GREAT BARRIER REEF
MARINE PARK AUTHORITY

RESEARCH PUBLICATION No. 63

Economic and Financial Values of the Great Barrier Reef Marine Park

KPMG Consulting

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A REPORT TO THE GREAT BARRIER REEF MARINE PARK AUTHORITY

ISSN 1037-1508
ISBN 0 642 23085 4

Published March 2000 by the Great Barrier Reef Marine Park Authority.

National Library of Australia Cataloguing-in-Publication data:

Economic and financial values of the Great Barrier Reef Marine Park.

ISBN 0 642 23085 4.

1. Tourist trade - Economic aspects - Queensland - Great Barrier Reef. 2. Fishing - Economic aspects - Queensland - Great Barrier Reef Marine Park. 3. Boats and boating - Economic aspects - Queensland - Great Barrier Reef. 4. Fisheries - Economic aspects - Queensland - Great Barrier Reef. I. Great Barrier Reef Marine Park Authority (Australia). II. KPMG Consulting. (Series : Research publication (Great Barrier Reef Marine Park Authority (Australia)) ; no. 63).

333.91809943

GREAT BARRIER REEF
MARINE PARK AUTHORITY

PO Box 1379
Townsville Qld 4810
Telephone (07) 4750 0700

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SUMMARY

The purpose of this paper was to update the financial values presented in Driml (1997b), and also further discuss methods by which resource values for the Great Barrier Reef Marine Park may be estimated on an ongoing basis. The identification of appropriate models was considered an essential first step for the effective evaluation of resource management strategies as the type and format of the data required for estimating resource values depends highly on the evaluation model.

Our analysis found that the three direct uses of the Great Barrier Reef Marine Park generated average revenues of about $700 million per annum over the period 1993–94 to 1997–98. We note that the financial year 1995–96 recorded a significantly higher number of tourists than the other years under review, which generated a higher than average level of revenue for the Great Barrier Reef Marine Park.

Great Barrier Reef Marine Park
Gross Financial Value of Direct Uses
($'000) *

	1993–94	1994–95	1995–96	1996–97	1997–98
Commercial Tourism	411 149	436 513	507 392	430 627	454 836
Commercial Fishing	141 722	120 630	149 429	141 458	136 180
Recreational Fishing and Boating	112 038	120 194	117 953	113 258	107 572
Total	664 910	677 337	774 774	685 342	698 588

* = nominal dollars. Source: KPMG Consulting

In preparing the estimates of financial values, KPMG refined the approach adopted by Driml (1997b), and in this respect, the outcomes of the two studies are not necessarily comparable. We note that the methodology utilised by KPMG is open to further refinement as secondary data sources evolve over time.

The estimates of the financial values of the direct uses of the Great Barrier Reef Marine Park do not include consideration of the flow-on impact, or the effect of linkages of these activities, with other industries in the state economy. We have extended this direct contribution analysis and considered the indirect or flow-on effects of those activities, in terms of output and employment, on the economy of the State of Queensland through the use of input-output analysis. The following table summarises the initial, flow-on and total impacts for output and employment associated with the nominated economic activities that utilise the Great Barrier Reef Marine Park, for the year 1994–95.

Summary of Output Effects GBRMP-based Activities, Queensland, 1994–95

Activity	Output Effects			Employment Effects		
	Initial Output ($m)	Flow-on ($m)	Total Impact ($m)	Initial Employ. (no.)	Flow-on (no.)	Total Impact
Commercial Tourism	436.5	407.9	844.4	7 421	5 467	12 888
Commercial Fishing	120.6	73.3	193.9	1 568	1 152	2 720
Recreational Fishing and Boating	120.2	134.7	254.9	N/A	2 008	2 008
Total	677.3	615.9	1 293.2	8 989	8 627	17 616

Source: KPMG Consulting

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.

Traditional techniques to organise information to evaluate alternative projects or programs to assist decision making, specifically, Cost Benefit Analysis, 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 Cost Benefit Analysis as the exclusive or main decision-making tool in natural resource management.

We have suggested that it would be advisable for the Great Barrier Reef Marine Park Authority to consider the use of complementary decision-making models such as Multiple Objective Decision Support Systems or Multiple Criteria Analysis which allow the analyst to incorporate both pecuniary and non-pecuniary values in the decision-making process. Multiple Criteria Analysis provides a formal process which is sufficiently flexible to facilitate the incorporation of information from a number of disciplines. It is an appropriate tool to assist decision making when the problem to be addressed is complex and poorly defined; when there are multiple and competing objectives; and, in situations where there are multiple stakeholders with conflicting points of view about the appropriate decision.

It needs to be emphasised that the compilation of an economic data set for use in decision making requires the same long-term investment in appropriate research as is the case for scientific data. To this end the Marine Park Authority needs to give serious consideration to both ad hoc data collection exercises, possibly on a consultancy arrangement as is the existing practice, and to long-term research projects in collaboration with appropriate research institutions, for instance, under ARC SPIRT* grants with Universities.

* Australian Research Council *Strategic Partnerships with Industry – Research and Training Scheme*

1 INTRODUCTION

1.1 Background and Purpose

The Great Barrier Reef Marine Park Authority (GBRMPA) has published various research papers estimating the financial values of activities which directly utilise the Great Barrier Reef Marine Park (GBRMP), including commercial tourism, commercial fishing, recreational fishing and recreational boating. The most recent analysis, *Dollar Values and Trends of Major Direct Uses of the Great Barrier Reef Marine Park* (Driml 1997b), estimates gross financial values of these major direct uses over the financial years 1991–92 and 1995–96. Driml, Hundloe and Blamey (1997) explored the broader issues of economics associated with the GBRMP, discussing methodologies to ascertain economic resource values, and how ecological economics could be applied to the management of the GBRMP. Further, in *Protection for Profit* (Driml 1994a), research was also presented on resource values associated with the GBRMP that are not measured in dollar terms, but should be considered in order to effectively manage the Marine Park.

The purpose of this paper is to update the financial values presented in Driml (1997b), and also further discuss methods by which resource values for the Marine Park may be estimated on an ongoing basis. This is to allow for the identification of appropriate models for the effective evaluation of resource management strategies.

Specifically, the terms of reference of this assignment were to:

- report on the trends in gross financial values of the direct uses of the Great Barrier Reef World Heritage Area;
- review methodologies for reporting on the economic values of the Great Barrier Reef World Heritage Area and make recommendations for reporting those values;
- calculate gross financial values for commercial tourism for as many years as is possible since 1997–98 and provide information on visitor numbers and Reef use;
- provide information on sources for indicators of Reef uses and gross financial values for commercial fishing and recreational fishing and boating in the Great Barrier Reef Marine Park and World Heritage Area; and
- recommend appropriate economic and financial reporting cycles specific to the Authority's requirements.

1.2 Scope of Works Completed

KPMG, Dr Richard Brown and Dr Jackie Robinson were engaged by GBRMPA to complete this assignment, essentially updating the earlier Driml reports with respect to financial use values and also to provide details as to methodologies for reporting on economic values of the Marine Park.

We note that the scope of the study was limited to desk research only, with no primary research incorporated within the scope of works. Further, the authors prepared this study in the context of attending one briefing session with various GBRMPA representatives.

In completing the update of financial use values, KPMG completed the following tasks:

- review secondary data sources on tourism activity and prepare current estimates of financial use values for tourism activity;
- analyse Queensland Fisheries Management Authority data on the volume and gross wharf value of fish landed in ports within the Marine Park;
- review current literature on the value of recreational fishing and boating, extrapolate historical values into the future and compare the results; and
- summarise financial values from tourism activity, commercial fishing and recreational fishing and boating in the Marine Park.

In preparing the estimates of financial values, KPMG refined the approach adopted by Driml (1997b), and in this respect, the outcomes of the two studies are not necessarily comparable. We note that the methodology utilised by KPMG is open to further refinement as secondary data sources evolve over time.

In preparing a methodology for estimating economic values associated with the GBRMP, Dr Richard Brown and Dr Jackie Robinson completed the following tasks:

- determine flow-on impacts of the financial values through use of input-output analysis;
- discuss various economic decision-making models to assist GBRMPA, including detailing primary and secondary data requirements; and
- detail methodologies associated with Multiple Criteria Analysis (MCA), including presenting steps associated with its process.

In conclusion, we have summarised the financial values associated with the Marine Park and identified a methodology by which economic values associated with the Marine Park may be determined.

1.3 Warranties and Disclaimer

The statements and opinions in this report are given in good faith but, in the preparation of this report, KPMG Consulting has relied upon information provided by officers of the Great Barrier Reef Marine Park Authority.

This report has been prepared for the Great Barrier Reef Marine Park Authority and accordingly no warranty is given to third parties who may seek to utilise the information contained in this report.

The findings of this report are based on the sources indicated. Neither the whole or any part of this report nor any reference thereto may be included in or with or attached to any document, circular, resolution, letter or statement other than mentioned previously without our prior written consent in the form and context in which it appears.

2 FINANCIAL VALUES

This chapter of the report presents information on the direct, measurable income that is derived through utilising the GBRMP. The main uses of the GBRMP include:

- commercial tourism;
- commercial fishing; and
- private recreational fishing and boating.

It is noted that the estimates of the gross financial values of the direct uses of the GBRPM are not an estimate of the values of the existence of the protected area. Even in the absence of such a declared heritage area or marine park, the area would still be used for tourism, commercial and recreational fishing and boating but the financial values generated might be lower due to the greater degradation of the resource. In brief, it cannot be assumed that *all* estimates in terms of tourism, fishing etc. are attributable to the existence of the GBRMP itself or to the activities of GBRMPA in regulating its use.

The following sections present the most up-to-date information on the financial benefits gained through utilising the GBRMP in each of these major use groups.

2.1 Commercial Tourism

Commercial tourism in the GBRMP has been defined as including tourism on vessels and stays on island resorts, but excludes expenditure on air transport by tourists travelling to the region. The rationale for excluding this expenditure element relates to difficulties in attributing the proportion of total aircraft expenditure relating to activities within the GBRMP, as opposed to activities outside the Marine Park.

The financial value of commercial tourism in the GBRMP comprises expenditure on:

- trips on vessels in the GBRMP;
- accommodation on the mainland associated with the trip to the GBRMP; and
- holidays on island resorts (excluding on reef trips).

2.1.1 Passenger Expenditure on Commercial Tourism Vessels

The Great Barrier Reef Marine Park Authority collects information on the number of passenger days spent on commercial tourism vessels through administration procedures associated with the Environmental Management Charge (EMC).

In Driml (1997b), the value of passenger days spent on commercial tourism vessels was estimated by the following relationship:

$$V_{PV} = \sum (PD_{PVi} \times F_{PVi})$$

where:

V_{PV} = Value of passenger days spent on commercial tourism vessels in the GBRMP;

PD_{PVi} = Passenger days by type of commercial tourism vessel; and

F_{PVi} = Fares per trip per passenger day by commercial tourism vessel.

Passenger days by commercial tourism vessel was supplied through data analysis completed by GBRMPA, while fares per trip per passenger day were estimated through a prices survey conducted as part of the Driml (1997b) report.

Discussions with GBRMPA reveal that the data analysis completed for the Driml (1997b) report has not been updated, nor could it be updated in the time required to complete this analysis. Given this, we have assumed the same relative allocations over the analysis period in terms of

trip types, region and fares per passenger day (adjusting for inflation) as used in the Driml (1997b) report. These assumptions are detailed in the following table.

Table 2.1 Great Barrier Reef Marine Park key assumptions

Trip type and region	% of passenger days	Fares per passenger day $ 1995–96
Bareboat Whitsundays	2.9	90.00
Weekly cruise	1.0	220.00
Weekly fishing	0.1	100.00
Twice weekly	2.1	200.00
Daily dive	4.8	120.00
Daily cruise	4.3	70.00
Capricorn 100+ pax day trips	1.7	120.00
Mackay/Whitsundays 100+ pax day trips	8.5	120.00
Townsville 100+ pax day trips	3.7	120.00
Cairns 100+ pax day trips	35.4	120.00
Cruise ship	0.1	320.00
Unknown	35.5	70.00
Source: Driml 1997b		

Table 2.2 summarises passenger trips by type over the period 1993–94 to 1997–98.

Table 2.2 Great Barrier Reef Marine Park number of passenger days by trip type

Trip type and region	1993–94	1994–95	1995–96	1996–97	1997–98
Bareboat Whitsundays	45 141	42 676	48 692	44 384	43 022
Weekly cruise	15 254	14 421	16 454	14 998	14 538
Weekly fishing	994	939	1 072	977	947
Twice weekly	33 410	31 586	36 038	32 850	31 842
Daily dive	75 430	71 311	81 363	74 165	71 889
Daily cruise	66 901	63 247	72 163	65 779	63 760
Capricorn 100+ pax day trips	26 259	24 825	28 324	25 818	25 026
Mackay/Whitsundays 100+ pax day trips	133 122	125 851	143 592	130 889	126 872
Townsville 100+ pax day trips	57 771	54 616	62 314	56 802	55 058
Cairns 100+ pax day trips	555 526	525 187	599 219	546 208	529 445
Cruise ship	1 919	1 814	2 070	1 887	1 829
Unknown	556 425	526 037	600 189	547 092	530 301
Total[(a)]	1 568 151	1 482 510	1 691 490	1 541 850	1 494 529
(a) Equal to EMC passenger day data. Source: KPMG Consulting, GBRMPA					

Based on the assumptions and passenger trip numbers detailed above, we have estimated the gross value of passenger days on commercial tourism vessels in the Great Barrier Reef Marine Park as shown in table 2.3.

Table 2.3 Great Barrier Reef Marine Park gross value of passenger expenditure on commercial tourism vessels*

	1993–94	1994–95	1995–96	1996–97	1997–98
Total	$148 785 000	$145 874 000	$172 821 000	$160 046 000	$155 903 000
* = nominal dollars. Source: KPMG Consulting, GBRMPA					

2.1.2 Accommodation Expenditure—Mainland Accommodation

Tourism expenditure on accommodation associated with the GBRMP may be categorised as either being mainland accommodation or reef/island accommodation.

Driml (1997b) assumes that persons who utilise commercial tourism vessels within the GBRMP stay in mainland accommodation for two nights either prior to, and/or, upon completion of, their Marine Park trip.

While information on passenger days is captured within the Environmental Management Charge, that data set does not detail the actual number of passengers travelling on commercial tourism vessels. That is, passengers may be travelling on board a vessel for more than one day, such as a weekly bareboat passenger, weekly cruise passenger or a weekly fishing trip passenger. Therefore, passenger day data needs to be adjusted to take into consideration trip duration.

Trip duration by type of trip has been estimated by GBRMPA, and is presented in table 2.4.

Table 2.4 Great Barrier Reef Marine Park average trip duration by trip type

Trip type and region	Trip duration (days)
Bareboat Whitsundays	7
Weekly cruise	4
Weekly fishing	5
Twice weekly	3
Daily dive	1
Daily cruise	1
Capricorn 100+ pax day trips	1
Mackay/Whitsundays 100+ pax day trips	1
Townsville 100+ pax day trips	1
Cairns 100+ pax day trips	1
Cruise ship	3
Unknown	2
Source: Driml 1997b	

Total passenger numbers who potentially utilise commercial accommodation on the mainland can then be derived through the following simple formula:

$$PN_{PV} = \sum \left(\frac{PD_{PVi}}{TD_{PVi}} \right)$$

where:

PN_{PV} = Total passenger numbers utilising commercial tourism vessels in the GBRMP;

PD_{PVi} = Passenger days by type of commercial tourism vessel; and

TD_{PVi} = Trip duration by commercial tourism vessel.

Table 2.5 presents number of passengers by trip type for the period 1993–94 to 1997–98.

In determining the mainland accommodation expenditure associated with these passengers, the following adjustments need to be taken into consideration to avoid over-estimation:

- daytrippers;
- visitors staying with friends and relatives; and
- visitors sharing commercial accommodation.

Research conducted by the Queensland Tourist and Travel Corporation (QTTC) in the early 1990s provides insight into the size of the daytripper market and the number of visitors staying with friends and relatives in the Mackay, Northern and Far North statistical divisions.

In 1990, approximately 5%, 8% and 10% of daytrippers in the Mackay, Northern and Far North statistical divisions respectively visited either the GBRMP or Whitsunday islands, totalling some 446 700 visitors. Also, the number of visitors staying with friends and relatives in the

Mackay, Northern and Far North statistical divisions during 1990 was approximately 876 300.

Table 2.5 Great Barrier Reef Marine Park average number of passengers by trip type

Trip type and region	1993–94	1994–95	1995–96	1996–97	1997–98
Bareboat Whitsundays	6 449	6 097	6 956	6 341	6 146
Weekly cruise	3 814	3 605	4 114	3 750	3 635
Weekly fishing	199	188	214	195	189
Twice weekly	11 137	10 529	12 013	10 950	10 614
Daily dive	75 430	71 311	81 363	74 165	71 889
Daily cruise	66 901	63 247	72 163	65 779	63 760
Capricorn 100+ pax day trips	26 259	24 825	28 324	25 818	25 026
Mackay/Whitsundays 100+ pax day trips	133 122	125 851	143 592	130 889	126 872
Townsville 100+ pax day trips	57 771	54 616	62 314	56 802	55 058
Cairns 100+ pax day trips	555 526	525 187	599 219	546 208	529 445
Cruise ship	640	605	690	629	610
Unknown	278 212	263 018	300 094	273 546	265 151
Total	1 215 458	1 149 078	1 311 056	1 195 072	1 158 394
Source: KPMG Consulting, GBRMPA					

The QTTC Queensland Visitor Survey (QVS) identifies the total number of visitors staying in commercial accommodation within the Fitzroy, Mackay, Northern and Far North statistical divisions in 1990 as 2 542 200 persons. Given daytrippers, visitors staying with friends and relatives' and visitors staying in commercial accommodation are mutually exclusive groups, we are able to estimate the relative size of each market segment.

Table 2.6 Great Barrier Reef Marine Park total visitors by market segment, 1990, Fitzroy, Mackay, Northern and Far North statistical divisions

Market segment	Visitor numbers	Market share
Visitors staying in commercial accommodation	2 542 200	65.8%
Visitors staying with friends and relatives	876 300	22.7%
Daytrippers	446 700	11.5%
Total	3 865 200	100.0%
Source: QTTC, KPMG Consulting		

This analysis suggests that of the total passengers utilising commercial vessels within the GBRMP, approximately 66% are likely to stay in commercial mainland accommodation pre and/or post their Reef trip.

Further, it is likely that these passengers will share commercial accommodation. The QVS also presents details on the size of groups travelling together, as detailed in table 2.7. For the purposes of this analysis we have assumed that group size also represents the average number of persons sharing a room within commercial accommodation.

Table 2.7 Average group size staying in commercial accommodation

	1990–91	1991–92	1992–93	1993–94	1994–95	1995–96	1996–97	1997–98
Fitzroy	2.10	2.00	2.00	1.98	2.23	2.01	1.99	2.04
Mackay	2.10	2.20	2.00	2.00	1.80	1.79	1.95	1.98
Northern	2.10	1.90	1.90	2.24	2.00	1.98	2.10	2.03
Far North	2.10	2.10	1.90	2.00	2.12	2.09	2.13	2.06
Average	2.16	2.06	1.92	2.08	2.07	2.10	2.09	2.07
Note: 1997–98 equals average group size for each statistical division over the period 1990 to 1997. Source: QTTC								

In order to estimate the number of room nights sold in commercial mainland accommodation the following equation needs to be applied:

$$RNS = \sum \left(\frac{PN_i \times PCA_i}{GSCA_i} \right)$$

where:

RNS = Total rooms night sold of commercial mainland accommodation;
PN_i = Passenger numbers utilising commercial tourism vessels in period i;
PCA_i = Percentage of passengers staying in commercial mainland accommodation in period i; and
$GSCA_i$ = Average group size staying in commercial mainland accommodation in period i.

Table 2.8 presents estimates of room nights sold in commercial mainland accommodation directly relating to passengers of commercial vessels within the GBRMP.

Table 2.8 Great Barrier Reef Marine Park number of room nights sold to passengers by trip type

Trip type and region	1993–94	1994–95	1995–96	1996–97	1997–98
Bareboat Whitsundays	2 121	2 228	2 556	2 139	2 045
Weekly cruise	2 411	2 295	2 577	2 362	2 312
Weekly fishing	63	60	67	62	60
Twice weekly	7 040	6 701	7 525	6 897	6 751
Daily dive	47 685	45 386	50 965	46 716	45 728
Daily cruise	42 293	40 254	45 202	41 434	40 557
Capricorn 100+ pax day trips	17 445	14 644	18 536	17 066	16 103
Mackay/Whitsundays 100+ pax day trips	87 556	91 971	105 522	88 295	84 410
Townsville 100+ pax day trips	33 926	35 921	41 399	35 580	35 652
Cairns 100+ pax day trips	365 377	325 871	377 144	337 323	337 613
Cruise ship	210	188	217	194	194
Unknown	175 879	167 400	187 978	172 305	168 660
Total	782 006	732 918	839 689	750 374	740 086
Source: KPMG Consulting, GBRMPA					

As noted in Driml (1997b), it is possible to broadly identify the statistical division from which some trip types depart, and then associate specific accommodation expenditure on a per night basis in order to estimate the gross value of mainland accommodation per statistical division. Where it is not possible to identify statistical division, average accommodation expenditure is utilised to estimate gross value of mainland accommodation.

Table 2.9 presents average mainland accommodation expenditure per room per visitor night by statistical division for the period 1990–91 to 1997–98.

Table 2.9 Average mainland accommodation expenditure per room per visitor night by statistical division 1990–91 to 1997–98*

	1990–91 $	1991–92 $	1992–93 $	1993–94 $	1994–95 $	1995–96 $	1996–97 $	1997–98 $
Fitzroy	57.71	52.14	58.14	68.41	71.87	68.18	67.18	69.36
Mackay	87.17	84.48	79.76	106.98	99.22	92.09	90.58	92.44
Northern	41.10	38.38	41.53	65.21	55.80	63.76	62.81	61.06
Far North	72.01	79.38	78.60	90.12	117.17	124.48	104.63	101.83
Average	66.34	63.07	63.45	84.38	88.11	112.52	103.21	102.71
* = nominal dollars. Note: 1997–98 equals 1996–97 expenditure adjusted for inflation. Source: QTTC, KPMG Consulting								

Applying these estimates of mainland accommodation expenditure to the number of room nights sold generates a total gross value of mainland accommodation expenditure associated with passengers of commercial tourism vessels of the GBRMP.

Table 2.10 Great Barrier Reef Marine Park mainland accommodation expenditure by trip type ($'000)*

Trip type and region	1993–94 $	1994–95 $	1995–96 $	1996–97 $	1997–98 $
Bareboat Whitsundays	226.9	221.0	235.4	193.7	189.0
Weekly cruise	203.4	202.2	289.9	243.8	237.4
Weekly fishing	5.3	5.3	7.6	6.4	6.2
Twice weekly	594.1	590.4	846.7	711.8	693.4
Daily dive	4 023.7	3 998.9	5 734.8	4 821.4	4 696.6
Daily cruise	3 568.8	3 546.7	5 086.3	4 276.2	4 165.5
Capricorn 100+ pax day trips	1 193.4	1 052.5	1 263.8	1 146.6	1 116.9
Mackay/Whitsundays 100+ pax day trips	9 366.7	9 125.0	9 717.6	7 997.9	7 802.5
Townsville 100+ pax day trips	2 212.2	2 004.4	2 639.4	2 234.8	2 177.0
Cairns 100+ pax day trips	32 927.8	38 183.1	46 947.0	35 292.7	34 379.1
Cruise ship	19.0	22.0	27.0	20.3	19.8
Unknown	14 840.9	14 749.2	21 151.9	17 782.8	17 322.5
Total	69 182.2	73 700.7	93 947.4	74 728.3	72 805.9
* = nominal dollars. Source: KPMG Consulting					

2.1.3 Tourist Expenditure at Great Barrier Reef Resorts

Information on the number of visitors, visitor nights and expenditure on accommodation within Great Barrier Reef Marine Park resorts is captured within the Australian Bureau of Statistics (ABS) Survey of Tourist Accommodation. The QVS also provides details of visitors, visitor nights and total visitor expenditures within the Great Barrier Reef tourist area.

As noted above, both the ABS Survey of Tourist Accommodation and QVS provide data on the number of visitors staying in accommodation within the GBRMP. However, the ABS data is generally considered to be more timely and accurate, although not as detailed as the QVS in terms of information on type of expenditure. That is, the QVS provides a breakdown of visitor expenditures by the following categories:

- food and beverage expenditure;
- pleasure shopping;
- gambling;
- entertainment, admission fees, equipment hire;
- transport fares;
- vehicle expenses;
- other incidentals; and
- accommodation.

In Driml (1997b), tourist expenditure at Great Barrier Reef resorts was estimated through utilising 'visitor night' data sourced from the ABS Survey of Tourist Accommodation and expenditure data on a visitor night basis sourced from the QVS. Average expenditure data was also adjusted to exclude expenditure on transport and fares so as to avoid double counting of expenditure on reef trips.

Table 2.11 presents data on room nights, guest nights and guest arrivals from the ABS Survey of Tourist Accommodation for the period 1990–91 to 1997–98.

Table 2.11 ABS survey of tourist accommodation room nights, guest nights and guest arrivals 1990–91 to 1997–98

	1990–91	1991–92	1992–93	1993–94	1994–95	1995–96	1996–97	1997–98
Room nights	304 906	421 461	470 310	568 658	620 103	67 954	469 055	577 441
Guest nights	763 752	852 958	961 234	1 190 310	1 353 920	1 238 282	1 184 260	1 267 266
Guest arrivals	162 233	221 479	291 571	329 772	345 584	232 906	284 766	330 850
Source: ABS, KPMG Consulting								

Table 2.12 outlines expenditure patterns since 1993–94 in the Great Barrier Reef Tourism Area.

Table 2.12 Great Barrier Reef tourist area expenditure by type per visitor night*

	1993–94 $	1994–95 $	1995–96 $	1996–97 $	1997–98 $
Food and Beverage	39.40	40.34	47.60	38.40	43.32
Pleasure Shopping	15.04	14.38	17.56	16.34	16.53
Gambling	0.77	–	0.42	1.25	0.84
Entertainment	12.29	6.89	17.39	15.39	13.51
Transport Fares	14.30	11.84	18.19	15.97	15.72
Vehicle Expenses	3.66	2.36	6.53	2.89	4.02
Other Incidentals	4.14	3.33	5.59	4.40	4.55
Accommodation	87.00	92.93	99.23	86.71	95.66
Total Expenditure	176.60	172.07	212.51	181.35	194.16
Total Expenditure *less* Transport	162.30	160.23	194.32	165.38	178.44
* = nominal dollars. Source: QVS Note: 1997–98 expenditure estimates based on average over period 1994 to 1996.					

Applying these estimates of adjusted total expenditure, we are able to calculate the gross value of island resort based tourism expenditure. These estimates are presented in table 2.13.

Table 2.13 Great Barrier Reef Marine Park gross value of island resort based tourism expenditure*

	1993–94	1994–95	1995–96	1996–97	1997–98
Total	$193 182 000	$216 939 000	$240 623 000	$195 853 000	$226 127 000
* = nominal dollars. Source: KPMG Consulting, GBRMPA					

2.1.4 Summary

Table 2.14 summaries the gross value of commercial tourism activities within the Great Barrier Reef Marine Park and surrounding environs attributable to Marine Park tourists.

Table 2.14 Great Barrier Reef Marine Park gross value of tourism expenditure ($'000)*

	1993–94 $	1994–95 $	1995–96 $	1996–97 $	1997–98 $
Tourism Vessel Passengers	148 785	145 874	172 821	160 046	155 903
Mainland Accommodation	69 182	73 701	93 947	74 728	72 806
Island Resorts	193 182	216 939	240 623	195 853	226 127
Total	411 149	436 513	507 392	430 627	454 836
* = nominal dollars. Source: KPMG Consulting, GBRMPA					

2.2 Commercial Fishing

Information on the size and value of commercial fishing operations in the Great Barrier Reef region is recorded by Queensland Fisheries Management Authority (QFMA) and analysed by the Fisheries Branch of the Queensland Department of Primary Industries (DPI).

The GBRMP area utilised for commercial fishing as described in this report is the region from 10°41' south to 24°30' south—the northern and southern boundaries of the Park.

Tables 2.15 and 2.16 present information on the size of the commercial fishing catch (in tonnes) and its estimated gross 'wharf' value by fish species.

Table 2.15 Size of commercial fishing catch in the Great Barrier Reef Marine Park (tonnes)

Species name	1991	1992	1993	1994	1995	1996	1997
Barramundi	208	133	167	140	135	128	152
Coral Trout	1 417	1 469	1 274	1 163	1 372	1 647	1 352
Crab	579	827	1 336	2 002	1 512	1 869	1 958
Lobsters	388	518	642	584	732	631	692
Mackerel—Grey	66	74	56	52	46	60	124
Mackerel—Spanish	465	415	442	449	344	454	655
Mullet	132	111	100	151	226	186	128
Other	831	758	905	880	1 014	1 235	1 720
Prawn	5 134	4 070	5 107	4 560	5 803	6 478	5 444
Red Throat Emperor	513	545	544	545	471	572	759
Scallop	724	741	1 763	1 074	1 519	528	797
Shark	143	161	196	219	267	248	309
Snapper	24	13	12	17	39	43	62
Squid	9	13	21	23	24	23	37
Threadfin—Blue	104	85	92	101	87	79	95
Threadfin—King	80	60	71	63	53	60	62
Whiting	77	99	28	29	21	28	24
Total	10 893	10 093	12 755	12 050	13 666	14 268	14 372
Source: QFMA, DPI							

Table 2.16 Gross value of commercial fishing catch in the Great Barrier Reef Marine Park ($'000)*

Species name	1991 $	1992 $	1993 $	1994 $	1995 $	1996 $	1997 $
Barramundi	1 454	930	1 168	978	942	893	1 065
Coral Trout	14 170	14 694	12 740	11 628	13 721	16 473	13 518
Crab	4 040	5 062	7 017	9 347	7 801	8 847	9 435
Lobsters	4 661	6 218	7 712	7 022	8 884	7 574	8 305
Mackerel—Grey	393	442	339	313	274	358	744
Mackerel—Spanish	3 253	2 908	3 094	3 142	2 408	3 176	4 588
Mullet	398	335	300	455	679	559	384
Other	4 094	3 417	3 521	3 289	3 982	5 166	7 192
Prawn	62 840	51 071	65 803	58 067	75 419	82 542	68 071
Red Throat Emperor	2 564	2 726	2 719	2 724	2 357	2 861	3 796
Scallop	14 482	14 784	35 169	21 334	30 283	10 397	15 818
Shark	858	966	1 176	1 314	1 604	1 490	1 853
Snapper	189	104	100	134	311	344	498
Squid	44	67	104	113	119	113	186
Threadfin—Blue	416	340	367	403	350	314	382
Threadfin—King	320	239	283	254	213	239	248
Whiting	309	397	111	116	83	112	97
Total	114 486	104 700	141 722	120 630	149 429	141 458	136 180
* = nominal dollars. Source: QFMA, DPI							

The above analysis provides an indication of the relative importance of each species to commercial fishing within the Great Barrier Reef region. As shown in figure 2.1, prawns represent the most significant species in terms of both catch (38% of total catch size) and value (50% of total value) in the region.

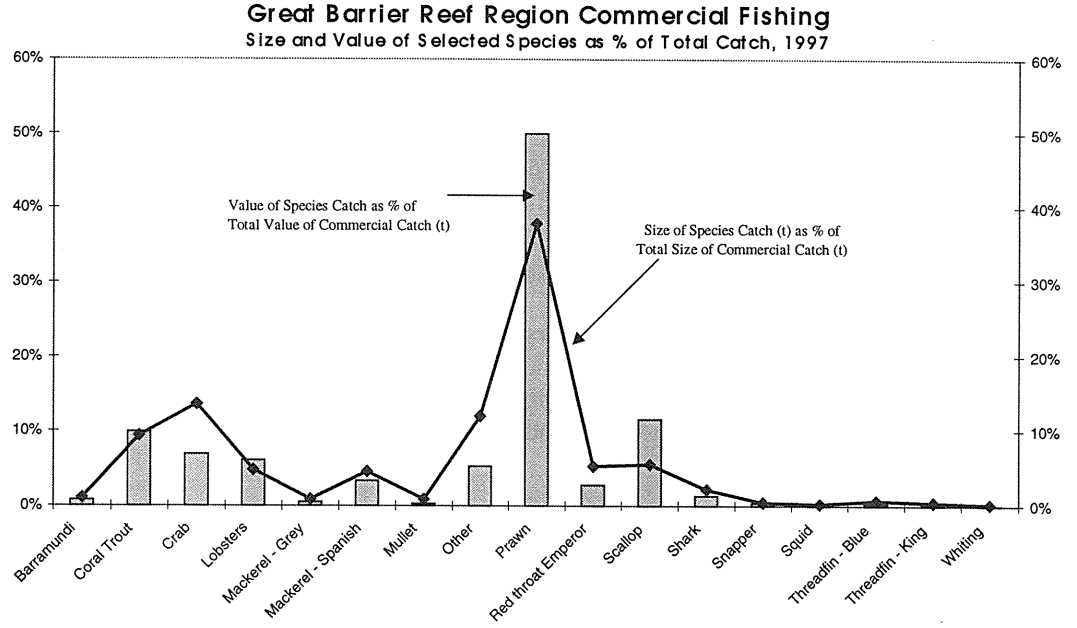


Figure 2.1 Size and value of selected commercial fishing species for the Great Barrier Reef region, 1997

2.3 Private Recreational Fishing and Boating

Queensland Department of Transport statistics reveal a total of 37 951 recreational motor boats registered within the areas adjacent to the catchment area.

Research conducted by Blamey and Hundloe (1993) estimated that nearly two-thirds (63%) of registered private boats within areas adjacent to the GBRMP were used for recreational fishing within the Marine Park itself. Further, this study also found average expenditure in 1990 on recreational fishing and boating to be approximately $3700 per vessel, including boat trip costs.

Assuming this per vessel expenditure by other recreational fishing and boating enthusiasts is consistent over time, adjusted for inflation, it is possible to estimate the value of recreational fishing and boating expenditure within the GBRMP for the study period.

Table 2.17 Great Barrier Reef Marine Park recreational fishing and boating

	1993–94	1994–95	1995–96	1996–97	1997–98
No. of boats registered adjacent to Marine Park	43 458	44 955	42 487	40 155	37 951
No. of boats used in Marine Park	27 379	28 322	26 767	25 298	23 909
Annual expenditure per boat	$4 092	$4 244	$4 407	$4 477	$4 499
Gross Value ($'000)*	$112 038	$120 194	$117 953	$113 258	$107 572
* = nominal dollars. Source: Blamey and Hundloe, KPMG Consulting					

Other published and unpublished research on the value of recreational fishing and boating in the catchment area vary from the estimate presented above. Details of this other research are presented below.

- An unpublished study by the Queensland Fisheries Management Authority and GBRMPA has estimated the gross value of recreational fishing and boating to the Queensland economy, and specifically the gross value of recreational fishing and boating derived from users of the Marine Park. The study has estimated there are approximately 28 900 recreational fishers utilising the GBRMP annually, generating gross income for the Queensland economy of between $84 million (cost of fishing approach) and $132 million (gross expenditure approach) per annum.
- Studies conducted in other Australian states provide an estimate of annual expenditure on recreational fishing by anglers. Average annual expenditure on recreational fishing by anglers in South Australia is approximately $750, Victoria $1000 and Western Australia $650. Assuming recreational anglers in the GBRMP have a similar spending pattern to other recreational anglers around Australia, it is estimated this group would contribute approximately $110 million to the Queensland economy.

In summary, various studies over the past few years have attempted to value annual expenditure by recreational anglers on fishing and boating in the GBRMP. Considering the results of these studies, it would appear that the gross value of recreational fishing and boating in 1997–98 (as determined through adjusting the Blamey and Hundloe (1993) methodology) of $108 million appears appropriate.

2.4 Summary

Table 2.18 presents the gross financial value of the three direct uses of the GBRMP for the period 1993–94 to 1997–98.

Table 2.18 Great Barrier Reef Marine Park gross financial value of direct uses ($'000)*

	1993–94 $	1994–95 $	1995–96 $	1996–97 $	1997–98 $
Commercial Tourism	411 149	436 513	507 392	430 627	454 836
Commercial Fishing	141 722	120 630	149 429	141 458	136 180
Recreational Fishing and Boating	112 038	120 194	117 953	113 258	107 572
Total	664 910	677 337	774 774	685 342	698 588
* = nominal dollars. Source: KPMG Consulting					

3 THE FLOW-ON IMPACT OF GBRMP-BASED ACTIVITIES

3.1 Introduction

The previous section of this report provided estimates of the value of a number of economic activities that utilise the GBRMP. These are estimates of the direct contribution of activities, they do not include consideration of the flow-on impact, or the effect of linkages of these activities, with other industries in the State economy. This section of the report provides an estimate of the indirect or flow-on effects of those activities, in terms of output and employment, on the economy of the State of Queensland. Input-output analysis has been used to estimate a set of multipliers for these activities from which it is possible to estimate the employment and output effects for any given change in expenditure.

A number of assumptions underlying the input-output impact estimates are emphasised at the outset.

First, the results from the input-output analysis presented here, measure the estimated impact of the normal operating and maintenance activities of GBRMP-based activities. They do not include the impact of expenditure associated with the construction or establishment of new or additional facilities.

Second, input-output analysis measures the backward linkages in the economy of the activities of an industry. That is, it measures the flow-on effects associated with the purchases of inputs into an economic activity, not the forward linkages, or value-added, of industries purchasing the final output.

Third, input-output analysis does not provide information about the efficiency of an investment to society as a whole, or about the environmental impacts of investment. It simply provides estimates of, among others, the output, employment and income effects of the economic activities of an industry on the economy of a region.

Finally, although input-output analysis presents information about the distribution of, say, output or employment effects of economic activity on industry sectors in the economy, it does not provide information about any trade-offs in the region, social or environmental, that may be associated with the economic activity. More detailed discussion about the input-output methodology, including the construction of the transaction matrix and the manipulation of the matrix to measure the impact of economic activity together with the limitations of the results, is provided in Jensen and West (1986).

Driml (1987) measured the economic impacts of 'all human activities' in the GBRMP. The impact of these activities on the economy of a number of statistical regions adjacent to the GBRMP, namely, Mackay, Cairns, Townsville and Rockhampton, was measured over a number of years. For this report, estimates of the impact of activities based on the GBRMP are confined to three main activities, namely:

- commercial fishing;
- commercial tourism; and
- recreational fishing and boating.

These GBRMP-based activities have been defined, and presented with the data estimating their value of output, in the previous section. The economic region over which the impact of these activities has been measured is the State of Queensland.

3.2 Modelling the GBRMP-based Activities in the Input-Output Transaction Matrix

An existing input-output transaction table for the State of Queensland for 1994–95, developed at the Department of Economics, The University of Queensland, was adopted for this report. An

input-output transaction table, or matrix, traces, in monetary terms, the economic transactions, or inputs and outputs, of all economic activity in an economy over a particular period of time (usually one year). Because all economic activity is accounted for in an input-output transaction table, the GBRMP-based activities were already incorporated, in some form, within the 1994–95 transaction table for the Queensland economy. Modelling the activities was an exercise in determining which sectors, either intermediate or final demand, included the economic transactions of these activities. In brief, Commercial Fishing and Commercial Tourism were included in the intermediate sectors and Recreational Fishing and Boating was included as a part of Household final demand. Commercial Fishing in the GBRMP had been included in the Forestry and Fishing sector and Commercial Tourism was a part of the Recreation sector. These activities were disaggregated from the relevant sectors and the industrial significance of each, in terms of output and employment effects, measured.

Summary tables, presenting estimated multipliers and showing the important flow-on effects, in terms of output and employment, for each GBRMP-based activity, are provided below. More detailed information is provided in appendix tables 1–6.

Table 3.1 Summary of output effects GBRMP-based activities, Queensland, 1994–95

Activity	Initial Output ($m)	Flow-on ($m)	Total impact ($m)	Main Flow-on Sectors	% of Flow-on
Commercial Fishing	120.6	73.3	193.9	Trade	29.3
				Finance	16.8
				Transport/Communication	8.8
				Food Manufacturing	8.3
				Community Services	7.2
				Other sectors	29.6
				TOTAL	**100.0**
Commercial Tourism	436.5	407.9	844.4	Finance	26.0
				Trade	14.1
				Food Manufacturing	11.3
				Transport/Communication	8.0
				Community Services	6.5
				Other sectors	34.1
				TOTAL	**100.0**
Recreational Fishing and Boating	120.2	134.7	254.9	Trade	21.8
				Finance	14.1
				Commercial Tourism (GBRMP)	8.3
				Recreation	8.3
				Commercial Fishing (GBRMP)	7.9
				Other sectors	39.6
				TOTAL	**100.0**
COMBINED GBRMP IMPACT	**677.3**	**615.9**	**1 293.2**		
Source: KPMG Consulting					

For illustrative purposes the output figures for the year 1994–95 as shown in table 2.18 were used to estimate the sum of the direct and indirect effects on the economy of Queensland for the year 1994–95. Tables 3.1 and 3.2 reveal the initial or direct effect of GBRMP-based activities on gross output and employment respectively, however it should be noted that these aggregates refer to *gross* output and not value added. The column on the right hand side of each table identifies which economic sectors experience the strongest flow-on effects.

Table 3.1 shows that the combined activities of the GBRMP directly contributed $677.3m to the gross output of the Queensland economy in 1994–95. These activities also generated $615.9m in flow-on effects to gross output. Commercial fishing is shown to create an additional $73.3m in flow-on output in the economy. The Trade and Finance sectors source the greatest flow-on effect from commercial fishing, with 29.3% and 16.8% of the total flow-on effects respectively. The flow-on effects from Commercial Tourism are shown to create an additional $407.9m in output in the economy, sourced primarily from the Finance (26%), Trade (14%) and Food Manufacturing (11%) sectors. The flow-on effects from Recreational Fishing and Boating are shown to create an additional $134.7m of output, sourced mainly from the Trade and Finance sectors.

From this input-output analysis, gross output multipliers can be derived and then, on the assumption that the structure and inter-sectoral linkages in the economy do not change substantially, they can be used to estimate flow-on effects in subsequent years. The output multipliers for GBRMP activities are estimated to be 1.6 for Commercial Fishing, 1.9 for Commercial Tourism and 2.1 for Recreational Fishing and Boating (see appendix tables 1–6). This means that for every additional $ of output from Commercial Fishing activities, an additional $0.60 in output from flow-on effects in other industries in the Queensland economy will be created. The same calculations can be made for the other GBRMP-based activities. For example the value of additional gross output from Commercial Tourism activities in the GBRMP between 1994–95 and 1998–99 is estimated from table 2.18 to be $18.32m. In 1994–95 dollars this would be approximately $16.20m. Applying the multiplier of 1.9, this would equate to an additional $30.78m of direct and flow-on output in the State economy. Structural change is a relatively slow process, which means that the estimated output multipliers should provide accurate estimates of industry impact for some years hence.

Table 3.2 Employment effects GBRMP-based activities, Queensland, 1994–95

Activity	Initial Employment (no.)	Flow-on (no.)	Total impact	Main Flow-on Sectors	% of Flow-on
Commercial Fishing	1 568	1 152	2 720	Trade	47.8
				Finance	12.8
				Transport/Communication	11.7
				Community Services	6.0
				Recreation	5.4
				Other sectors	16.3
				TOTAL	**100.0**
Commercial Tourism	7 421	5 467	12 888	Trade	27.0
				Finance	23.3
				Community Services	12.6
				Transport/Communication	6.4
				Other Agriculture	6.0
				Other sectors	24.7
				TOTAL	**100.0**
Recreational Fishing and Boating	N/A	2 008	2 008	Trade	37.5
				Finance	11.4
				Recreation	11.4
				Commercial Tourism (GBRMP)	9.4
				Other sectors	30.3
				TOTAL	**100.0**
COMBINED GBRMP IMPACT	**8 989**	**8 627**	**17 616**		
Source: KPMG Consulting					

Using the same methodology it is also possible to estimate the impacts of GBRMP-based activities on employment. Table 3.2 reveals the initial or direct effect of GBRMP-based activities on employment in the economy of Queensland (1994–95) was 8989 persons. Additional, or flow-on, employment created by these activities is estimated at 8627 persons, giving a total, combined impact of 17 616 persons.

It should be emphasised that these are not necessarily full-time equivalent positions. Looking at the activities individually, the direct employment impact of Commercial Fishing in the GBRMP is estimated to be 1568 persons, and the flow-on effect is 1152 persons, giving a total impact of 2720 persons. Most of the flow-on employment is estimated to be in the Trade and Finance sectors; 47.8% and 12.8% respectively. Commercial Tourism is shown to provide employment (direct and flow-on) for 12 888 people. The flow-on employment is estimated to be in the Trade and Finance sectors; 27.0% and 23.3% respectively. Recreational Fishing and Boating by its nature does not 'employ' people directly. For this reason no figure appears in the first column of table 3.2. However, the flow-on effects from Recreational Fishing and Boating activities are shown to create employment for 2008 persons, mainly in the Trade (37.5%), Finance (11.4%) and Recreation (11.4%) sectors (see appendix table 4 for full details).

The employment multipliers for these activities are estimated to be 1.735 for Commercial Fishing and 1.737 for Commercial Tourism. No multipliers are calculated for Recreational Fishing and Boating because there is no initial employment in this activity. This means that for every additional person directly employed in Commercial Fishing activities, an additional 0.735 of a person will be employed elsewhere in the economy. The same calculations can be made for Commercial Tourism. The impact of additional output from GBRMP-based activities on employment in the State economy over the period to 1998–99 could be calculated by using the estimated multipliers.

It is recommended that the economic impact of GBRMP-based activities is monitored and data collection undertaken with this in mind. Estimates of the output and employment multipliers provided here will be appropriate for the medium term, or at least for as long as the economic structure of the economy, described by the technical coefficients in the input-output transaction matrix, accurately reflects the economy of the region.

Previous estimates of the output and employment impacts of economic activity in the GBRMP have been conducted on the individual statistical divisions adjacent to the Park (Driml 1987).

Recommendation
It is recommended that GBRMPA determines the region of significance, that is, the State of Queensland and/or the regional economies, and that data about the activities in the GBRMP be collected for that region of significance. If meaningful comparisons are to be made about the impact of these activities over time, then it is important to establish a consistent approach to data collection.

More specific recommendations relating to data requirements and data collections are addressed in section 4.1 of this report.

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).

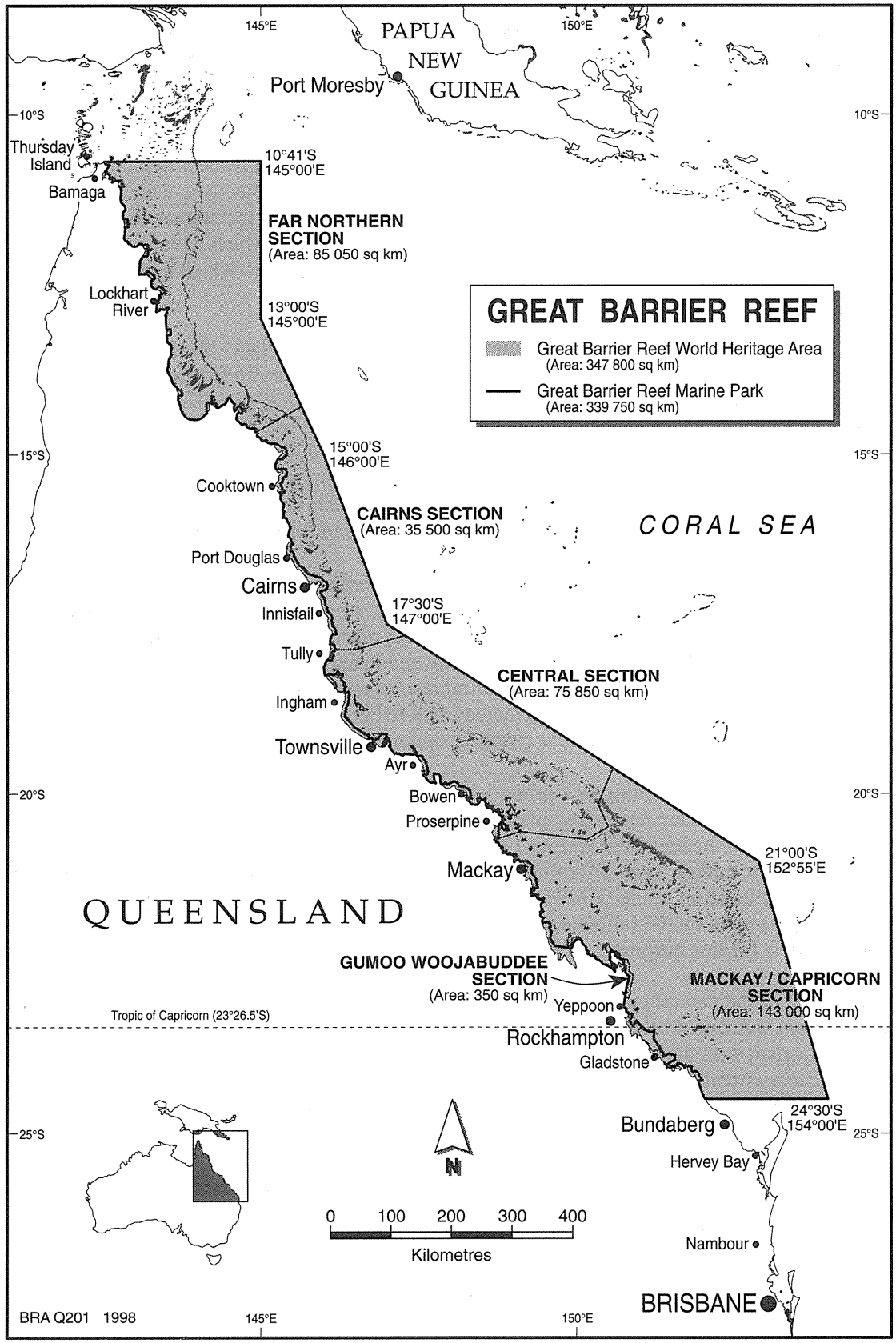
Although GBRMPA recognises the potential role of economics and economic valuation in its decision-making and management processes, to date this has not overtly occurred. A paper by Driml (1994) written for GBRMPA provides a basis for discussion of the role that economics could play in assisting GBRMPA 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.

However, as Tisdell and Wen (1997a) point out, there are a number of practical and philosophical difficulties with the TEV approach, and, perhaps most importantly, its use does not take into consideration the longer term sustainability of, in this instance, tourism, nor of the GBRMP's natural attributes. As Tisdell (1991) demonstrates, tourism can destroy tourism in two ways: by overcrowding and by degrading the attraction or natural attribute which attracted tourists in the first place. Uncertainties of this sort could lead to the wrong monetary values being assigned to uses of a natural resource. In turn these could result in irreversible damage to the reef. Market failure of this ilk suggests the need for a more interventionist approach. This argument is extended by Davis and Tisdell (1995) to the case of recreational scuba diving in the GBRMP, in which it is concluded that no single policy instrument is capable of achieving an optimal result. For them, 'it is a judicious blend of regulation and economic instruments that will be needed' (p. 246).

It needs to be acknowledged that there will always be some costs, such as those arising from biodiversity impacts, which cannot be valued in monetary terms with any credibility. For this reason, it is suggested here, it would be advisable for GBRMPA to consider the use of complementary decision-making models such as Multiple Objective Decision Support Systems (MODSS) or Multiple Criteria Analysis (MCA) which allow the analyst to incorporate both pecuniary and non-pecuniary quantitative values in the decision-making process. MCA provides a formal process which is sufficiently flexible to facilitate the incorporation of information from a number of disciplines. It is an appropriate tool to assist decision making when the problem to be addressed is complex and poorly defined; when there are multiple and competing objectives; and, in situations where there are multiple stakeholders with conflicting points of view about the appropriate decision.

One of the major benefits of MCA is the ability of the technique to incorporate information about the performance of alternative courses of action from a number of sources. Frequently, this information is not available in standard units of measure, such as dollars. By converting available information into standard units of measure, it is possible for trade-offs, particularly those related to environmental and social or cultural impacts, to be considered. We recommend the use of MCA as a decision-making aid for GBRMPA but, as demonstrated below, this should be used to complement and not as a substitute for other decision-making models such as CBA and input-output analysis.

Irrespective of which decision-making models GBRMPA decides to use, the issue of the relative weight to be given to the gains and losses of different stakeholder groups, including future generations, has to be addressed explicitly. Where there are conflicting and competing objectives between users of a given natural resource, it needs to be made explicit how the gains and losses accruing to different stakeholders are to be compared. Within CBA, a system of distributional weighting is sometimes proposed, where the gains and losses to different stakeholder groups are assigned different weights based on the analyst's interpretation of policy makers' preferences. Within MCA the weighting of criteria are determined by soliciting stakeholder preferences which are then used to rank alternative options. In either case, a value judgement about the relative importance of each extra dollar gained or lost by the various stakeholder groups has to be made. Not all analysts will agree on what the 'appropriate' value judgement and system of weighting should be. For this reason it is imperative that the analyst assesses the robustness of the prescribed outcome derived from the decision-making model by undertaking some form of sensitivity testing in which the weights are allowed to vary within a given range. If the outcome is found to be sensitive to how the gains and losses from alternative decision scenarios are weighted across the different stakeholder groups, it is important that these are presented to the decision makers in such a manner that they are made fully aware of the distributional implications of their final choices; i.e. what the trade-offs are in terms of benefits and costs accruing to the different stakeholders. The implication of this is that all forms of economic evaluation will need to be undertaken on a disaggregated basis to identify, for each stakeholder group, the income gains and losses (in CBA) and preferences as expressed by their ranking of evaluation criteria (in MCA).

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.

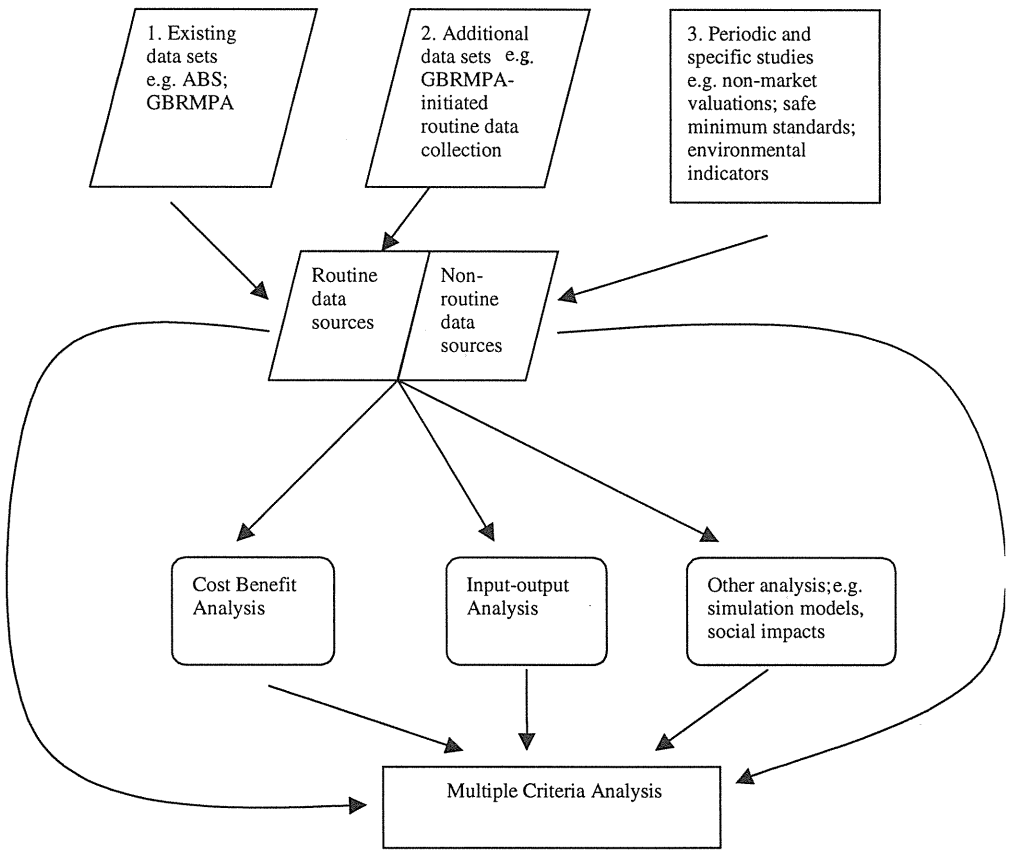


Figure 4.1 Schematic representation of data requirements and uses

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.

4.1.1 Routine Data Sets

The types of routine data from existing sources for use in GBRMPA decision making are illustrated in the first parts of this report, and include data on fishing from bodies such as QFMA, and on hotels and tourism from ABS and GBRMPA. Compilation of tables in this report from these sources has highlighted a number of deficiencies that need to be addressed.

4.1.1.1 Commercial Fishing

The statistical sections of this report rely heavily on information from QFMA and DPI. One of the main problems identified here is that the volume of catch landed is based on port of delivery rather than location of catch. This makes economic analysis of value added and income generated on a regional basis unreliable and inaccurate. Furthermore, limited price information for wholesale and retail product makes it difficult to estimate values of catch at the point of initial production. What is required is a more comprehensive data set that would permit the disaggregation of gross output into value added at each point in the production and marketing chain. One important potential additional data source would be the routine collection of data through routine surveys of commercial fishers at all main points of embarkation/disembarkation to assess volumes and composition of fish catches as well as other data relating to frequency of trip, costs, etc.

4.1.1.2 Commercial Tourism

The QTTC Queensland Visitors Survey (QVS) which provided valuable insight into numbers of visitors visiting the Park, duration of visits and expenditure patterns, has been recently discontinued. The statistical sections of this report rely mainly on ABS data which is generally considered to be more timely and accurate although not as detailed as the QVS in terms of information on type of expenditure. Detailed tourist expenditure information is vital for most forms of economic analysis, particularly input-output analysis and CBA. It is recommended that GBRMPA initiates data collection of this nature for use in its decision making. Alternatively, if GBRMPA rejects this recommendation, then it is strongly advised that they consistently adopt one data source rather than mix a number of sources. To have multiple sources could lead to over counting or double counting.

4.1.1.3 Recreation

Fishing

Estimates of recreational fishing and boating in this, and previous statistical reports on the GBRMP, have been based primarily on studies conducted by Blamey and Hundloe (1993) who have relied heavily on Queensland Department of Transport statistics on recreational motor boats registered within the areas adjacent to the GBRMP. Alternative ways of collecting data about recreational fishing, including surveys undertaken at launching points, such as that undertaken by Reid and Campbell (c. 1998) would provide more robust estimates. To limit recreational fishers to those with registered boats adjacent to the GBRMP, overlooks users of the Reef who live inland. Future surveys should endeavour to capture all users.

Tourism

There is a range of secondary data sources available for use in estimating the financial use values associated with GBRMP tourism expenditure. A summary of these data sources is presented below.

Queensland Visitor Survey, QTTC	• Survey of domestic and international tourists, detailing visitors, visitor nights, spend by type and length of stay. • Final survey year is 1997.
Survey of Tourist Accommodation,	• Sample survey of commercial accommodation

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).

Choice of indicator however does not need to be based on specific scientific, economic or social data but rather on what is important for a particular catchment. In relation to the choice of appropriate indicators, Brown (1998) recommends that:

> a good indicator is visually arresting, politically significant, and scientifically valid for the use to which it is to be put. It must carry meaning at the individual as well as the social level. Most of all it must fit within a framework familiar to scientist, politician, administrator and conservationist alike. For indicators to speak to decision makers at local, national or global scales, they must be sensitive to matters of time and social priorities, of place and scales, and in a framework that links social, economic and environmental data. (p. 272)

There appear to be few rigorous definitions of the concept of sustainable tourism. However, the literature suggests that sustainable indicators of industries and projects require the simultaneous achievement of economic, social and bio-physical sustainability. Sustainable tourism therefore requires that these three characteristics be satisfied simultaneously. To make the concept of sustainable tourism operational, Tisdell and Wen (1997b) necessitates the prior identification of what it is that needs to be sustained. They ask, for example, whether this should be the number of tourists, tourist receipts, or, some other feature such as ecological or cultural features. They argue that:

> natural resource managers such as GBRMPA...may be tempted to claim that because certain tourism indicators (such as number of tourists, tourist nights or tourist receipts, or even the net economic benefits flowing from the region) are increasing, that their approach to tourism and natural resource management is generating sustainable development. (p. 4)

Recommendation
It is recommended that GBRMPA establishes a set of appropriate sustainability indicators, covering economic, social, and environmental characteristics, that are sensitive to changes in resource use in the Park. The indicators should be selected to ensure that changes in these characteristics are monitored on a consistent basis over time and across the whole area of the GBRMP. These indicators should also provide an appropriate basis for setting safe minimum standards (SMS) for future uses of the GBRMP.

4.1.2.3 Safe Minimum Standards and Carrying Capacities

Two mechanisms to regulate uses of natural resources are the maintenance of safe minimum standards (SMS) and enforcement of a carrying capacity.

SMS, defined as 'the minimum stocks of biological resources consistent with the resilience of ecosystems of interest' (Garrod & Willis 1999, p. 267), may be an effective conservation instrument to protect the total stock of a species. This in effect sets an aggregate reserve stock for species and their habitat. Exploitation of stocks in excess of the reserve can be determined by the market. But, as Driml (1994) correctly points out, even when the population as a community agree that SMS should be maintained, the present generation's actions in the market place may imply the use of a resource at a level that degrades it beyond its sustainable level. She suggests that the Precautionary Principle, which places the burden of proof on the potentially damaging activities, should be adopted in setting limits which guarantee sustainable use. Once limits have been set using expert opinion based on current knowledge, the role of an economic tool such as CBA, would be to maximise net economic benefits, subject to the constraint that the SMS is not violated.

In view of the uncertainty with respect to identifying an appropriate SMS combined with the possibility if irreversible damage, if errors are made, influences optimal decisions. The extra benefit of keeping options open, as suggested by the precautionary principle, could be the optimal course of action (Tisdell 1996).

The concept of carrying capacity, particularly as a guide to the management of tourism, has raised considerable interest. In this context it is defined as a 'maximum number of visitors that can be tolerated without irreversible or unacceptable deterioration of the physical environment and without considerably diminishing user satisfaction' (Seidl & Tisdell 1998, p. 13). While the carrying capacity of natural areas is acknowledged as a useful concept, Tisdell (1996) cautions about its use as a managerial tool. Tisdell is particularly concerned that dissimilar carrying capacities may apply to different characteristics of a tourist site. This results in carrying capacities which are not definite or discrete. However, there is general recognition that the interaction of tourism and the state of the ecosystem is an important consideration for management of tourist sites. The application of carrying capacity, however, can involve considerable subjectivity. Because different forms of utility are obtained by visitors visiting the site arising from the volume of tourists visiting an area and the state of its ecosystems, setting carrying capacities can be subjective. Tisdell (1996) illustrates the subjectivity by drawing on a situation where the total utility obtained by visitors may continue to rise with an increase in the number of visitors even after the ecosystem has begun to show some deterioration, or the physical state of an area declines. In brief, the carrying capacity will be a reflection of the level of environmental modification regarded as acceptable for a particular site. In addition, not all aspects of an ecosystem are equally vulnerable. As a result, therefore, judgement is required about the relative importance of site attributes before a carrying capacity can be determined. It is recommended that long-term monitoring studies are undertaken to identify critical thresholds and obtain further information about the re-growth rates of different species.

Although a carrying capacity as a resource management tool for the GBRMP might be regarded as useful, it is recommended that GBRMPA exercises caution, avoiding situations where carrying capacity estimates are treated as finite limits or thresholds.

Recommendation
Long-term monitoring studies are required to gain further information about biological thresholds while tourists as consumers, need to be studied in terms of their reaction to overcrowding and their willingness to pay for significant attributes of the natural resource.

4.1.2.4 Assessing Stakeholder Preferences

Increasingly, the input of stakeholders in the decision-making process, with respect to resource management, is acknowledged as improving the legitimacy of the process of decision making as well as the determination of the final choice of option (Robinson 1999). Surveys provide the opportunity to inform, as well as solicit, information.

Recommendation
To this end, a survey of stakeholders could be undertaken to solicit preferences for resource management, and, more importantly to identify the criteria or objectives for management and to establish the relative importance of identified objectives. It is not envisaged that such a survey would be required on a regular basis but if it were undertaken periodically, say every three to five years, stakeholder involvement in decision-making processes, particularly if an MCA approach is adopted, would be considerably improved.

All of these data sources, as individual sources of information, provide valuable information to decision makers. However, they all provide valuable inputs into an integrated model of decision making, MCA.

4.2 The MCA Model

Multiple Criteria Analysis is appropriate for supporting or aiding decision making in complex situations where information is uncertain and where there are problems associated with quantifying outcomes (particularly in monetary units) associated with different management policies or options. It is especially appropriate where there are a number of users of the resource who are in conflict over appropriate uses and where there is conflict over the objectives for

management. MCA provides a formal process to facilitate the incorporation of information from a number of disciplines in a decision-support framework to identify a management strategy which is transparent and credible.

The credibility of the outcomes from an MCA is dependent on the quality of data and simulation models identifying the problem to be addressed and measuring the impact on the ecology of alternative management strategies. The transparency of the outcomes from an MCA is determined by the extent to which stakeholders are involved in the process of decision making and the extent to which the trade-offs between alternative users and subsequent impacts are made apparent (see Robinson (1999) for a more detailed discussion about MCA and its application) in the Australian (north Queensland) context.

The MCA model is best presented by way of a hypothetical example, in this case one involving a proposed new zoning of an area within the GBRMP. If we assume that the objective of the rezoning is to protect an area recently devastated by a natural disaster to allow regeneration of coral and replacement of fish stocks, and that there are a number of vested interest groups involved in the process of determining the best management option, each with their own specific interests to protect which appear to conflict with the interests of others.

Four possible alternative arrangements for use of an area of the GBRMP are considered:
- controlled fishing and tourist activities;
- restricting access to the area to non-fishing tourist activities only (i.e. look but don't take);
- seasonal closure to all fishing and tourist activities; and
- closing the area to all fishing and tourist activities.

The criteria used to evaluate the management alternatives could include:
- preserving the natural environment;
- providing employment;
- maximising income from commercial fishing;
- providing opportunities for recreation and tourism; and
- minimising disruption to indigenous local people.

Whereas unrestricted fishing and tourism might satisfy the objectives of commercial fishers, tourist operators and recreational users of the GBRMP, they could result in destruction of the natural environment, disruption to the indigenous peoples in the area and ultimately in a decline in tourism and fishing industries in the future.

MCA facilitates the collection of data, including data to develop expert systems and simulation models as well as data about the preferences of interest groups or stakeholders, to support the evaluation of the alternatives.

Derivation of the effects matrix, the ranking of options and the type of information required during the process, is an integral part of the MCA process which is presented schematically in figure 4.2.

Although the steps in the analysis are presented in the order in which they would logically occur, the process is designed to be interactive with stakeholders and is likely to be cyclical with steps revisited as additional or more reliable information becomes available.

The information conventionally supplied to decision makers to demonstrate the trade-offs when making a choice between a number of options with competing outcomes is shown in figure 4.3. To *populate* or to enter the elements of the effects matrix, information is required from a number of sources, and specifically, from a number of disciplines.

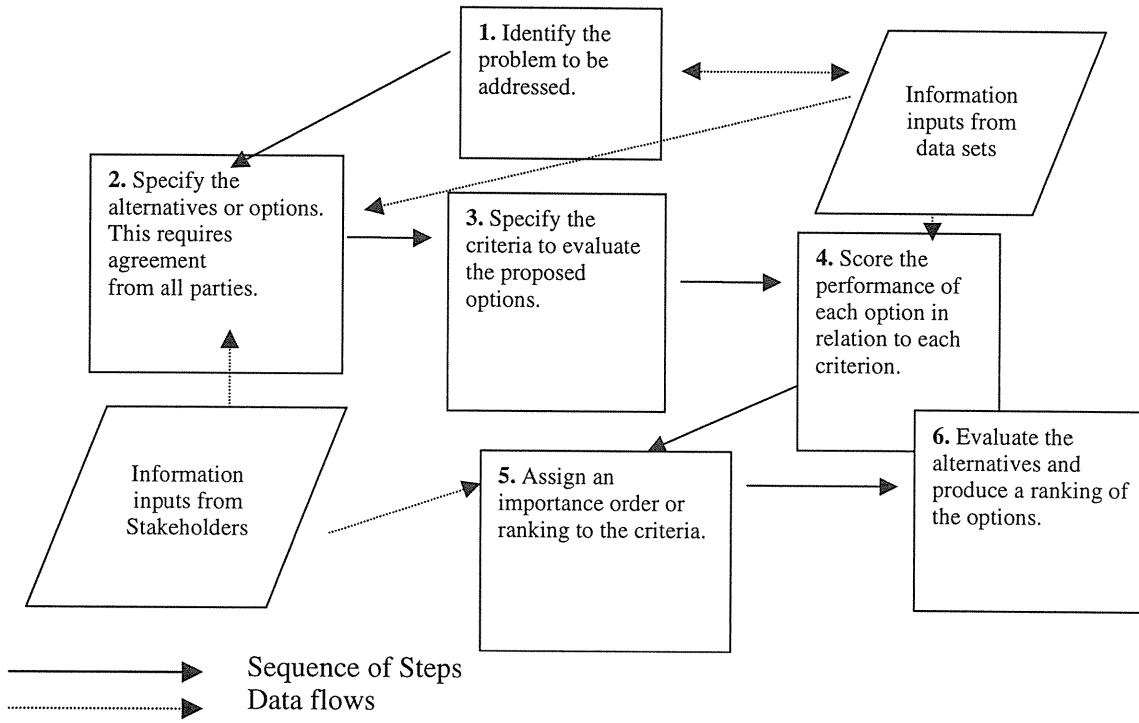


Figure 4.2 Schematic presentation of the steps in the Multiple Criteria Analysis process

4.2.1 Scoring the Alternatives in Relation to the Criteria

Before scores are assigned to each option in relation to each criterion, the 'do nothing' option must be identified so that the options can be evaluated as marginal or incremental to the 'do nothing' option. Scores are presented in an 'effects table'. An effects table, or matrix, displays the criteria in the rows and the alternatives in the columns. As already indicated above, MCA has an advantage over CBA in that it is able to deal with both quantitative and qualitative criteria.

For example, for the employment creation criterion in the resource management example, the score for Option 4 could be no additional jobs, Option 1 could be three jobs and that of Option 3 could be 90 jobs. Note that some of the criteria are expressed in qualitative, or ordinal, form. For example, the score for the social effects on the indigenous population is low under Option 1 and very low under Option 3. It is recommended that, as far as possible the criteria be 'standardised' (RAC 1992). Standardisation involves reducing the criteria scores to a comparable basis. In the GBRMP management example, standardisation would mean ensuring that all the dollar scores are expressed on a scale such as between 0 and 10. Employment generation could be converted into a score, using, say, '10' for the highest estimated employment level, and '0' for the lowest.

4.2.2 Weighting the Scores According to the Weights Assigned to the Criteria

The next step in the MCA process involves 'prioritising' the criteria by assigning different rankings or weights. The weights can be assigned by the analyst, the decision maker or they can be based on the views of the stakeholders, solicited through a survey. The weights can also be generated mathematically. Another approach is the 'analytical hierarchy process' in which weights are estimated based on pairwise comparisons (Saaty 1980; Forman 1990). The scores are then weighted according to the ranking or weights assigned to the criteria.

4.2.3 Ranking the Alternatives and Making a Recommendation

The final step in MCA is to establish a ranking of the options and to make a recommendation.

The outcome from an MCA process is a prioritisation of alternative courses of action or projects. Depending on the number of options and criteria, the process can generate a vast amount of information. Graphical methods have been shown to be an effective way of presenting the results for different alternatives (Janssen & van Herwijnen 1991). Interactive computer packages (see, for example, DNR 1999) are now available which enable the decision maker to view graphical outputs, as well as what happens if any of the key parameters or assumptions change.

Objectives for Management	**Zoning Options**			
	1	2	3	4
Increased employment opportunities in north Qld (no jobs)	3	10	90	0
Minimal impact on the marine environment (water quality)				
Increased commercial fishing (size of catch)				
Increased tourism (no. of visitors)				
Minimal social effects on indigenous population (quality of life)	Low	High	Very low	High

Figure 4.3 Schematic representation of an effects matrix for zoning options for the Great Barrier Reef Marine Park

5 CONCLUSION

The purpose of this paper was to update the financial values presented in Driml (1997b), and also further discuss methods by which resource values for the Marine Park may be estimated on an ongoing basis. The identification of appropriate models was considered an essential first step for the effective evaluation of resource management strategies as the type and format of the data required for estimating resource values depends highly on the evaluation model.

The scope of the study was limited to desk research only, with no primary research incorporated within the scope of works. A draft of the report was presented to, and discussed with, GBRMPA representatives for final comment.

Financial Values

The estimates of the gross financial values of the direct uses of the GBRPM should not be treated as estimates of the values attributable to its status as a protected area. Even in the absence of such a declared heritage area or marine park and the regulatory and infrastructural support provided by GBRMPA, the area would still be used for tourism, commercial and recreational fishing and boating but the financial values generated might be lower due to the greater degradation of the resource. In brief, it cannot be assumed that *all* estimates in terms of tourism, fishing etc. are attributable to the existence of the GBRMP itself or to the activities of GBRMPA in regulating its use.

Our analysis found that the three direct uses of the Great Barrier Reef Marine Park generated average revenues of about $700 million per annum over the period 1993–94 to 1997–98. We note that the financial year 1995–96 recorded a significantly higher number of tourists than the other years under review, which generated a higher than average level of revenue for the GBRMP.

Table 5.1 Great Barrier Reef Marine Park gross financial value of direct uses ($'000)*

	1993–94	1994–95	1995–96	1996–97	1997–98
Commercial Tourism	$411 149	$436 513	$507 392	$430 627	$454 836
Commercial Fishing	$141 722	$120 630	$149 429	$141 458	$136 180
Recreational Fishing and Boating	$112 038	$120 194	$117 953	$113 258	$107 572
Total	$664 910	$677 337	$774 774	$685 342	$698 588
* = nominal dollars. Source: KPMG Consulting					

In preparing the estimates of financial values, KPMG refined the approach adopted by Driml (1997b), and in this respect, the outcomes of the two studies are not necessarily comparable. We note that the methodology utilised by KPMG is open to further refinement as secondary data sources evolve over time.

It should be noted also that these are estimates of the *gross* value of expenditure and cannot be used to assess the contribution of these activities to income or the Gross Regional Product (GRP). For this purpose, estimates of *value added* generated by each sector would be required.

Input-Output Analysis

The estimates of the financial values of the direct uses of the GBRMP do not include consideration of the flow-on impact, or the effect of linkages of these activities, with other industries in the State economy. We have extended this direct contribution analysis and considered the indirect or flow-on effects of those activities, in terms of output and employment, on the economy of the State of Queensland through the use of input-output analysis. The following table summarises the initial, flow-on and total impacts for output and employment associated with the nominated economic activities that utilise the GBRMP, for the year 1994–95.

Table 5.2 Summary of output effects GBRMP-based activities, Queensland, 1994–95

Activity	Output Effects			Employment Effects		
	Initial Output ($m)	Flow-on ($m)	Total Impact ($m)	Initial Employ. (no.)	Flow-on (no.)	Total Impact
Commercial Tourism	436.5	407.9	844.4	7 421	5 467	12 888
Commercial Fishing	120.6	73.3	193.9	1 568	1 152	2 720
Recreational Fishing and Boating	120.2	134.7	254.9	N/A	2 008	2 008
Total	677.3	615.9	1 293.2	8 989	8 627	17 616
Source: KPMG Consulting						

It is recommended that the economic impact of the activities of GBRMP-based activities is monitored and data collection undertaken cognisant that the initial financial estimates may be utilised to determine flow-on economic impacts. It is recommended that GBRMPA determines the region of significance, that is, the State of Queensland and/or the regional economies, and that data about the activities in the GBRMP be collected for that region of significance. If meaningful comparisons are to be made about the impact of these activities over time, then it is important to establish a consistent approach to data collection.

Economic Decision-making Management Tool

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.

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.

We have suggested that it would be advisable for GBRMPA to consider the use of complementary decision-making models such as Multiple Objective Decision Support Systems (MODSS) or Multiple Criteria Analysis (MCA) which allow the analyst to incorporate both pecuniary and non-pecuniary values in the decision-making process. MCA provides a formal process which is sufficiently flexible to facilitate the incorporation of information from a number of disciplines. It is an appropriate tool to assist decision making when the problem to be addressed is complex and poorly defined; when there are multiple and competing objectives; and, in situations where there are multiple stakeholders with conflicting points of view about the appropriate decision.

Irrespective of which decision-making models GBRMPA decides to use, the issue of the relative weight to be given to the gains and losses of different stakeholder groups, including future generations, has to be addressed explicitly. Where there are conflicting and competing objectives between users of a given natural resource it needs to be made explicit how the gains and losses accruing to different stakeholders are to be compared.

Data Requirements

The following figure 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.

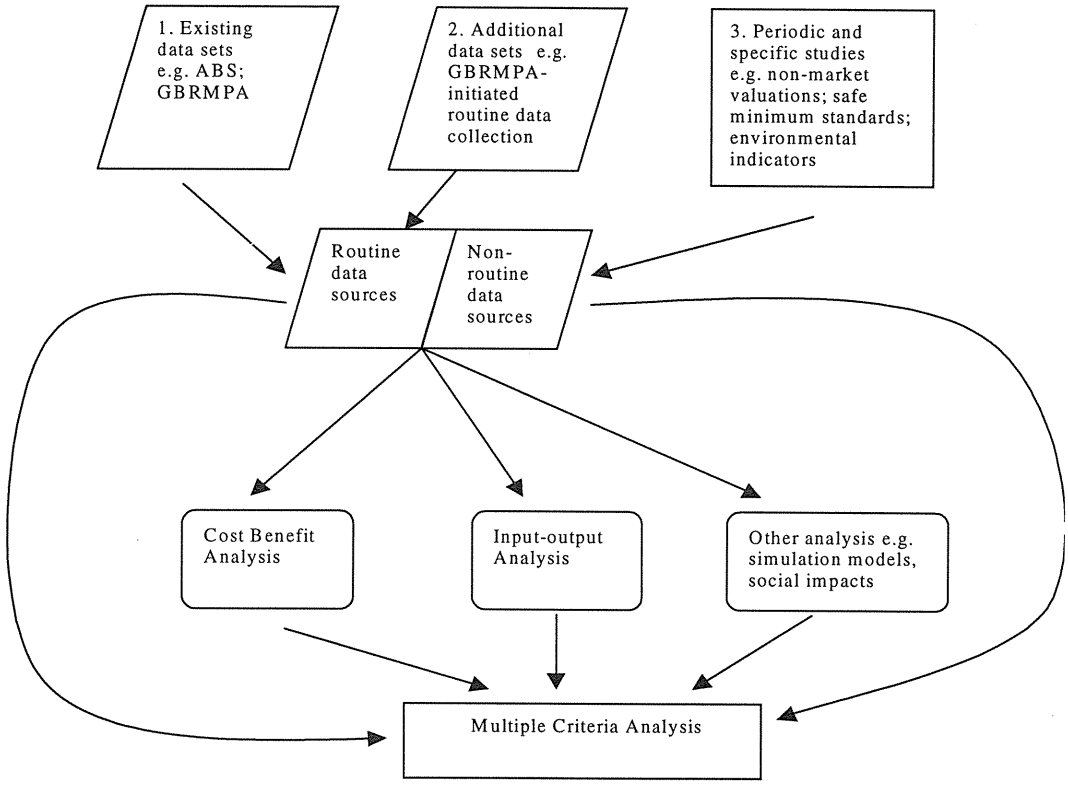


Figure 5.1 Schematic representation of data requirements and uses

It is recommended that GBRMPA:

- Undertake a number of survey-based studies to derive 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.
- Establish a set of appropriate sustainability indicators, covering economic, social, and environmental characteristics, that are sensitive to changes in resource use in the Park. The indicators should be selected to ensure that changes in these characteristics are monitored on a consistent basis over time and across the whole area of the GBRMP. These indicators should also provide an appropriate basis for setting safe minimum standards (SMS) for future uses of the GBRMP.
- Establish long-term monitoring studies in order to gain further information about biological thresholds, while tourists, as consumers, need to be studied in terms of their reaction to overcrowding and their willingness to pay for significant attributes of the natural resource.
- Undertake a survey of stakeholders to solicit preferences for resource management, and, more importantly, to identify the criteria or objectives for management and to establish the relative importance of identified objectives. It is not envisaged that such a survey would be required on a regular basis but if it were undertaken periodically, say every three to five years, stakeholder involvement in decision-making processes, particularly if an MCA approach is adopted, would be considerably improved.

It needs to be emphasised that the compilation of an economic data set for use in decision making requires the same long-term investment in appropriate research as is the case for scientific data. To this end GBRMPA needs to give serious consideration to both ad hoc data collection exercises, possibly on a consultancy arrangement as is the existing practice, and to long-term research projects in collaboration with appropriate research institutions, for instance, under ARC SPIRT* grants with Universities.

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* Australian Research Council *Strategic Partnerships with Industry – Research and Training Scheme*

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APPENDIX

Notes

This appendix contains six tables of detailed results from the input-output analysis estimating the impact of Great Barrier Reef Marine Park uses on the Queensland economy for the year 1994–95. Tables 1, 3 and 5 show the impacts of Commercial Fishing, Recreational Fishing and Boating, and Commercial Tourism, respectively, on the value of gross output, while tables 2, 4 and 6 show the respective employment effects.

'Sector' column: This column lists the main sectors used to describe the Queensland economy, including the three 'sub-sectors' of the GBRMP, CFGBRMP (Commercial Fishing), CTGBRMP (Commercial Tourism), and RFGBRMP (Recreational Fishing).

'Initial' column: This column shows the initial impact of output or employment attributable to that sector.

'Flow-on' column: This column shows the multiplier effects of output or employment created in all other sectors of the economy generated by the initial impact on output or employment as shown in the **'initial'** column.

'Rank' column: This shows the ranking of sectors in terms of the relative size of the flow-on effects.

'%' column: This shows the percentage contribution of each sector to the total flow-on effects.

'Total', 'Rank' and '%' columns: These show the sums of the initial and flow-on effects, and the ranking and percentage contribution respectively of each sector in terms of its combined initial and flow-on effects.

Appendix Table 1. Output effects commercial fishing GBRMP

	Queensland 1995				($t)		
Sector	**Initial**	**Flow-on**	**(Rank)**	**(%)**	**Total**	**(Rank)**	**(%)**
Animal	0	620.95	15	0.8	620.95	16	0.3
O'Agric	0	929.36	13	1.3	929.36	14	0.5
For/Fsh	0	232.55	19	0.3	232.55	20	0.1
Coal/Pe	0	352.76	18	0.5	352.76	19	0.2
O'Minin	0	59.43	21	0.1	59.43	22	0.0
Food M	0	6092.48	4	8.3	6092.48	5	3.1
Wood M	0	2266.37	9	3.1	2266.37	10	1.2
Mach/Ap	0	1947.25	11	2.7	1947.25	12	1.0
Metals	0	900.91	14	1.2	900.91	15	0.5
Non Met	0	474	16	0.6	474	17	0.2
O'Manuf	0	3282.29	6	4.5	3282.29	7	1.7
Elec/Ga	0	3006.22	8	4.1	3006.22	9	1.6
Build/c	0	385.4	17	0.5	385.4	18	0.2
Trade	0	21440.16	1	29.3	21440.16	2	11.1
Tpt/Com	0	6458.89	3	8.8	6458.89	4	3.3
Finance	0	12293.81	2	16.8	12293.81	3	6.3
Pbl.Adm	0	2177.4	10	3.0	2177.4	11	1.1
Com Ser	0	5247.6	5	7.2	5247.6	6	2.7
Recreat	0	3070.14	7	4.2	3070.14	8	1.6
CFGBRMP	120629	0	22	0.0	120629	1	62.2
CTGBRMP	0	1889.8	12	2.6	1889.8	13	1.0
RFGBRMP	0	153.2	20	0.2	153.2	21	0.1
TOTAL	120629	73280.99		100.0	193910		100.0
Multiplier	1.000	0.607			1.607		

Appendix Table 2. Employment effects commercial fishing GBRMP

	Queensland 1995				(u)		
Sector	**Initial**	**Flow-on**	**(Rank)**	**(%)**	**Total**	**(Rank)**	**(%)**
Animal	0	5.3	14	0.5	5.3	15	0.2
O'Agric	0	14.75	12	1.3	14.75	13	0.5
For/Fsh	0	1.75	18	0.2	1.75	19	0.1
Coal/Pe	0	0.94	19	0.1	0.94	20	0.0
O'Minin	0	0.31	20	0.0	0.31	21	0.0
Food M	0	22.64	8	2.0	22.64	9	0.8
Wood M	0	17.46	9	1.5	17.46	10	0.6
Mach/Ap	0	17.21	11	1.5	17.21	12	0.6
Metals	0	3.78	16	0.3	3.78	17	0.1
Non Met	0	2.26	17	0.2	2.26	18	0.1
O'Manuf	0	17.44	10	1.5	17.44	11	0.6
Elec/Ga	0	9.56	13	0.8	9.56	14	0.4
Build/c	0	4.96	15	0.4	4.96	16	0.2
Trade	0	551.5	1	47.8	551.5	2	20.3
Tpt/Com	0	69.56	4	6.0	69.56	5	2.6
Finance	0	147.71	2	12.8	147.71	3	5.4
Pbl.Adm	0	35.9	6	3.1	35.9	7	1.3
Com Ser	0	135.16	3	11.7	135.16	4	5.0
Recreat	0	62.56	5	5.4	62.56	6	2.3
CFGBRMP	1568	0.0	21	0.0	1568	1	57.6
CTGBRMP	0	32.13	7	2.8	32.13	8	1.2
RFGBRMP	0	0.0	22	0.0	0.0	22	0.0
TOTAL	1568	1152.88		100.0	2720.88		100
Multiplier	1.000	0.735			1.735		

Appendix Table 3. Output effects recreational fishing and boating GBRMP

	Queensland 1995				($t)		
Sector	**Initial**	**Flow-On**	**(Rank)**	**(%)**	**Total**	**(Rank)**	**(%)**
Animal	0	858.10	17	0.6	858.10	18	0.3
O'Agric	0	1591.84	15	1.2	1591.84	16	0.6
For/Fsh	0	1036.21	16	0.8	1036.21	17	0.4
Coal/Pe	0	343.75	20	0.3	343.75	21	0.1
O'Minin	0	118.24	21	0.1	118.24	22	0.0
Food M	0	8418.01	8	6.2	8418.01	9	3.3
Wood M	0	2459.05	12	1.8	2459.05	13	1.0
Mach/Ap	0	10338.98	6	7.7	10338.98	7	4.1
Metals	0	1797.33	13	1.3	1797.33	14	0.7
Non Met	0	672.38	19	0.5	672.38	20	0.3
O'Manuf	0	8390.17	9	6.2	8390.17	10	3.3
Elec/Ga	0	2626.31	11	1.9	2626.31	12	1.0
Build/c	0	730.44	18	0.5	730.44	19	0.3
Trade	0	29313.86	1	21.8	29313.86	2	11.5
Tpt/Com	0	8876.71	7	6.6	8876.71	8	3.5
Finance	0	19030.25	2	14.1	19030.25	3	7.5
Pbl.Adm	0	1635.61	14	1.2	1635.61	15	0.6
Com Ser	0	3540.40	10	2.6	3540.40	11	1.4
Recreat	0	11193.63	3	8.3	11193.63	4	4.4
CFGBRMP	0	10630.06	5	7.9	10630.06	6	4.2
CTGBRMP	0	11145.97	4	8.3	11145.97	5	4.4
RFGBRMP	120190	0	22	0.0	120190.00	1	47.1
TOTAL	120190	134747.30		100.0	254937.30		100.0
Multiplier	1.000	1.121			2.121		

Appendix Table 4. Employment effects recreational fishing and boating GBRMP

	Queensland 1995				(u)		
Sector	**Initial**	**Flow-On**	**(Rank)**	**(%)**	**Total**	**(Rank)**	**(%)**
Animal	0	7.33	18	0.4	7.33	18	0.4
O'Agric	0	25.26	12	1.3	25.26	12	1.3
For/Fsh	0	7.82	16	0.4	7.82	16	0.4
Coal/Pe	0	0.91	20	0.0	0.91	20	0.0
O'Minin	0	0.62	21	0.0	0.62	21	0.0
Food M	0	31.28	10	1.6	31.28	10	1.6
Wood M	0	18.95	13	0.9	18.95	13	0.9
Mach/Ap	0	91.39	7	4.5	91.39	7	4.5
Metals	0	7.55	17	0.4	7.55	17	0.4
Non Met	0	3.20	19	0.2	3.20	19	0.2
O'Manuf	0	44.57	9	2.2	44.57	9	2.2
Elec/Ga	0	8.35	15	0.4	8.35	15	0.4
Build/c	0	9.40	14	0.5	9.40	14	0.5
Trade	0	754.03	1	37.5	754.03	1	37.5
Tpt/Com	0	95.60	6	4.8	95.60	6	4.8
Finance	0	228.65	2	11.4	228.65	2	11.4
Pbl.Adm	0	26.97	11	1.3	26.97	11	1.3
Com Ser	0	91.19	8	4.5	91.19	8	4.5
Recreat	0	228.08	3	11.4	228.08	3	11.4
CFGBRMP	0	138.18	5	6.9	138.18	5	6.9
CTGBRMP	0	189.49	4	9.4	189.49	4	9.4
RFGBRMP	0	0	22	0.0	0	22	0.0
TOTAL	0	2008.82		100.0	2008.82		100.0

Appendix Table 5. Output effects commercial tourism GBRMP

	Queensland 1995				($t)		
Sector	**Initial**	**Flow-on**	**(Rank)**	**(%)**	**Total**	**(Rank)**	**(%)**
Animal	0	4697.34	14	1.2	4697.34	15	0.6
O'Agric	0	20758.26	6	5.1	20758.26	7	2.5
For/Fsh	0	1268.53	19	0.3	1268.53	20	0.2
Coal/Pe	0	2257.54	18	0.6	2257.54	19	0.3
O'Minin	0	992.98	20	0.2	992.98	21	0.1
Food M	0	46033.53	3	11.3	46033.53	4	5.5
Wood M	0	13700.34	10	3.4	13700.34	11	1.6
Mach/Ap	0	4099.38	15	1.0	4099.38	16	0.5
Metals	0	4069.67	16	1.0	4069.67	17	0.5
Non Met	0	3425.09	17	0.8	3425.09	18	0.4
O'Manuf	0	12525.72	11	3.1	12525.72	12	1.5
Elec/Ga	0	18968.3	8	4.7	18968.3	9	2.2
Build/c	0	7172.94	13	1.8	7172.94	14	0.8
Trade	0	57435.63	2	14.1	57435.63	3	6.8
Tpt/Com	0	32724.19	4	8.0	32724.19	5	3.9
Finance	0	105911.05	1	26	105911.05	2	12.5
Pbl.Adm	0	7767.1	12	1.9	7767.1	13	0.9
Com Ser	0	26698.5	5	6.5	26698.5	6	3.2
Recreat	0	15924.25	9	3.9	15924.25	10	1.9
CFGBRMP	0	20703.18	7	5.1	20703.18	8	2.5
CTGBRMP	436514	0.00	22	0.0	436514	1	51.7
RFGBRMP	0	777.03	21	0.2	777.03	22	0.1
TOTAL	436514	407910.56		100.0	844424.56		100.0
Multiplier	1.000	0.934			1.934		

Appendix Table 6. Employment effects commercial tourism GBRMP

	Queensland 1995				(u)		
Sector	**Initial**	**Flow-on**	**(Rank)**	**(%)**	**Total**	**(Rank)**	**(%)**
Animal	0	40.11	14	0.7	40.11	15	0.3
O'Agric	0	329.45	5	6.0	329.45	6	2.6
For/Fsh	0	9.57	18	0.2	9.57	19	0.1
Coal/Pe	0	6	19	0.1	6	20	0.0
O'Minin	0	5.19	20	0.1	5.19	21	0.0
Food M	0	171.07	8	3.1	171.07	9	1.3
Wood M	0	105.57	10	1.9	105.57	11	0.8
Mach/Ap	0	36.24	15	0.7	36.24	16	0.3
Metals	0	17.1	16	0.3	17.1	17	0.1
Non Met	0	16.31	17	0.3	16.31	18	0.1
O'Manuf	0	66.54	12	1.2	66.54	13	0.5
Elec/Ga	0	60.3	13	1.1	60.3	14	0.5
Build/c	0	92.35	11	1.7	92.35	12	0.7
Trade	0	1477.39	1	27	1477.39	2	11.5
Tpt/Com	0	352.42	4	6.4	352.42	5	2.7
Finance	0	1272.55	2	23.3	1272.55	3	9.9
Pbl.Adm	0	128.05	9	2.3	128.05	10	1.0
Com Ser	0	687.67	3	12.6	687.67	4	5.3
Recreat	0	324.47	6	5.9	324.47	7	2.5
CFGBRMP	0	269.11	7	4.9	269.11	8	2.1
CTGBRMP	7421	0	21	0.0	7421	1	57.6
RFGBRMP	0	0	22	0.0	0.0	22	0.0
TOTAL	7421	5467.46		100.0	12888.46		100.0
Multiplier	1.000	0.737			1.737		

Kuehrca.