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Program 8: Sustainable Use and Management of Marine Resources of the Great Barrier Reef

Project 4.8.6: Analysis of recreational and tourism use and impact on the Great Barrier Reef for managing sustainable tourism **[Objectives (a) and (c)]**

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1. Project Objectives

An overview of Project 4.8.6 is available from the Marine and Tropical Sciences Research Facility (MTSRF) website: http://www.rrrc.org.au/mtsrf/theme_4/project_4_8_6.html

Objective (a): Identify relative social and economic values of key marine species, including large fish around tourist facilities; and

Objective (c): Identify impacts of tourism and visitation to key reef sites and sustainable levels of visitation to these sites (this component deferred pending additional MTSRF funding and/or co-investment).

2. Project / Task Methodology

Objective (a): Identify relative social and economic values of key marine species, including large fish around tourist facilities

Surveys of tourists visiting the Great Barrier Reef (GBR) and interacting with iconic marine wildlife species (e.g. minke whales, sharks and rays, turtles and large fishes such as Maori wrasse, Potato cod and Queensland grouper), combined with a business expenditure survey of GBR tourism operators providing these experiences, will provide the first in-depth assessment of some of the relative social and economic values of these iconic marine species and their impact on the local and regional economy.

Field assessments of the quality of key wildlife attractions, impacts and their management will be conducted and will require the continued in-kind support of industry. Assessment of social values requires an understanding of visitor expectations, satisfaction and perceptions of iconic wildlife species. An understanding of these social and economic values of these key species is required for a Triple Bottom Line (or Quadruple Bottom Line) evaluation of the sustainability of tourism utilising these important resources.

MTSRF funding allocated to Project 4.8.6 Objective (a): $28,000 per annum for four (4) years (financial years 2006/2007 – 2009/2010).

Objective (c): Identify impacts of tourism and visitation to key reef sites and sustainable levels of visitation to these sites (this component deferred pending additional MTSRF funding and/or co-investment).

Data collected through the visitor survey, focus groups and operator survey will establish the importance of specific attractors in the reef experience, the importance of specific sites as triggers to attract visitors and key elements of the experience that determine satisfaction levels. Combining this knowledge with environmental sustainability levels will assist in determining the level of visitor sustainability if there are restrictions placed on visitor numbers or visitor usage of specific sites. A number of management tools will be identified and a sustainable level of visitation framework developed as a new assessment and management tool to assist GBR managers mitigate impacts of loss of sustainability through overuse.

No specific MTSRF funds were allocated to Project 4.8.6 Objective (c): Task deferred pending project scoping, additional MTSRF funding and/or co-investment.

3. Progress towards Milestones – Project 4.8.6 Objective (a)

All current milestones towards the objective have been met or exceeded. Research activities since project commencement include:

1. Research team project scoping and pilot visitor survey development (September to October 2006).
2. Pilot passenger survey sampling of two live-aboard dive tourism vessels in the far northern GBR (October to December 2006; sample of n=87 achieved; preliminary results presented below).
3. Data entry and preliminary analyses of far northern GBR marine species pilot passenger questionnaire (February to June 2007).
4. Development of GBR tourism operator Business Expenditure Survey and Key Informant Interview questionnaire (January to March 2007).

5. GBR tourism operator Business Expenditure Survey sampling (commenced April 2007; ongoing).

6. GBR tourism operator Key Informant Interview questionnaire sampling (commenced April 2007; current sample n=10; ongoing).

7. Research team scoping and development of GBR dwarf minke whale social and economic values visitor survey (May 2007).

8. Sampling of GBR dwarf minke whale social and economic values visitor survey (June to August 2007).

A research plan summary with associated key milestones (Reports to the MTSRF and manuscripts for peer-reviewed publication) is presented below (Table 1). In this milestone report we present preliminary findings of the 2006 pilot passenger survey (far northern GBR; survey instrument attached as Appendix 1) and an update on the progress of the GBR tourism operator Business Expenditure Survey and Key Informant Interview (survey instruments attached as Appendices 2 and 3 respectively). Details of research team communications and consultation with industry and management agency stakeholders are also presented.

Table 1: Project 4.8.6 Objective (a) research plan summary and key milestones for 2007 to 2010.

Species target group	Sampling timeline	Key Milestones	
		Report	Peer-reviewed
Multi-species	Far Northern GBR Pilot Survey 2006; Economic expenditure interviews of operators (through 2007).	**June 2007** 1. Preliminary report on pilot survey and interviews (this report).	
Sharks and large fishes (multi-species questionnaire)	August 2007 to April 2008	**June 2008** 2. Preliminary report on social and economic values of sharks and large fishes.	December 2008
Minke whales	June/July 2007 and June/July 2008	**June 2009** 3. Report on social and economic values of dwarf minke whales.	December 2009
Turtles	October to December 2007-2009	**March 2010** 4. Report on social and economic values of marine turtles.	June 2010
Key Marine Species (all of the above)		**June 2010** 5. Final report on the social and economic values of key marine species.	July 2010

3.1 Summary of research team consultation / meetings with tourism industry and management agency stakeholders since project commencement

September to October 2006: Consultation and project scoping via telephone and email conducted with EPA/QPWS (Jesse Low, Team Leader, Coastal and Marine Impact Assessment Parks Services) on project objectives and development of pilot passenger survey in far northern GBR.

October to November 2006: Consultation with Undersea Explorer and Explorer Ventures (live-aboard dive tourism operations) in development of far northern GBR pilot passenger survey; sampling conducted October to December 2006.

8 November 2006: Research team scoping meeting held with Great Barrier Reef Marine Park Authority (GBRMPA) staff from Species Conservation, Research and Monitoring, and Tourism and Recreation Groups (Kirstin Dobbs, Sarah Salmon, Andrew Chin, Lisha Mulqueeny,
Chris Briggs and Leanne Brown).

15 December 2006: Project objectives and proposed methodology presented to tourism industry (seven of nine GBRMPA permitted swim-with-minke whales operators), GBRMPA and QPWS staff at the Dwarf Minke Whale Tourism Monitoring Programme 2006 Post-Season Industry Workshop, Cairns. Project summary and key objectives included in the Minke Whale Project Research Newsletter # 9 (15/12/2006) distributed to industry and management participants at the above workshop.

5 April 2007: Project Information Sheet ("Understanding the social and economic values of key marine species in the Great Barrier Reef") developed and distributed to GBR tour operators participating in the GBR tourism operator Business Expenditure Survey and Key Informant Interview survey.

16-18 April 2007: Seventeen GBR tourism operators based in Cairns and Port Douglas contacted by email and telephone to participate in the GBR tourism operator Business Expenditure Survey and Key Informant Interview survey. Key Informant Interviews conducted with ten operators; surveys ongoing through 2007.

25 May 2007: Project update presented to swim-with-minke whales tourism operators, GBRMPA, DEW and QPWS staff at the Dwarf Minke Whale Tourism Monitoring Programme 2007 Pre-Season Industry Workshop, Cairns.

3.2 Preliminary findings of Pilot Visitor Survey (Far Northern GBR), October to December 2006

3.2.1 Methods

Sampling and questionnaire design

Sampling using a self-administered questionnaire was conducted on the only two live-aboard dive tourism vessels (*Undersea Explorer* and *Nimrod Explorer*) conducting regular, scheduled, specialised expeditions to the Far Northern Section of the GBRMP between October and December 2006. Key features of these trips include sightings and interactions with large (breeding) aggregations of green turtles (*Chelonia mydas*) in the vicinity of remote and significant turtle nesting islands (e.g. Raine Island), as well as relatively high concentrations of sharks and pelagic fishes, encountered opportunistically.

An additional feature of the *Undersea Explorer* Far Northern expeditions includes the capture, tagging and release of tiger sharks (*Galeocerdo cuvier*), conducted by R. Fitzpatrick as part of a satellite tracking program. The opportunity for tourists to watch the shark being tagged (from the safety of the vessel) is promoted as a highlight of the trip.

Questions in the pilot survey were designed to elicit passenger values, perceptions and experiences from their interactions with turtles, sharks, sea birds and large fishes. The importance of sightings of these wildlife was explored, including their relative attractive power for visitors to the region. Visitor expenditure patterns in the Cairns and Port Douglas region were also detailed, enabling subsequent apportioning of expenditures in the region attributable to specific wildlife groups or species. The survey instrument is attached as Appendix 1.

Data collection and response rate

A total of eight trips (four by each vessel) were sampled between the 15 October and 15 December 2006. Questionnaires were distributed and collected by vessel crew towards the end of each trip, and their completion by passengers was entirely voluntary. Total passenger numbers from each trip were obtained from the dive company offices to calculate the response rate. A total of 122 passengers were carried between the two vessels over the eight trips. From these, 87 completed questionnaires were returned. An additional two questionnaires were only partially completed by passengers (and one questionnaire was completed by a crew member) and these have been excluded from the analyses. The response rate is therefore calculated as 89/122, or 73%.

3.2.2 Technique for estimating the regional economic 'impact' of key marine species

Economic value versus economic impact: Preliminary background

The economic 'value' of any good or service is *not* the same as its price, since people are often willing to pay more than the asking price to enjoy a particular good or service. In theory, the total value of a good is given by the area under its demand curve and this will equal the amount actually paid (total expenditure) *plus* 'consumer surplus'. It is notoriously difficult to try and estimate this value – particularly when interested in non-priced goods (e.g. environmental quality, key marine species).

The preliminary visitor survey did not, therefore, attempt to collect information relating to the total economic 'value' of key marine species. Instead, it sought to collect information that allows researchers to estimate the economic *impact* of the tourism that relies on those key marine species. Not only does this approach exclude non-tourism values associated with the key marine species, but it also ignores the consumer surplus attributable to the tourism values. This approach thus generates an unambiguous underestimate of the total 'value' of the species.

Economic impact

Simplistically, the regional economic 'impact' of key-species tourism is equal to:

> The tourist expenditure that is attributable to the species
> > multiplied by
> The regional (Keynesian) 'multiplier'

Researchers who wish to estimate the economic impact of key-species tourism thus need information that will allow them to determine, (a) how much regional tourist expenditure is directly attributable to the species; and (b) the size of the regional multiplier. Hence the need for two surveys: the visitor surveys collect information that allows researchers to assess (a), whilst the tour-operator surveys provide information about (b).

Using visitor survey data to estimate the regional expenditure that is attributable to key marine species

This study attempts to attribute visitor expenditure to individual species in a three-step procedure:

1. It uses survey data to estimate the total regional expenditure of each respondent.
2. It uses responses to questions about the importance of the dive-boat trip to the overall decision to travel to the Cairns/Port Douglas region to determine the proportion of total regional expenditure that can be 'attributed' to the dive-boat trip.
3. It uses responses to questions about the relative importance of different species of marine wildlife in the decision to go on dive-boat trip to determine how much of the 'attributable' dive-boat expenditure can be 'attributed' to individual marine species.

Note, Step (3) implicitly assumes that all attributable dive-boat expenditure can be attributed to individual species. It thus neglects the fact that some at least some dive-boat expenditure may be attributable to non-marine attributes of the dive trip (the dive experience itself, the time with friends, the boat trip itself, etc.). Consequently, this will tend to overestimate the total expenditure attributable to each species.

However, estimates that are generated from this process do not include the value of sightings of iconic wildlife species by other types of tour operators (e.g. sightseeing cruises, sunset cruises, etc.). And this will tend to underestimate the total regional expenditure that is attributable to each species.

Since the biases work in opposite directions, and since one cannot tell, a priori, which bias is stronger, one cannot tell whether final estimates will over or under estimates of regional economic impact of individual species. Readers are thus encouraged to think of these final estimates as providing information about the relative importance of different species in attracting tourist expenditure (rather than as a means of generating estimate of absolute value of individual species).

Estimates of the regional economic impact of dive boat trips (based on estimates of the proportion of total expenditure that is directly attributable to the dive boat) are more robust.

3.2.3 Preliminary Results

The following results represent preliminary analyses of the pilot passenger survey conducted from October to December 2006. Further in-depth analyses are continuing through 2007 for subsequent reporting and peer-reviewed publication.

Sample demographics

Of the total sample, 56% were male. The mean age of respondents was 44.7 years (range 20-68 years). Respondents originated from fourteen countries, with the largest groups coming from the United States (29 respondents), followed by Australia (22), Germany (9), the United Kingdom and the Netherlands (7 each). First time visitors to the GBR represented 58% of the sample, and first time visitors to the Far Northern Section of the GBR represented 88% of the sample.

The majority of respondents were highly experienced SCUBA divers, with 87% of the sample holding Advanced Open Water (PADI) certification or higher. The mean number of years of SCUBA experience for the sample was 13.2 years (ranging from 1-39 years' experience), and the median total number of dives conducted by respondents (in their lifetime) was 266 dives (ranging from 29 to 3,000 dives).

For 58% of the sample, taking this dive trip to the far northern GBR was the main purpose of their trip away from home. For 36%, the dive trip was one of several activities and/or destinations on their trip away from home.

Importance of seeing particular marine wildlife groups and species

Respondents were asked, "How important was it for you to see these marine wildlife when choosing this far northern GBR dive trip?" and were provided with a ten-point semantic differential scale (where 1 = 'Not at all important' and 10 = 'Very important') for a list of key marine wildlife groups, including marine turtles, sharks, fishes, sea birds and 'other wildlife'. Respondents were also asked to list 'any species in particular' for each group, and were provided the option to tick a box if they 'would not have chosen this dive trip if there were no chance of seeing this wildlife group'.

The mean rating scores (out of ten) for each wildlife group were:

- Marine turtles: 8.4
- Sharks: 8.4
- Fishes: 8.5
- Sea Birds: 4.1

Particular species of marine turtle listed by respondents were green turtles (n=4) and hawksbill (n=1). The small number of respondents indicating a particular species suggests that while seeing marine turtles was an important consideration when choosing the trip, there was limited consideration of any particular species. Nineteen respondents (22%) indicated that they would not have chosen this dive trip if there was no chance of seeing marine turtles.

Particular species of sharks listed by respondents included: tiger sharks (n=13), grey reef sharks (n=4), silvertip whalers (n=3), leopard sharks (n=2), hammerheads (n=2) and white tip reef sharks (n=1). Twenty-two respondents (25%) indicated that they would not have chosen this dive trip if there was no chance of seeing sharks.

Particular species of fish listed by respondents included: barracuda (n=2), trevally (n=2), wrasses, stingrays, mackerel, tuna, nudibranchs, bat fish, 'bumpheads' and 'other pelagics' (all n=1). Additional responses were 'large variety more important', 'all' and 'schools of fish'. Fifteen respondents (17%) indicated that they would not have chosen this dive trip if there was no chance of seeing the particular species of fish that they had nominated.

Only one respondent listed a particular sea bird ('boobies') and another respondent indicated 'life on cays' in general. Only two respondents indicated that they would not have chosen this dive trip if there was no chance of seeing sea birds.

Other wildlife species that were listed by respondents as important considerations when choosing their dive trip included: nudibranchs (n=6), manta rays (n=5), corals (n=5), soft corals (n=2), coral spawning, dugongs, turtles, cetaceans, whales, dolphins, octopus, cuttlefish, sponges, shells, jellyfish, parrot fish, marine invertebrates, flat worms, frog fish, pipe fish and crocodiles (all n=1). Six respondents (7%) indicated that they would not have chosen this dive trip if there was no chance of seeing the particular species they had listed.

Satisfaction perceptions of the far northern GBR

Respondents were asked to rate their overall satisfaction with their far northern GBR diving trip, as well as their wildlife experiences on the dive trip, on separate ten-point scales (ranging from 1 = Very Poor to 10 = Excellent). Mean scores for these questions were 8.7 and 8.8 respectively. The mean rating for the follow up question asking, "Overall, how well did this far northern GBR diving trip meet your expectations?" (3.5 out of 5) indicates that on

average passengers' expectations of the trip were slightly exceeded by their actual experience. Fifty-two of the respondents (60%) indicated that they would very likely return, or definitely return to visit the far northern GBR again in future.

Respondents were asked to rate the 'environmental quality' of the sites they visited in the far northern GBR on their dive trip. 'Environmental quality' was defined as "How healthy do you perceive the reefs and wildlife populations to be in the region?" and a ten-point rating scale (1 = Very poor environmental quality to 10 = Excellent environmental quality) was provided. The mean rating for this question was 8.0. The mean rating for a follow up question asking, "Did the environmental quality of the sites you visited meet your expectations?" (3.2 out of 5) indicates that on average respondents expectations were met or slightly exceeded.

Wildlife species / groups contributing to satisfaction

Respondents were asked, "How much did your interactions with each of the following types of marine wildlife contribute to your overall satisfaction with your trip?", and were provided with a ten-point semantic differential scale (where 1 = 'Didn't contribute at all to my satisfaction' and 10 = 'Contributed a great deal to my satisfaction') for the same list of key marine wildlife groups provided earlier in the survey. Respondents were again asked to list 'any species in particular' for each group, and were provided the option to tick a box if they did not see this wildlife.

The mean rating scores (out of ten) for each wildlife group were:

- Marine turtles: 8.8
- Sharks: 8.4
- Fishes: 8.5
- Sea Birds: 4.7

Respondents listed particular wildlife species they encountered and in some cases the locations at which they were seen. Marine turtle species reported to have been encountered during the trips were green, loggerhead and hawksbill turtles. Shark species reported to have been encountered were grey reef, silvertip whalers, tiger, wobbegong, epaulette, leopard, hammerhead, white tip reef and tawny reef sharks. Fish species listed by respondents as having been encountered were Maori wrasse, barracuda, potato cod, snapper, moray eels, red bass and leafy scorpion fish. Sea bird species reported to have been encountered were brown boobies, night herons and frigate birds. Other marine wildlife groups/species listed by respondents were dugong (from a single sighting on one trip), nautilus, nudibranchs, manta rays, cetaceans, dolphins, corals and 'marine invertebrates'. No respondents indicated that they had not seen any marine turtles, and only two respondents indicated that they had not seen sharks on their trip.

Preliminary analysis of economic values of wildlife groups/species

As noted earlier, this study attempts to attribute visitor expenditure to individual species in a three-step procedure:

1. In the first place, we used survey data to estimate the total regional expenditure of each visitor. Specifically, respondents were asked to indicate the approximate amount that they had spent per day on different categories of goods. This was done by asking them to tick an appropriate expenditure category, as per the questionnaire excerpt below:

Item – Cost PER DAY	$0	$1-20	$21-50	$51-100	$101-150	$151-200	$201-300	>$300
Food or drinks from a takeaway								
Meals in a café or restaurant								
Groceries								
Accommodation								
Other (please specify):								

When estimating total expenditure on each category of good, we used the mid-point of each (e.g. $35 for the range $21-$50; $75 for the range $51-$100, etc.), although the lowest amount (e.g. $300) was used for the top category, giving an unambiguous downward bias to final estimates. These mid-points were then added together to arrive at an estimate of daily regional expenditures across all items *except* the dive-boat. Preliminary estimates indicate that the average visitor spent $328 per day while in the region. These daily expenditure estimates were then multiplied by the total number of days spent in the region, to generate an estimate of total regional non-boat spending. Preliminary estimates indicate that the average visitor spent $1,737 in the region – approximately 23% in the Port Douglas area and the rest in and around Cairns. This roughly accords with the proportion of time spent in the different regions (approximately 27% in Port Douglas).

Estimates of the *total* regional per-visitor expenditure (including dive boat expenditures) were then generated by adding the total regional expenditure estimates to:

- The cost of the dive boat trip (*mean preliminary estimate = $3943 per person*); and
- Extra expenditures from the dive boat trip (*mean preliminary estimate = $272 per person*).

Mean preliminary estimates indicate that each respondent spent close to $6,000 in the region ($5952 per person).

2. We then used responses to questions about the importance of the dive-boat trip to the overall decision to travel to the Cairns/Port Douglas region to determine the proportion of total regional expenditure that can be 'attributed' to the dive-boat trip. Figure 1 provides details on how that was done, listing the questions (and responses) that were used, and identifying the number of respondents falling within each category.
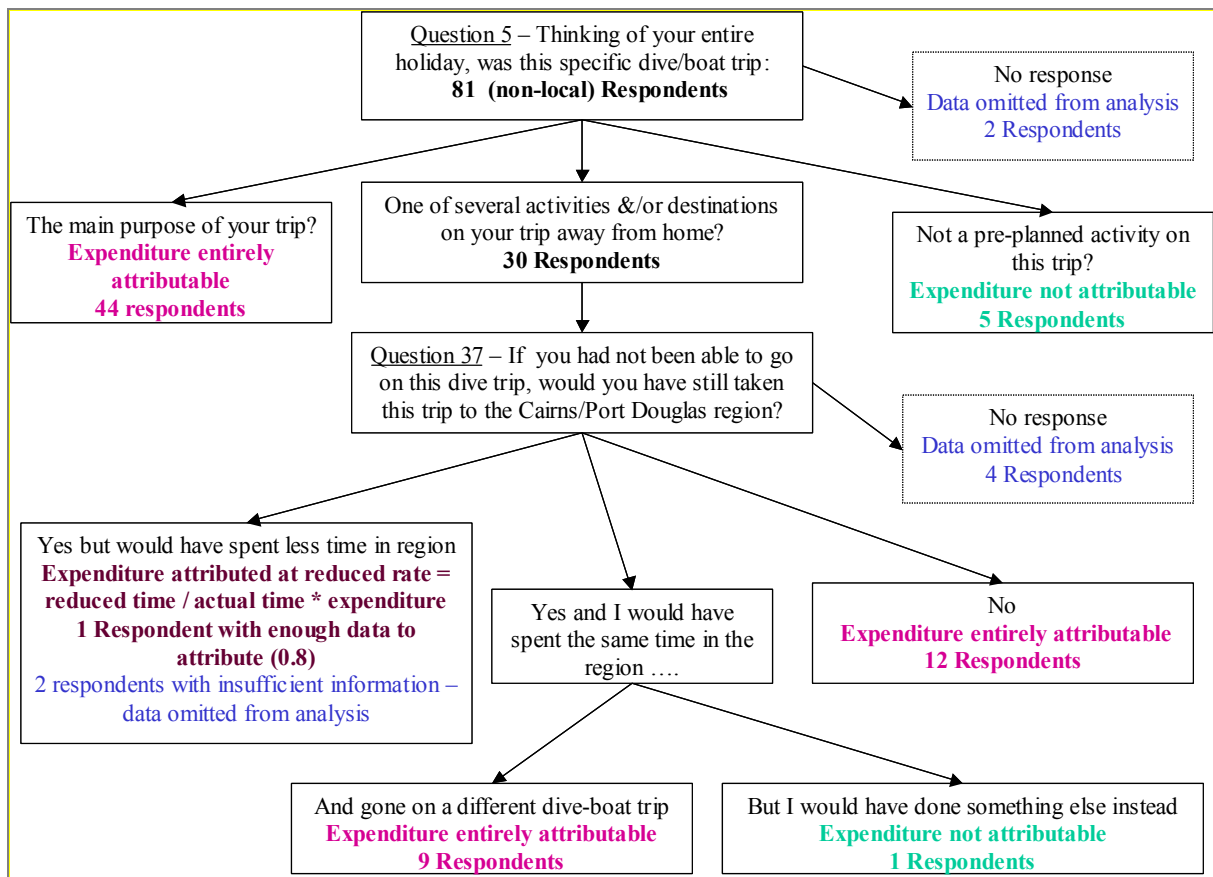
Figure 1: Analysis tree diagram for attributing regional expenditure to key marine species.

It seems that *most* regional expenditure is directly attributable to the dive-boat trip (i.e. visitors would not have come to the region if they could not go on the trip). Specifically, preliminary estimates indicate that the dive boats are directly responsible for almost ninety percent of respondent expenditure within the region (approximately $5,321 per person[1]).

3. We then used responses to questions about the relative importance of different species of marine wildlife in the decision to go on dive-boat trip to determine how much of the 'attributable' dive-boat expenditure can be 'attributed' to individual marine species. For example, the proportion of attributable dive boat expenditure that was attributed to sea turtles was calculated by dividing each visitor's response to the question on the 'importance' of sea turtles by the total 'importance' of all species (i.e. the sum of all importance scores). Preliminary estimates of the per-visitor regional expenditure that is attributable to each marine species considered in this questionnaire are as follows:

- Marine turtles: $1,360
- Sharks: $1,375
- Fishes: $1,354
- Sea Birds: $589
- Other wildlife: $643

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[1] Not all respondents answered all questions. So these figures vary somewhat depending upon the way in which missing data is handled.

3.3 Update on the progress of the GBR tourism operator Business Expenditure Survey and Key Informant Interview

Survey design

In order to establish the direct and indirect economic contributions of GBR dive tourism operators to their local economy, a Business Expenditure Survey and Key Informant Interview were designed by the research team and sampling began in mid April 2007. A strict agreement of confidentiality of data from this survey was undertaken with each respondent, ensuring that no operators or individuals will be identifiable from the results.

In order to encourage participation by GBR tourism operators, a promotional 'Information Sheet' was developed and distributed to operators via email, accompanying requests for their participation.

It is important to note that prior to the commencement of this project, members of the research team (Birtles, Valentine, Curnock and Mangott) had established a strong collaborative relationship with many of the Cairns and Port Douglas dive tourism operators included in the target sample, over a twelve-year period, via the Minke Whale Project (led by Birtles). The confidence of the tourism industry in this research project and their trust of the research team have proven invaluable in achieving industry support for the project and high levels of participation in the surveys.

Sampling progress

After introducing the project and presenting an outline of objectives and methods to swim-with-minke whales permitted tourism operators, GBRMPA and QPWS managers at the 2006 Post-Season Minke Whale Tourism Monitoring Workshop (15 December 2006), a total of seventeen Cairns and Port Douglas-based Reef tourism operators were contacted via telephone and/or email and asked to participate in early April 2007. An MS-Word copy of the Business Expenditure Survey was emailed to participants, with instructions for it to be completed in their own time, by a person with sufficient detailed financial knowledge of the company. Over 16-18 April 2007, Research Assistants Arnold Mangott and Matt Curnock visited the offices of participating GBR tourism operators in Cairns and Port Douglas to conduct Key Informant Interviews with owners/managers of participating operators.

At the time of writing this report, sampling of these operators is continuing, with Key Informant interviews conducted with ten of the seventeen operators over 16-18 April and remaining interviews with Cairns and Port Douglas-based operators planned between June to August 2007. Completed Business Expenditure Surveys have so far been received from four operators. Further completed Business Expenditure Surveys are expected to be returned by remaining operators between June and August 2007. Our approach to sampling of the Business Expenditure Surveys has been to allow operators to 'take their time' in completing this long and very detailed survey as we recognise that they are very busy with the day to day management of their operations. We have had assurances from many of the operators that they are supportive of the project and are completing the survey in gradual stages when time is available. We have received only one refusal to participate from a single operator.

Sampling of Cairns and Port Douglas-based operators is continuing between June and August 2007 and sampling of Townsville and Whitsundays-based GBR tourism operators is planned for August to December 2007.