4 CHOICE OF ECONOMIC DECISION-MAKING MODEL TO ASSIST GBRMPA

This section considers the possible future use of data, including scientific, social and economic for assisting in decision making with respect to the management of the GBRMP. At the outset of this discussion, it must be acknowledged that decision making with respect to natural resource management is complex and commonly involves multiple objectives which are competing and conflicting. As a result, therefore, appropriate tools or techniques to organise data to assist in decision making will necessarily be limited to those which have the capacity to facilitate the incorporation of information from a number of disciplines which can identify an outcome that offers a compromise solution.

To assess GBRMPA's economic data requirements and methods of data collection processes as inputs into its decision-making and management tasks, it is necessary to first identify the types of economic decision-making models most appropriate to GBRMPA's needs. In this report we consider a number of possible decision-making tools of potential use by GBRMPA. The data requirements to implement these tools are discussed briefly, and the extent to which existing data sets meet these requirements is assessed. Identifying the most important gaps and priorities for additional data collection and making specific recommendations for future data collection depends on which of these tools GBRMPA decides to use, and for what purpose(s).

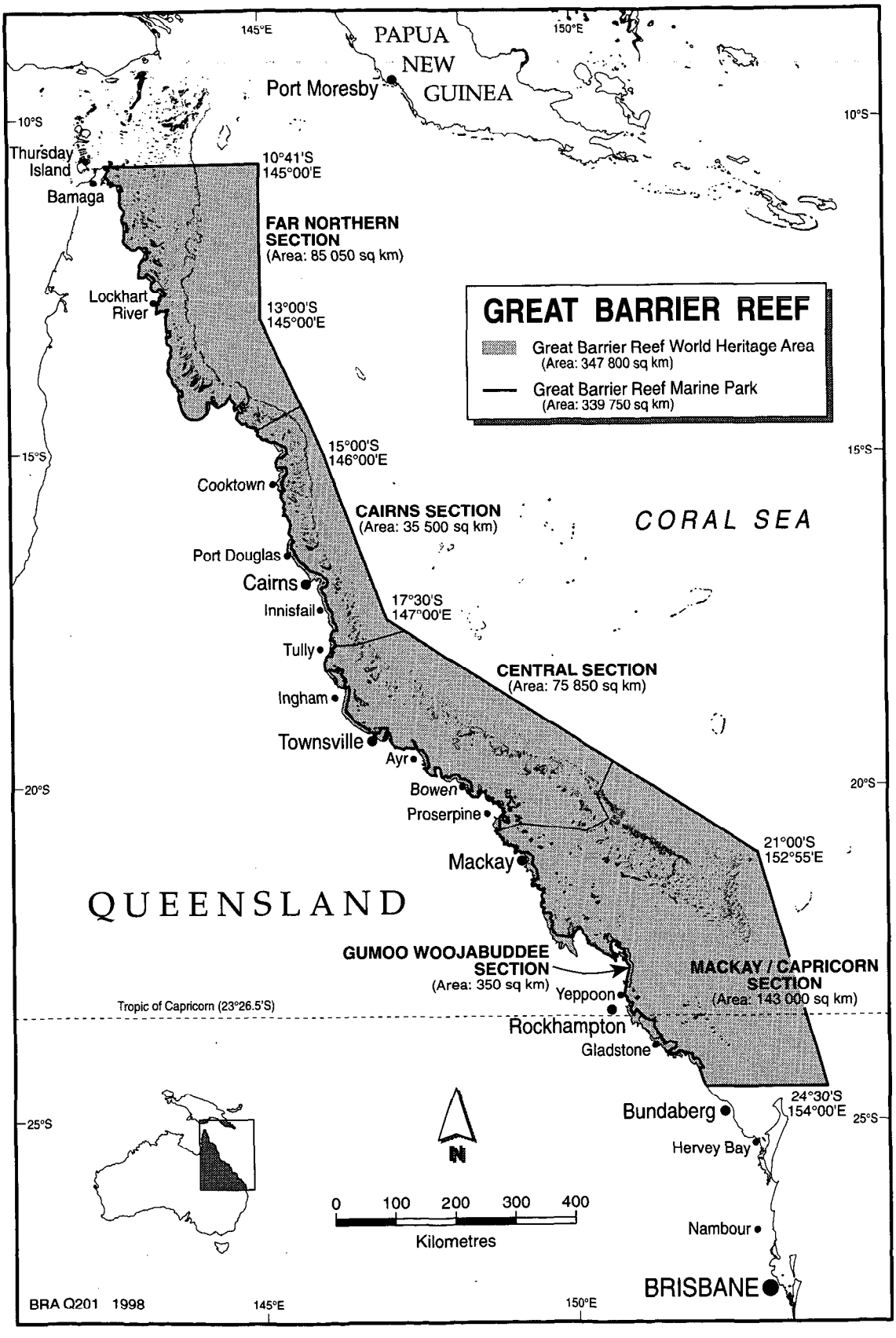
Although GBRMPA recognises the potential role of economics and economic valuation in its decision-making and management processes, to date this has not overtly occurred. A paper by Driml (1994) written for GBRMPA provides a basis for discussion of the role that economics could play in assisting GBRMPA meet its planning and management objectives. In this paper it is pointed out that the GBRMP, like other natural resources, offers multiple uses, both direct or active (e.g. tourism, commercial fishing, recreational fishing and other recreational activities) and indirect or passive (e.g. scientific, existence, option, and bequest).

GBRMPA currently uses zoning as a primary tool to manage the competing uses for the GBRMP. Zoning plans are developed in consultation with users and interested members of the community, and delineate where various types of use can occur. The GBRMP is managed, by delineating where and/or when different forms of use are permitted. There are four categories of zone and the delineation of the GBRMP is reviewed every five to 10 years (a map of the GBRMP is presented on the following page). How GBRMPA could employ economic decision-making models for this purpose is discussed below.

Management of the natural environment, particularly when this involves areas of natural beauty and important sources of biodiversity, requires the reconciliation of the exploitation of protected areas for tourism with the conservation objective. To date, GBRMPA has not operationalised a formal process or technique to manage decision making with respect to zoning for the GBRMP which provides a process to solicit input by stakeholders, or which clearly identifies and measures the possible trade-offs between conflicting uses (Driml 1994a, 1997b).

Tourism, which is allowed in most of the Park in one form or another (except those areas zoned as preservation zones), subject to various restrictions and permits, has become the most important commercial use of the GBRMP and continues to grow. This has brought it into increasing competition with conservation and other commercial and non-commercial uses.

As in any situation where there are competing potential uses of a scarce resource, the issue of optimal allocation arises. Where markets exist and function effectively this issue can be resolved through the price mechanism of the free market. In an ideal world the preferences of the various users would be expressed through their 'votes' in the market place and from which a set of market prices reflecting the appropriate values of alternative uses would arise, thereby also determining the 'optimal' allocation of the GBRMP's various resources. However, where there is market failure or where markets do not exist' there is a need for intervention.



Map 1. The Great Barrier Reef Marine Park, Australia

To this end economic analysis is required to assist the decision-making authorities in identifying the most desirable use, or, combination of uses, to which the GBRMP should be put. This requires economic valuation of alternative uses and some formal system of weighting and

aggregating the economic gains and losses to the various individuals or 'stakeholders' involved, to enable appropriate comparisons of alternative use allocations to be made. This raises some important issues: what decision-making models would be best suited to GBRMPA's requirements; what data are required to operationalise such models; and, where dollar values are required, what method(s) of valuation would be most appropriate.

Traditional techniques to organise information to evaluate alternative projects or programs to assist decision making, specifically, Cost Benefit Analysis (CBA), require the quantification, in dollar terms, of the full opportunity cost of all of the proposed alternatives to doing nothing. A number of possible problems arise in relation to using CBA as the exclusive or main decision-making tool in natural resource management.

First, for only some of the resource's (the resource being the GBRMP) uses, such as commercial fishing and tourism, is there a market and hence a value provided by the market. For other uses, both direct, such as recreational activities, and indirect, such as existence, there is no market or market value, yet the GBRMP has obvious value to those using it, actively or passively.

Second, even if there were well-functioning markets for each use, the resulting allocation of resources can only be considered both economically efficient ('optimal') and socially desirable to the extent that we also consider the existing 'voting power' of the various stakeholders, as determined by their relative income levels in the market, as desirable. The relative weights given by the market mechanisms to the preferences of the various players, both among contemporaries and between present and future generations, determines the socially optimal allocation of resources. If, for whatever reason, the distribution of 'voting power' (e.g. income) changes, so too does the market-determined, optimal allocation of resources. It therefore follows that if a market-determined resource allocation is deemed to be socially optimal, we must also consider the relative 'voting power' of competing stakeholder groups in the market place as socially optimal. We refer here to the issue of *equity*. In the context of non-renewable resources, such as the GBRMP, it is necessary to consider the implications for both intra- and inter-generational equity arising from any changes to the pattern of a resource's uses when adopting an economic decision-making model such as CBA.

Third, and related to the preceding point, with or without market prices, there are likely to be numerous uncertainties, arising from our current lack of knowledge about the possible effects on resources, such as damage to the coral arising from tourist activities, and the prospects, if any, for the eventual recovery of a damaged natural resource. Such uncertainties, combined with possible irreversibilities have profound implications for decision making and the determination of what constitutes an 'optimal' allocation of resources and/or use of a natural resource. A CBA approach could fail if prices used did not also reflect the hidden benefit that accrues from the option of postponing the decision to use a resource, and thereby avoiding possible irreversible damage; at least until a point in time when sufficient information is available to accurately assess the capacity of the resource to recover from any damage inflicted through its use. In other words, intervention based on the *precautionary principle* to decide the extent of, say, tourist activities on the Reef, could provide a more optimal allocation of resources than one based on the *Total Economic Value* within a CBA decision-making framework, as discussed below.

Although considerable research has been directed towards developing consistent techniques to value non-use attributes of the environment, there is a general lack of confidence in the outcomes. CBA also assumes that sufficient ecological information is available to make trade-offs explicit. As Driml (1994) correctly argues, this is clearly not the case. She goes on to argue that CBA 'should be considered mostly for their potential application to specific decisions in zoning or management planning such as areas of competing direct uses, or assessment of major project proposals' (p. 5). To this end Driml (1994a, 1997b) and Driml and Common (1995) propose the *Total Economic Value* (TEV) approach which provides a monetary measure of the TEV of the uses of a natural resource which takes into account both marketed and non-marketed values.

4.1 Data Requirements

Figure 4.1 provides a schematic representation of alternative data sources and their possible uses in different forms of analysis to support GBRMPA's decision making. We distinguish between 'routine' and 'non-routine' data sources. Within the routine data sets we distinguish between those that already exist and continue to be compiled, versus additional data requirements that we identify for future compilation on a routine basis by GBRMPA or other agencies. Non-routine data are those data that may be focused on particular attributes or aspects of management of GBRMP and often require lengthy and costly collection processes, perhaps as part of ongoing scientific research studies. Included here would be studies of valuations of non-marketed attributes and uses of the GBRMP and those designed to establish safe minimum standards.

Data of both sorts are required for various forms of economic and other analyses, such as input-output analysis, CBA and social impact assessment (SIA), all of which have potentially useful roles in GBRMPA's decision making. However, as argued above, in none of these forms of analysis, when used individually, is it possible to take account of all decision-making criteria. MCA is shown in figure 4.1 to be an appropriate method to bring together information of all forms and types, from multiple disciplines, to be used in a single, coherent decision-support framework.

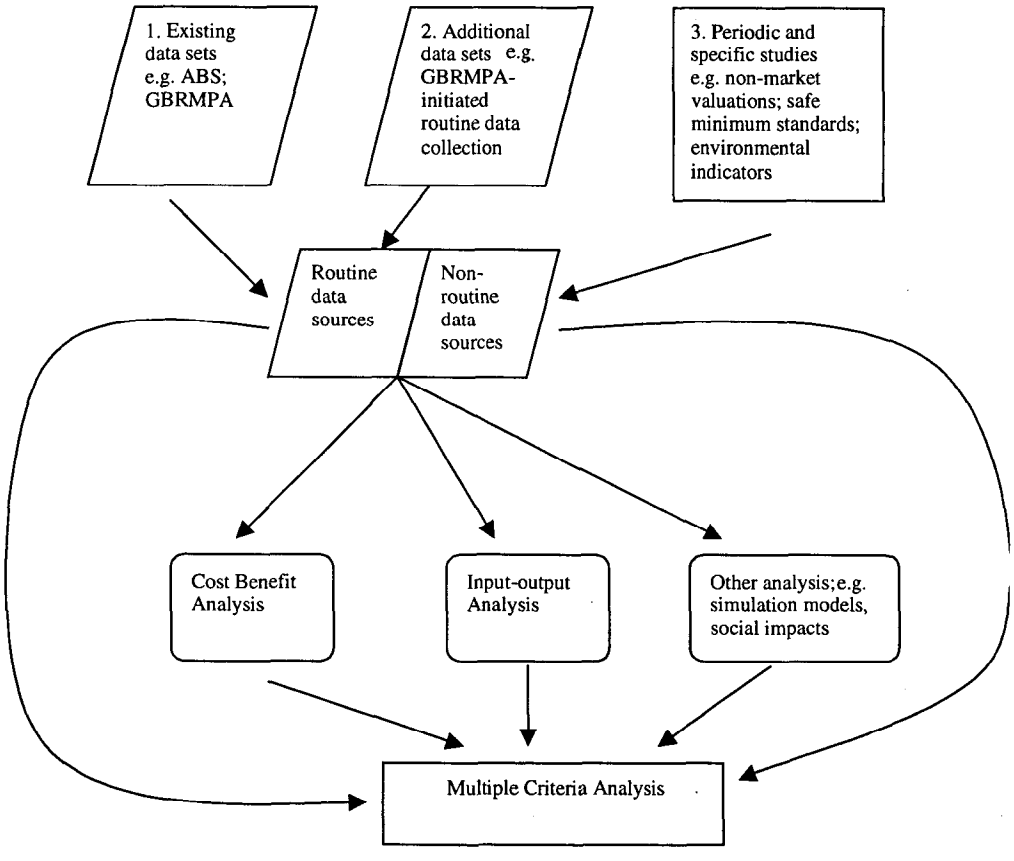


Figure 4.1 Schematic representation of data requirements and uses

The data required to undertake an MCA are multidisciplinary. They include economic, social and scientific data. It is expected that some of the required data are currently collected by GBRMPA on a routine basis and some would need to be collected on an ad hoc or non-routine basis. Non-routine data collection, to provide information about a specific activity in the GBRMP, would include simulation models, to demonstrate 'what is' and to determine the relationship between specific elements in the ecological system. Alternatively, an expert system, to predict a measured response to a change in natural conditions or exogenous impact, would contribute to an increased understanding of the ecosystem.

Australian Bureau of Statistics	establishments, detailing visitors, visitor nights, length of stay and spend on accommodation. • Survey methodology changed from census survey to sample survey in 1998, and is therefore not directly comparable to pre-1997 survey results.
Domestic Tourism Monitor, Bureau of Tourism Research	• Survey of domestic tourists detailing origin, time spent, accommodation nights by region. • Survey finished in 1997–98, replaced by National Visitor Survey, which incorporates tourist expenditure data.
International Visitor Survey, Bureau of Tourism Research	• Survey of international tourists departing from international airports, detailing length of stay, expenditure by type of spend.
National Visitor Survey, Bureau of Tourism Research	• Survey of domestic tourists detailing origin, time spent, accommodation nights, and expenditure by type by region. • Survey commenced in 1997–98 to replace the Domestic Tourism Monitor.

In order to present historical data for this study, we utilised the Queensland Visitor Survey and the Survey of Tourist Accommodation, however we appreciate that the next time this study is to be conducted, the data should be sourced from the International Visitor Survey and the National Visitor Survey. Further, as these data sources vary to those previously used, it must be noted that the results of future studies will necessarily not be comparable to either this report or earlier Driml studies.

4.1.2 Specific Non-routine Studies

4.1.2.1 Valuation of Non-marketed Uses

As economic valuation of the Park's various uses requires estimation of both market and non-market values there is a need to consider which methodology for valuation of non-market uses would be best suited for this purpose. Methods of non-market valuation can be broadly divided among those that attempt to estimate a demand curve for each of the resource's uses and those that estimate the cost of various regulatory or preventative actions, or on the physical relationships between policy actions and environmental quality, economic efficiency, or welfare (Garrod & Willis 1999). The demand curve approach is generally considered the better of the two approaches, but there is yet no consensus on which particular methodology provides the best estimate of a demand curve for a non-market use. There are two types of approach to this: the *revealed preference* and the *expressed preference* approaches. The former rely on estimates of what consumers actually spend in the market on the purchase of similar or related goods or services and include the *Travel Cost* method and the *Hedonic Pricing* method (Hanley & Splash 1993; Garrod & Willis 1999). The *expressed preference* approaches use experiments and surveys to elicit from consumers what amounts they would be willing to pay for the various uses of a particular resource. Table 4.1 provides a useful summary of the different valuation methods, their purposes, data requirements and examples of Australian applications.

For a more detailed discussion of these methods see, for example, Garrod & Willis (1999), Hanley & Splash (1993), Sinden (1994) and Young (1991). The choice of valuation technique to be adopted in any study estimating environmental benefits depends on the purpose of the study and the economic values required. Until very recently, the most highly regarded (and still, the most commonly used) methodology was the *Contingent Valuation Method* (CVM). The validity and reliability of the CVM methodology has been the subject of extensive discussion and criticism which has led to a number of important refinements, both in the design of the survey instrument and interpretation and analysis of the results obtained. One of the most serious methodological criticisms of CVM has been the open-ended nature of the questions put

to survey respondents about their willingness to pay (or accept) for a particular use. Another severe drawback is that CVM is capable of being used to estimate the value of only one or two resource use options (Morrison et al. 1996). Alternative approaches that are essentially variations of CVM include *Contingent Ranking, Contingent Rating,* and *Paired Comparison.* The main difference between these and CVM is that they require the respondents in an experiment to rate or rank discrete, alternative combinations of attributes and their levels, relevant to a particular natural resource. However, these methods also suffer a number of methodological weaknesses.

Table 4.1 Methods to estimate values

Method	What can be valued?	What data are required?	Australian examples
1. Travel cost	Consumers' surplus	Quantities and costs for each visitor group	Recreation, poverty
2. Hedonic pricing	Consumers' surplus and total benefit	Price and characteristics of a good, from many exchanges of the good	Soil conservation, pollution, noise, aesthetics, woodland preservation
3. Contingent valuation	Consumers' surplus and total benefit	Willingness-to-pay responses in surveys	Air pollution, wildlife and habitat preservation, life
4. Marginal product	Producers' surplus	Increase in output from increase in input	Water, timber, life, soil conservation
5. Defensive expenditure	Consumers' surplus	Increase in expenditure to maintain welfare	Fishing, rural way of life
6. Utility analysis	Consumers' surplus	Utility functions from each consumer	Recreation, rural way of life, environmental preservation
7. Benefit transfer	Consumers' surplus and total benefit; producers' surplus and total cost	Value in similar case, model to transfer to new case	Fishing
Source: Sinden 1994, table 1, p. 339			

More recently, however, a 'new' methodology for valuation of natural resources, *Choice Modelling,* has been developed. This method is believed to be less prone to the biases and other limitations of other expressed preference approaches, more firmly grounded in economic theory, capable of providing measures of both relative and absolute (Morrison et al. 1996). Although the methodology itself is not new, having been developed in the 1970s and 1980s in the context of marketing and transportation economics (see Hensher 1981; Louviere & Henscher 1982), its adaptation and application to non-market valuation in environmental economics is very recent and still in its formative stage. Validity and reliability tests are inconclusive, although recent applications of the methodology have met with some success in terms of theoretical and predictive validity and reliability (Morrison et al. 1996). Recent advances/developments in Choice Modelling (CM) offer a new and potentially superior alternative method to the Contingent Valuation Method (CVM), particularly in the context of decision making where there are competing potential uses (active and passive) of a natural resource. To our knowledge there has been no attempt as yet to investigate the applicability of this methodology in estimating economic values for the GBRMP's uses.

The Choice Modelling procedure begins with a listing of all the attributes of the natural resource, in our instance, the GBRMP, and all levels over which these attributes could realistically vary under the range of feasible policy options. With a manageable number of choice sets, a questionnaire is then designed in which the respondent is required to make a series of choices, each time selecting one from two of the possible choice sets plus another representing a 'no change' scenario. The specification of the attributes and attribute levels as well as the design of the questionnaire and background information to be presented to respondents needs to be undertaken on an interactive and iterative basis with small focus groups

drawn from the sample of potential respondents. These data are then analysed using a conditional multinomial logit regression model, from which values for the resource's individual attributes as well the aggregate value of the resource, in our case, the GBRMP, are derived.

Recommendation
It is recommended that GBRMPA gives serious consideration to undertaking a number of survey-based studies of this sort, with a view to deriving realistic and defendable estimates of trade-off values between alternative GBRMP uses. The number and spatial range of such studies required will depend upon the extent to which *benefit transfer* is considered a reliable methodology for estimating values of identical or similar attributes in a context or location other than that in which a survey-based estimate has been derived.

When values are estimated for a given set of environmental attributes at a specific site or area of, say the GBRMP, and are then used to value the same or similar attributes elsewhere on the GBRMP, the term *Benefit Transfer* (BT) is applied. This method of valuation is generally advocated when resources are constrained to the extent that commissioning research projects is not feasible. Caution needs to be exercised in using this method, even in situations where the attributes may be considered identical. The reason for this is that the characteristics of the consumers and/or stakeholders may differ, or, the relative prices of other goods and services good vary by location. Valuation studies are usually not designed with benefit transfer in mind. If GRMPA wishes to consider the use of BT, given the physical size of the GBRMP area and the limited financial and other resources available for research, it is imperative that any study to assess environmental values ought to be designed from the outset with the possibility of BT in mind. As Garrod and Willis (1999) note, 'There is scope in environmental valuation for research into spatial variations in value estimates, as distinct from merely replicating valuation studies at different points in space' (p. 369).

4.1.2.2 Environmental Indicators

The identification of measurable attributes of the ecological sustainability of the economy of a nation, region, catchment or farm unit is explored by Walker and Reuter (1996). They define indicators as 'key attributes that give an impression of major trends and condition, and are based on the key components of the whole agro-ecosystem' (p. 7). They also argue that ecological sustainability indicators are 'precise and accurate in describing a particular function of the environment and will serve to signal desirable or undesirable changes' (p. 7).

More recently, the State of the Environment Advisory Council (SEAC) (1996) and the Australian Local Government Association (ALGA) (1997) have adopted the pressure-state-response model developed by the Organisation for Economic Cooperation and Development (OECD) to propose a set of indicators that reflect priority issues in regional policies, plans and strategies. The pressure-state-response model is based on indicators which represent key elements of more complex systems. It is a model developed to assess or evaluate natural resource management. Pressure indicators are selected as representing human activities that affect the environment; response indicators represent the human response to a perceived environmental problem; and state indicators register changes in the environment which reflect the impact or pressures and/or the effectiveness of the response. The report by ALGA has identified data sources of selected indicators and identified gaps in the currently available data. One of the findings from the report states that 'there is currently a dearth of reliable baseline data' and that establishment of quantifiable benchmarks or indicators for evaluation of resource management is an important requirement (p. 10).

Preparation of the State of the Environment report (SEAC 19976) has involved the development of a set of indicators that can be used to assess the condition of natural resources. It is anticipated that these indicators will provide 'a good foundation for future development' (p. ES-6).