputs of the steering committee to reflect the values of their communities in determining the relevance of the social indicators that were established. However, the survey data now needs to be further explored by the CMAs with local communities.

From the CMA staff review, it was apparent that many of the river health officers had a very good understanding of their local communities, and that their knowledge was relevant in testing and further exploring the survey data. Cavaye (2003) suggests that gaining feedback from informed people, such as river health officers in this case, can be a cost-effective way of collecting detailed interpretable data that can be used with the survey

data for prioritising and assessing river health engagement activities. For example, when Corangamite CMA started developing a communication strategy, they presented and discussed the data with river health officers. This discussion led them to prioritise their engagement activities to:

1. connect communities and individuals more with rivers
2. increase positive river health behaviours
3. target urban communities, especially recreational users of waterways
4. target a new group not specifically targeted before—visitors to the region, especially the surf coast and Great Ocean Road

Using Surveys to Measure Social Indicators of River Health

The survey methodology developed for the project provided river managers with:

- a better understanding of community expectations, attitudes and behaviours towards river management specifically, and water resource management more broadly
- information to help them develop priorities (both social and environmental) for action
- a tool to assess the long-term (five to ten years) effectiveness of river health community education and engagement activities against defined targets over time

However, it is important to recognise the limitations of this tool. The survey does not:

- target CMA's key groups such as landholders with river frontage, rather it is designed for the general public in the catchment communities
- discriminate between people's different river health values, showing everyone as having high river health aspirations
- detect *all* social features relevant to river health such as community capacity or social networks
- does not detect short-term changes in social condition

- stand alone; it needs to be interpreted by the CMA and its communities
- test actual behaviour—it only measures stated behaviours; the literature such as Booth et al. (2004) cautions on interpreting the relationships between what people value, how they intend to behave and how they actually behave
- produce results at a local river reach, and is only applicable at a broad scale (state-wide or CMA-wide)

Discussion

While we have developed the first comprehensive pilot study conducted in Australia of the social condition of communities with regard to river health, more research is needed to comprehensively assess social condition for river health.

If river managers are to gain a thorough understanding of community expectations, attitudes and behaviours towards river management, they will need indicators at scales finer than we could develop in this project. For example, a recommendation for the next survey is to implement a process so that respondents can more easily identify specific river reaches in their catchment. While this project provides the CMAs with information to help them develop priorities (both social and environmental) for action, much of the information needs to be interpreted with caution as there is no ideal 'social condition' to which the information can be compared. There is a need for oganisations to develop good methods to involve the general public in interpreting data from their own experience and helping to set social and environmental priorities for river health in their regions.

The Victorian Department of Sustainability and Environment will use this survey instrument to test social indicators regularly across Victoria—possibly every five years, like the ISC. This pilot project has provided benchmarking data to assess changes in social condition of river health over time in three regions. However, if river managers are to assess the long-term (five to ten years) effectiveness of river health community education and engagement activities against defined targets over time they will also need assistance from social scientists in setting targets and measuring them, and they will need the input of their communities in interpreting the data collected.

NOTES

1. This study is part of a larger project commissioned by the Victorian Department of Sustainability and Environment and managed by The University of Queensland.
2. The indicators developed through the SMART filter must be: simple (easily interpreted and monitored, and appropriate for community use), measurable (statistically verifiable, reproducible, comparable, able to be aggregated, responsive to management changes, and able to show trends over time), accessible (regularly monitored, cost-effective and consistent with other data sources), relevant (related to valued NRM factors and linked to regional NRM body goals and priorities) and timely (offering early warning of potential problems and future needs or issues).

REFERENCES

Aitken, L.G. (2000), 'Identifying Community Features and Processes in Sustainable Natural Resource Management', CIRM Occasional Paper, State of Queensland (Department of Natural Resources and Mines), Brisbane.

Azar, C., J. Holmberg and K. Lindgren (1996), 'Socio-ecological Indicators for Sustainability', *Ecological Economics*, 18(2), pp. 89–112.

Barrett, F. and D. Pascoe (2003), 'Environmental Compliance and Enforcement Indicators: Environment Canada Pilot Projects—Addressing Challenges', in INECE-OECD Expert Workshop on Environmental Compliance and Enforcement Indicators: Measuring What Matters, November, Paris, available at http://inece.org/indicators/proceedings/04d_canada.pdf, accessed on 27 August 2007.

Bellamy, J. (ed.) (2005), 'Regional Natural Resource Management Panning: The Challenges of Evaluation as Seen Through Different Lenses', Papers from Occasional Symposium, CSIRO Sustainable Ecosystems. Brisbane: Department of Natural Resources and Mines, 15 October.

Bellamy, J.A., D.H. Walker, G.T. McDonalds and J.G. Syme (2001), 'A Systems Approach to the Evaluation of Natural Resource Management Initiatives', *Journal of Environmental Management*, 63(4), pp. 407–23.

Booth, D.B., J.R. Karr, S. Schauman, C.P. Konrad, S.A. Morley, M.G. Larson and S.J. Burges (2004), 'Reviving Urban Streams: Land Use, Hydrology, Biology, and Human Behavior', *Journal of the American Water Resources Association*, October, pp. 1351–64.

Byron, L., R. Nelson, T. Webb and T. Cody (2006), *Socio-economic Indicators and Protocols for the National NRM M&E Framework: Capacity of Land Managers to Adopt Management Practices*. Canberra: National Land and Water Resources Audit.

Bulmer, M. (2001), 'Social Measurement: What Stands In Its Way?' *Social Research*, 68(2), pp. 455–77.

Cavaye, J. (2003), *Integrating Economic and Social Issues in Regional Natural Resource Management Planning: A Framework for Regional NRM Bodies*. Brisbane: Queensland Government.

Cavaye, J. (2005), *Capacity Assessment Methodology for NRM Regional Arrangements: Capacity Building SIP Project*. Brisbane: Queensland Natural Resources and Mines.

Parkins, J.R., R.C. Stedman and J. Varghese (2001), 'Moving toward Local-level Indicators of Sustainability in Forest-based Communities: A Mixed-method Approach', *Social Indicators Research*, 56, pp. 43–72.

Cobb, C. and C. Rixford (1998), *Lessons Learned from the History of Social Indicators*. San Francisco: Redefining Progress.

Curtis, A. and I. Byron (2002), *Understanding the Social Drivers of Catchment Management in the Wimmera Region*. Albury: The Johnstone Centre.

Curtis, A., I. Byron and J. MacKay (2005), 'Integrating Socio-economic and Biophysical Data to Underpin Collaborative Watershed Management', *Journal of the American Water Resources Association*, 41(3), pp. 549–63.

Curtis, A. and T. DeLacy (1997), 'Examining the Assumptions Underlying Landcare', in S. Lockie and F. Vanclay (eds.), *Critical Landcare: Centre for Rural Social Research Key Papers Number 5*. Wagga Wagga: Centre for Rural Social Research, Charles Sturt University, pp. 185–99.

Curtis, A., M. Lockwood and J. MacKay (2001), 'Exploring Landholder Willingness and Capacity to Manage Dryland Salinity in the Goulburn Broken Catchment', *Australian Journal of Environmental Management*, 8(1322–1698), pp. 79–90.

Effendi, Y. (2004), 'Waterways Satisfaction Monitor: A Quantitative Research Report for Melbourne Water', Melbourne Water, Melbourne.

Jackson, J.E., R.G. Lee and P. Sommers (2004), 'Monitoring the Community Impacts of the Northwest Forest Plan: An Alternative to Social Indicators', *Society and Natural Resources*, 17(3), pp. 223–33.

Force, J.E., G.E. Machlis, S.E. Dalton and D. Fosdeck (1995), *Monitoring Social Indicators for Ecosystem Management: The Technical Assessment Data*. Moscow: Interior Columbia River Basin Project.

Lockie, S., G. Lawrence, A. Dale and B. Taylor (2002), 'Capacity for Change: Testing a Model for the Inclusion of Social Indicators in Australia's National Land and Water Resources Audit', *Journal of Environmental Planning and Management*, 45(6), pp. 813–26.

Lockie, S., S. Rockloff, D. Helbers, K. Lawrence and M. Gorospe-Lockie (2005), 'A Conceptual Framework for Selecting and Testing Potential Social and Community Health Indicators Linked to Changes in Coastal Resource Management or Condition: A Discussion Paper', Coastal Cooperative Research Centre, Brisbane.

Machlis, G.E., J.E. Force and S.E. Dalton (1994), *Monitoring Social Indicators for Ecosystem Management*. Moscow: Interior Columbia River Basin Project.

Parkins, J.R., R.C. Stedman and J. Varghese (2001), 'Moving Toward Local-level Indicators of Sustainability in Forest-based Communities: A Mixed-method Approach', *Social Indicators Research*, 56(1), pp. 43–72.

Po, M., B.E. Nancarrow, Z. Leviston, N.B. Porter, G.J. Syme and J.D. Kaercher (2005), 'Predicting Community Behaviour in Relation to Wastewater Reuse; What Drives Decisions to Accept or Reject?' Water for a Healthy Country National Research Flagship. Perth: CSIRO Land and Water.

Rossi, R.J. and K.J. Gilmartin (1980), *The Handbook of Social Indicators: Sources, Characteristics, and Analysis*. New York: Garland STPM Press.

Stanley, J. (2006), *Developing Social Indicators for Natural Resource Management: A Practical Guide for Regional NRM Bodies in Queensland*. Brisbane: Department of Natural Resources and Mines and National Action Plan for Salinity and Water Quality.

Stanley, J., J. Mackenzie and B. Clouston (2006), *SMART and SPICED: Developing Social and Economic Indicators for Regional Natural Resource Management*. Brisbane: Department of Natural Resources and Water.

Taylor, B., S. Lockie, A. Dale, R. Bischof, G. Lawrence, M. Fenton and S. Coakes (2002), *Capacity of Farmers and Other Land Managers to Implement Change*. Canberra: NLWRA.

Vaughan, G.M. and M.A. Hogg (2005), *Introduction to Social Psychology*. Frenchs Forest: Pearson Education Australia.

Wolfenden, J., M. Evans and L. Dutra (2006), *What has been Learned that Increases the Opportunities for Irrigation Communities in a Changing World?* Toowoomba: Cooperative Research Centre for Irrigation Futures.