Wildlife Management Program No.27 Progress Report

Whale Shark Interaction Management Ningaloo Marine Park

Progress Report: 2005 Whale Shark Season

Department and Conservation and Land Management, Western Australia

GOVERNMENT OF WESTERN AUSTRALIA

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

Preface

The Western Australian Department of Conservation and Land Management (CALM) has a legislative responsibility to manage wildlife on CALM managed lands under the CALM Act 1987, and to manage fauna for conservation State-wide under the Wildlife Conservation Act 1950. The Department also has a recreation policy, the objective of which is to facilitate enjoyment of the natural attributes of public lands and reserved waters in a manner that does not compromise conservation and other management objectives. Management of whale shark interactions in marine reserves requires an integration of CALM's conservation and recreation objectives, and the principal role of CALM in this respect is to manage the commercial and recreational activities of visitors.

The Whale Shark Management Interaction Program 1987 – 2007 (Wildlife Management Program 27) has been approved by the Executive Director, Department of Conservation and Land Management, the Marine Parks and Reserves Authority and the Minister for the Environment. Approved Wildlife Management Programs are subject to modifications as directed by new findings, changes in the status of the species and completion of management actions.

Acknowledgements

Collaboration is the key to successful conservation and management of whale sharks and therefore thanks must go to all involved in the continued effort towards and advances in protection, education and research of this amazing species. I would therefore like to acknowledge all the whale shark industry staff, Ningaloo Reef Dreaming for their donation towards tagging of whale sharks at Ningaloo, Ningaloo Blue for copies of DVD footage provided throughout the season, North-West Air works and pilots, CALM Wildlife Officer's Doug Coughran, Peter Lambert and Adam Meyer, CALM volunteers Matthias Schneider and Martin Woodbridge; Allison Richards for her invaluable work with Whale Shark Watch at Ningaloo; Brad Norman and Jason Holmberg for their commitment to the Ecocean Whale Shark Photo-id Library; and to all researchers in Australia and worldwide who dedicate so much of their time to unlocking the secrets of this gentle giant that roams the oceans.

Citation:

Wilson, E., Mau, R. and Hughes, M. (2005). *Whale shark Interaction Management: Progress Report 2005*. Progress report for the Department of Conservation and Land Management Wildlife Management Program No. 27.

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EXECUTIVE SUMMARY

In 2005 there were a total of 14 whale shark licenses in use, 11 for operations based at Tandabiddi and three based at Coral Bay. Exemption from use was granted for one licence holder due to special circumstances. A total of 372 day trips were conducted. There was a 1% reduction in paying participants from 2004. The average number of passengers per tour rose from 13.9 in 2004 to 14.5. Overall, the average duration of a whale shark experience trip has increased by nearly 2 hours since 1996.

Approximately 10,000 'Experiencing Whale Sharks in Ningaloo Marine Park' brochures were distributed to the public during the 2005 whale shark season. Public information talks were held weekly throughout the whale shark season. Two news print stories were released locally in relation to whale sharks.

The ratio of sharks sighted in relation to the number of spotter plane hours flown (i.e. search effort) was calculated to determine the search effort per sighting. Over the four years of data available, an analysis showed an inter-seasonal trend of reduced search effort (full season) per shark sighted from 2002 to 2005. Anecdotal reports that whale shark numbers are declining is not supported by an analysis of the aerial spotter plane data for the last four years.

CALM continued to support the collaborative study documenting the movements and behaviour of whale sharks that aggregate seasonally at Ningaloo Reef. 15 tags were deployed, nine pop-up archival tags and six satellite transmitter tags, in the vicinity of Black Rock and Norwegian Bay between 26th April and 6th May.

The 2005 Season has seen the strongest indication yet that the use of the whale shark spot patterns are an effective way to establish estimates on whale shark numbers, their migration patterns, and morphological changes of individuals over time. Two whale sharks have been resighted after a period of 12 years indicating spot patterns appear to remain unchanged in individuals over four metres in length for a period up to 12 years. Following the whale shark conference the ECOCEAN Whale Shark PhotoID Library has been adopted as the global whale shark photoID database and already contains over 660 submissions from more than 20 range states.

The Ningaloo whale shark experience was labelled a "high quality" experience following social surveys in 1996. Since those days, participation numbers have increased by 150% from around 2000 to 5000 passengers. Yet, the actual passenger capacity does not appear to be anywhere near the potential maximum capacity of the existing licensing regime. These trends over the last 10 years prompted a similar visitor satisfaction survey to be carried out in 2005. Preliminary results indicate that overall expectations are being met and often exceeded and passengers are generally happy with all components of the trip, code of conduct and the experience itself.

CALM continued with its operational program which is a combination of boat ramp inspections, boat patrols, industry vessel placement, and aerial surveillance. The CALM Exmouth District Office was supported by visiting Wildlife Officers. There were several incidents which required further investigation and follow up during the 2005 season. Some management issues arose that require further follow up including the license condition

relating to the long established practise of queuing and handballing of vessels, the issue of using the videographer as a second supervisor and the licensing of videographers.

Recommendations:

RECOMMENDATION 1: CALM TO CONSIDER ADDITIONAL AERIAL SURVEYS BETWEEN YARDIE CREEK AND POINT EDGAR FOR THE 2006 SEASON.

RECOMMENDATION 2: CALM TO REVIEW WHALE SHARK LOG BOOK RECORDS ON BEHAVIOURAL RESPONSE DURING INTERACTION FOR 2002-2005 AND MAKE RECOMMENDATIONS WHETHER TO CONTINUE WITH COLLECTION OF THIS DATA FOLLOWING THE 2006 SEASON.

RECOMMENDATION 3: CALM TO PRODUCE A STANDARD OPERATING PROCEDURE FOR INDUSTRY AERIAL SPOTTER PLANE GPS DATA COLLECTION.

RECOMMENDATION 4: SEASON LOGBOOKS NEED TO BE MODIFED TO ENABLE RECORDING TO WHICH VESSEL A WHALE SHARK WAS HAND-BALLED.

RECOMMENDATION 5: ENCOURAGE VIDEOGRAPHERS TO PROVIDE CALM WITH A COPY OF DAILY WHALE SHARK FOOTAGE FOR RESEARCH THROUGHOUT THE SEASON UNDER LICENCE CONDITION.

RECOMMENDATION 6: CALM TO ASSIST PROFESSOR JENNIFER SCHMIDT'S GLOBAL GENETIC STUDY TO DETERMINE WHALE SHARK POPULATION DYNAMICS BY PROVIDING TISSUE SAMPLES IN THE 2006 SEASON.

RECOMMENDATION 7: CALM TO DEVELOP A WHALE SHARK GUIDING TRAINING PROGRAM.

RECOMMENDATION 8: CALM TO INCLUDE CONSIDERATION OF YARDIE CREEK AS A DEPARTURE POINT FOR WHALE SHARK INTERACTION TOURS AS PART OF THE PARKS AND VISITOR SERVICES PLAN FOR NINGALOO.

RECOMMENDATION 9: REGULAR REVIEW OF VISITOR SATISFACTION IN CONSULTATION WITH WHALE SHARK INDUSTRY OPERATORS AND RESEARCHERS SHOULD BE CONSIDERED TO START BEFORE THE FIVE YEAR LICENCE PERIOD EXPIRES AND AT FIVE YEAR INTERVALS THEREAFTER.

RECOMMENDATION 10: CALM TO INCREASE ITS ON-WATER PRESENCE DURING THE 2006 WHALE SHARK SEASON.

RECOMMENDATION 11: ENSURE THAT INDUSTRY VIDEOGRAPHERS/PHOTOGRAPHERS FILMING ON CALM LANDS (I.E. NINGALOO MARINE PARK) FOR COMMERCIAL GAIN HAVE A COMMERCIAL FILMING PERMIT.

RECOMMENDATION 12: CALM TO HOLD INDUSTRY STAFF LOGBOOK TRAINING SESSIONS AND RETURNED LOGSHEETS ARE CHECKED FOLLOWING THE FIRST TWO WEEKS OF THE SEASON.

1 INTRODUCTION

1.1 Background

The annual aggregation of whale sharks at Ningaloo were first documented in the early 1980's and through documentary makers and pioneers in the whale shark industry, Ningaloo is now recognised around the world as a hot spot for whale shark interaction and a model of successful nature based tourism. The Western Australian Department of Conservation and Land Management (CALM) was established under the CALM Act 1984 to fulfil a number of functions including responsibility for the conservation and protection of whale sharks (Coleman, 1997) whilst facilitating the development of sustainable tourism (Chapman, 2002). CALM recognises how quality tourism can help educate and inform visitors, leading to a greater understanding and awareness of the natural environment (Coleman, 1997). With the hunting of whale sharks in other countries still very much in the spotlight, understanding and protection of these gentle giants and their behaviours has never been more important. CALM's Wildlife Management Program for whale shark interaction provides a statement of the administrative, compliance auditing and research and monitoring measures to be followed to ensure that human-whale shark interactions in Ningaloo Marine Park are a sustainable activity that assists CALM in meeting both its conservation and recreation objectives.

CALM has several specific objectives in relation to management of whale shark interactions in marine reserves. These are:

1. to conserve whale shark populations by ensuring that individual sharks, or the group as a whole, are not being subjected to an unacceptable level of disturbance;
2. to facilitate the development of ecologically sustainable whale shark tourism in marine reserves;
3. to facilitate safe interaction between people and whale sharks by allowing reasonable access within an appropriate 'duty of care';
4. to raise public awareness and appreciation of whale sharks and broader marine conservation issues;
5. to develop and implement a management framework that provides equitable opportunities for commercial operators to deliver a quality experience;
6. to ensure that whale shark interaction does not adversely impact on other values and users of marine reserves; and
7. to recoup the costs of managing the interaction, whenever possible and appropriate, from the commercial operators, according to the 'user pays' principle.

Management of the whale shark interaction industry will continue to focus on education, research and monitoring, whilst working collaboratively with commercial operators.

1.2 Overview

Under the Whale Shark Interaction Management Program, the CALM Management Team is responsible for the implementation and review of the program. In terms of reporting requirements, the terms of reference of the Management Team are:

- to assess monitoring results;
- to make recommendations on further research and monitoring;
- to evaluate whether objectives were met; and
- to evaluate the overall cost-effectiveness of the program.

In order to meet these objectives, an annual progress report is prepared by the Exmouth District for review by the CALM Management Team. The report is divided into several sections namely: Administration – which includes commercial tourism operations licensing and industry logbook assessment; education; research and monitoring; and management, including operations and issues and actions that require further consideration or follow up.

2 ADMINISTRATION

2.1 Commercial tourism operators

In 2005 there were a total of 14 whale shark licenses in use, 11 for operations based at Tandabiddi, Exmouth and three based at Coral Bay. Exemption from use was granted for one licence holder due to special circumstances. In 2003 fourteen operators had their licenses renewed for a period of five years based on their satisfactory performance over the previous five years. One new licence was issued last year following an expression of interest. All licenses will expire on 31st December 2008.

2.2 Reasonable Extent

The demand for whale shark interaction licences is high, however CALM has not added to the number of existing licences and takes a cautionary approach to expansion of the industry (Coleman, 1997). Existing licences must therefore be used to a reasonable extent throughout the paying season. According to licence condition 49, which states '*The licence holder must ensure that activities authorised under the licence are conducted each year of the licence period. If the licence is not used to a reasonable extent, as determined by the Executive Director, the Executive Director may cancel the licence*', licencee's must offer whale shark tours and be available to accept bookings for at least 50% of the paying season, be actively promoting tours to be available during the paying season, and have valid reasons for non operation.

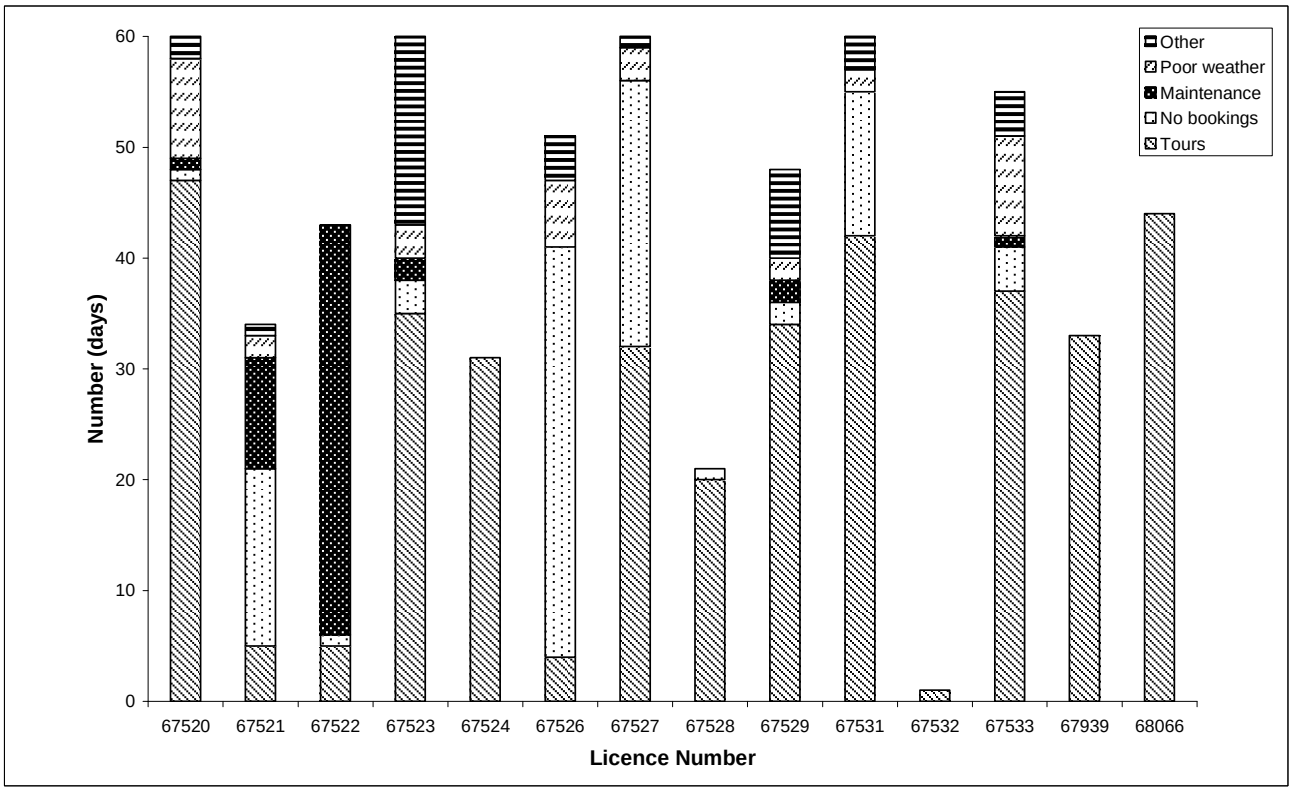


Figure 1: Comparison of the extent of daily use of all issued licenses over the paying season

The level of licence use throughout the paying season has increased over the last few years. The majority of licences in 2005 were being used to a reasonable extent, with nine licences participating in tours for over 50% of the paying season in 2005 (Figure 1). Only four licence holders recorded activities for each day of the paying season whether partaking in a tour or otherwise (Figure 1). This shows the need to improve daily recording throughout the paying season, in order to minimise assumptions of why tours were not conducted and therefore maintain data standards.

2.3 Whale shark tours

The actual number of tours conducted by all licensees in 2005 has decreased by 4% from 2004 with an 3% reduction in the number of tours with contact (Figure 2). However, the whale shark contact success rate has increased by 2% since 2004 (Figure 3). Overall, this change in contact success rate is minimal and levels of contact success have remained relatively steady since 1996.

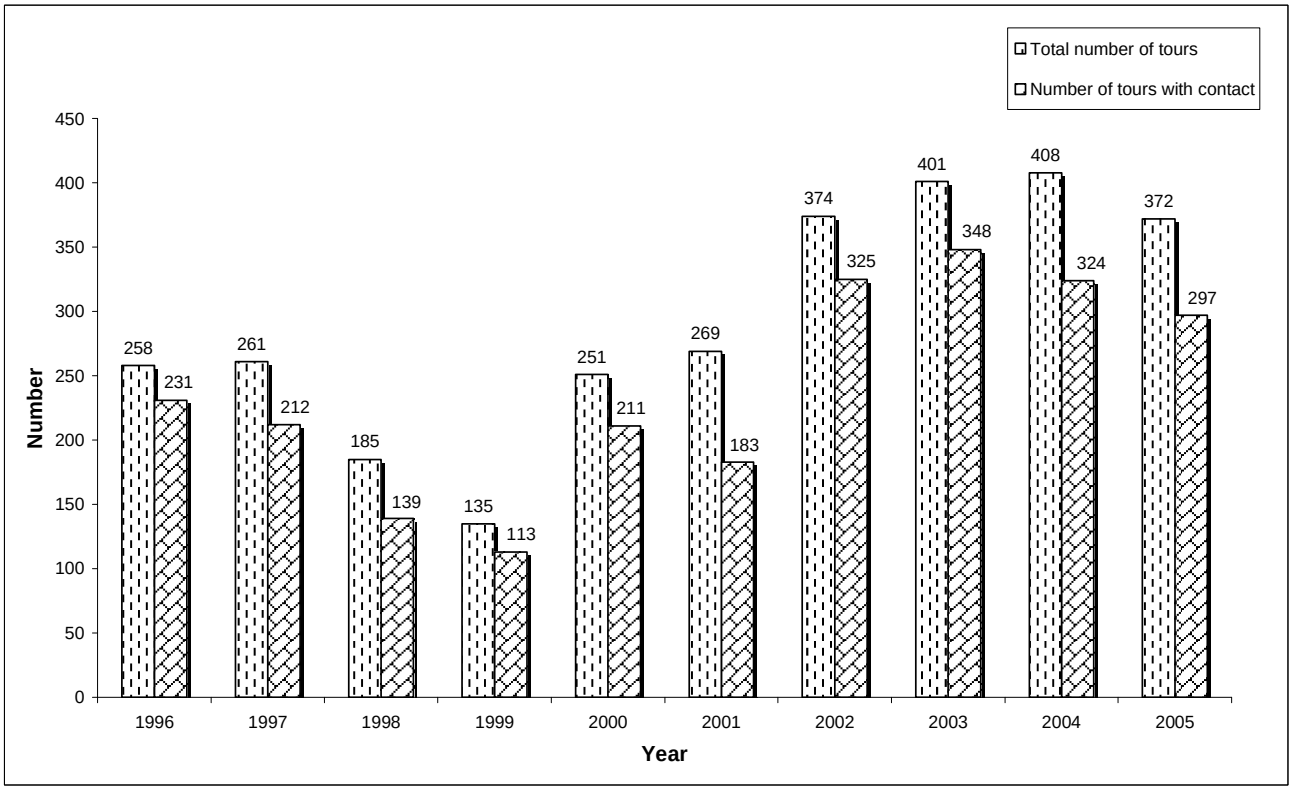


Figure 2: Comparison of whale shark tour numbers with and without whale shark contacts from 1996 to 2005.

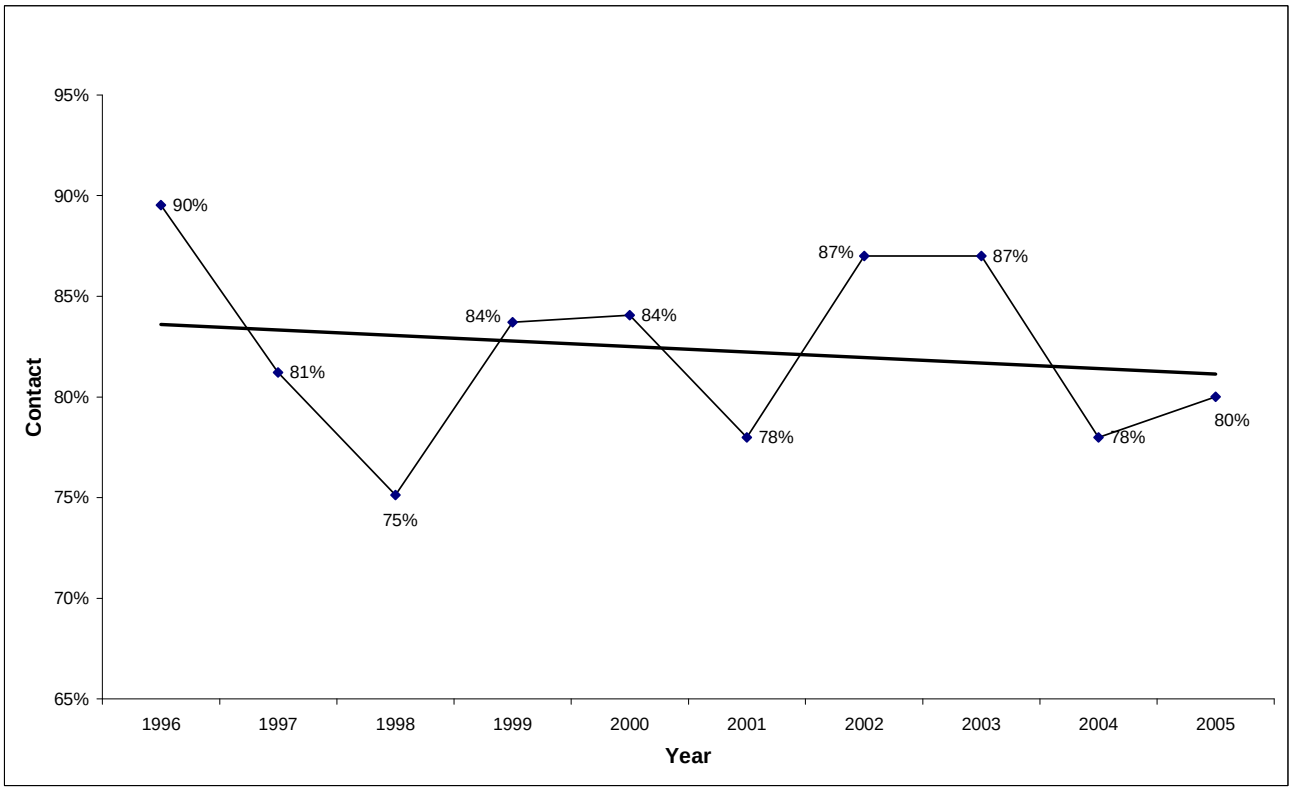


Figure 3: Whale shark contact success rate based on total trips with and without interactions

2.4 Passenger levels

Since the introduction of licences in 1993, participation in the Ningaloo whale shark experience has generally been on the increase (Coleman 1997), with a slight decline in 1999 which could be attributed to the impact of severe tropical Cyclone Vance which hit Exmouth on March 22. Since the all time peak in 2003 there has been a slight decline in paying passengers, however participation numbers are still more than double that of ten years ago. In 2005 there was a 1% reduction in paying participants from 2004 (Figure 4).

The 2% increase in whale shark contact success rate in 2005 was reflected by the decrease in the number of Free-Of-Charge (FOC) passengers (i.e. passengers that are on repeat trips due to the “no show, another go” operators policy) which reduced the actual number of passengers participating in whale shark tours in 2005 by 2% to 5396 persons (made up of both adults and children) (Figure 4).

The average number of passengers per tour increased from 13.9 in 2004 to 14.5 in 2005 (Figure 5). The decrease in the number of tours and the increase in the average number of passengers in 2005 could be a reflection of the fact that this season many vessels did not operate until they were about 75% full whereas last year vessels often operated despite low passenger numbers.

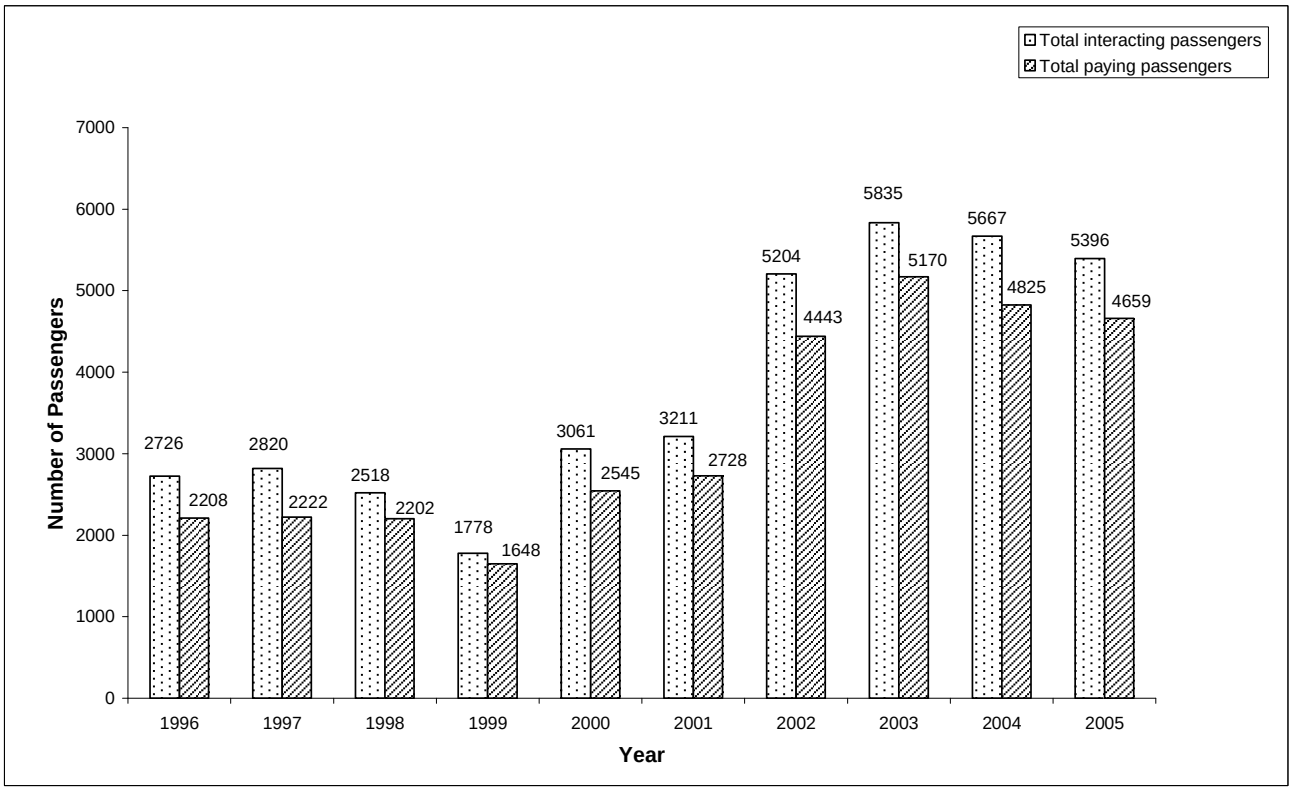


Figure 4: Total number of interacting and paying passengers participating in the Ningaloo Whale shark experience during the 'paying season' from 1996 to 2005

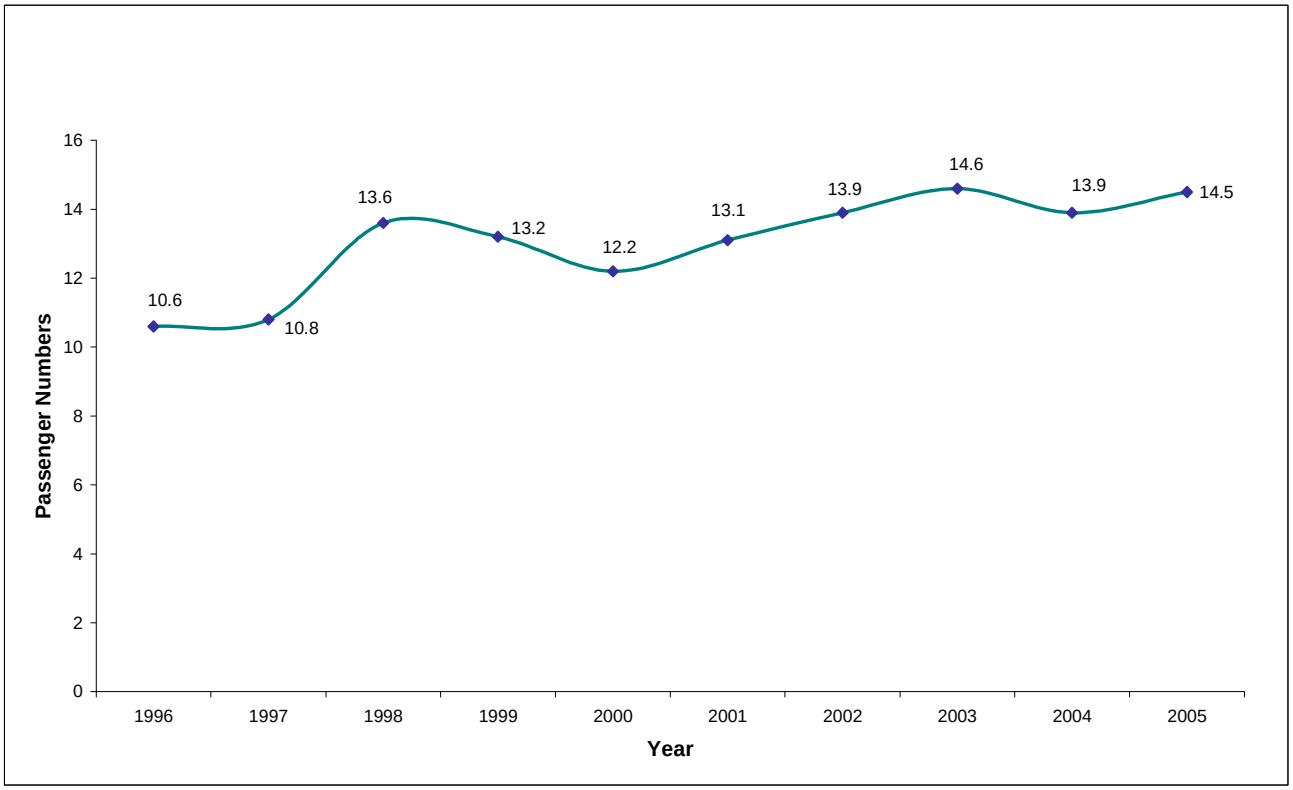


Figure 5: Average number of passengers per tour from 1996 to 2005

2.5 Whale Shark Tour Time

The average duration of a whale shark experience trip has increased by five minutes from last years time of 6 hours and 51 minutes in 2004 to 6 hours and 56 minutes (Figure 6). Overall, the average duration of a whale shark experience trip has increased by nearly two hours since 1996. It should be noted that this is not a necessarily a reflection on the time it takes to locate whale sharks as many trips now include snorkeling and diving as part of the standard whale shark experience.

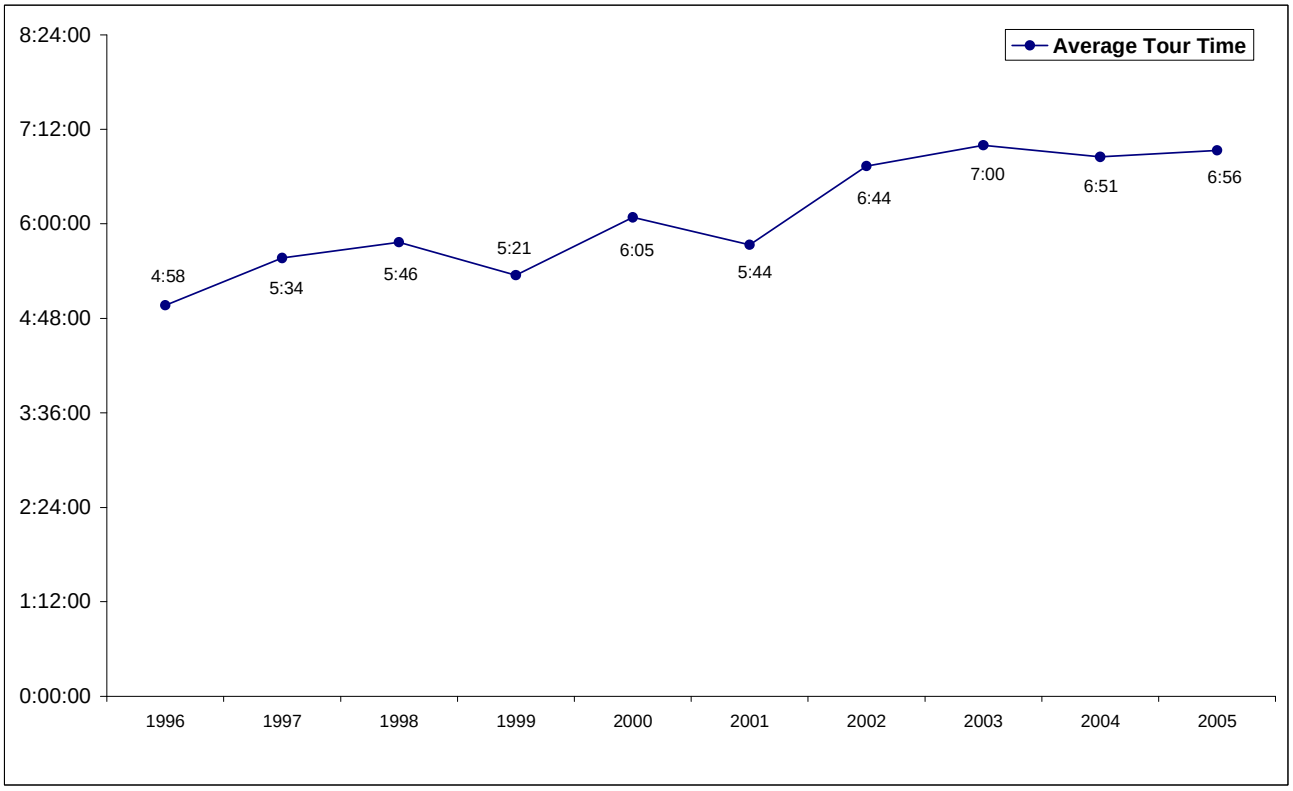


Figure 6: Average whale shark experience tour time from 1996 to 2005

2.6 Reported Whale Shark Interactions

The location of all reported whale shark interactions is shown in Figure 7. It is apparent that there is a gap, between Yardie Creek and Point Edgar, where no sightings are recorded. This is more likely due to the fact that spotter planes do not search this area and vessels do not conduct whale shark tours there on a regular basis, rather than the likelihood that whale sharks do not frequent the area. Based on the recommendations of the current aerial survey methodology review, this area may be a focus for additional aerial surveys in the 2006 season.

Recommendation 1: CALM to consider additional aerial surveys between Yardie Creek and Point Edgar for the 2006 season.

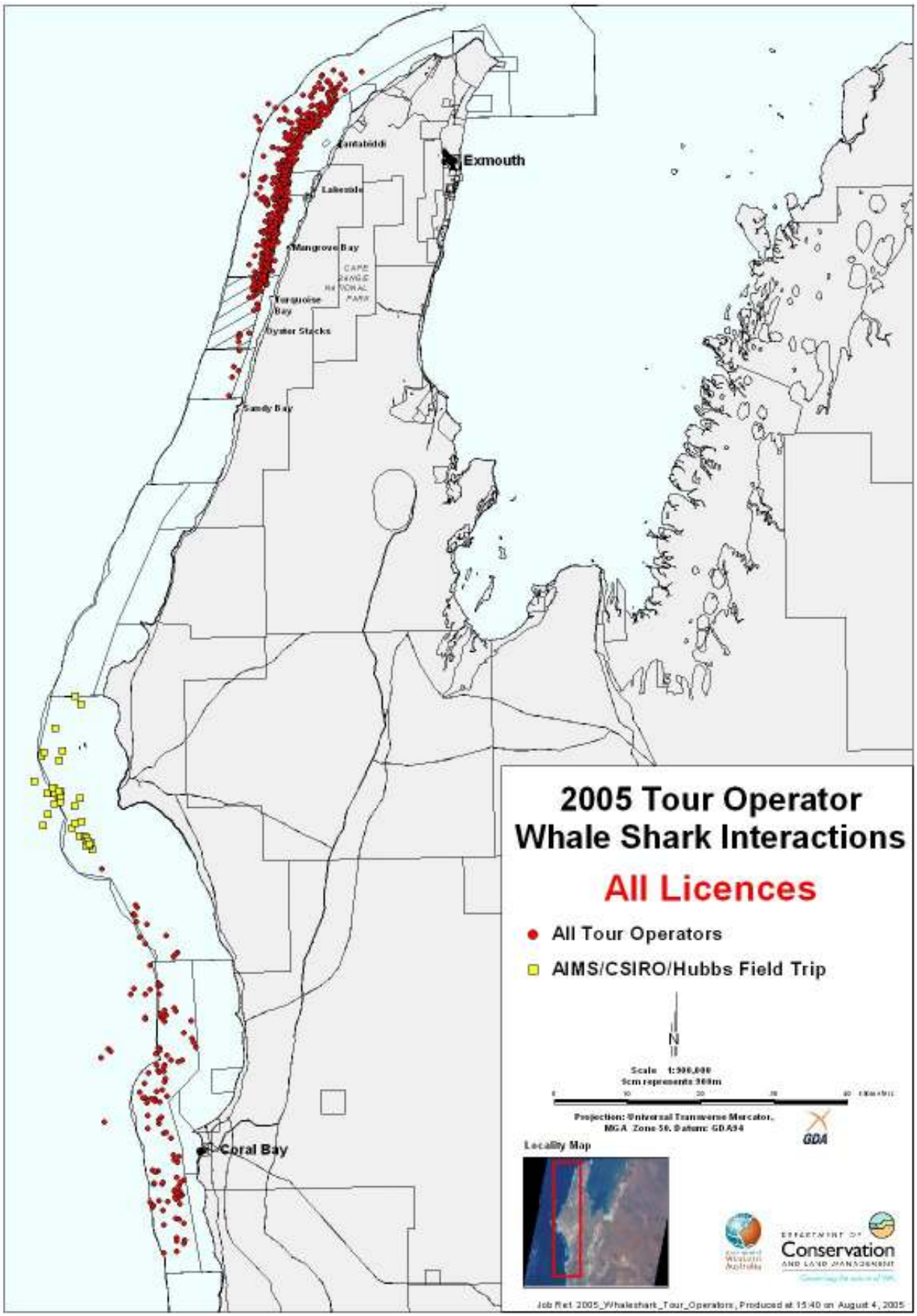


Figure 7: Location of reported whale shark interactions for the 2005 season

3 EDUCATION

CALM considers education as a primary strategy to ensure that visitors and stakeholders have a good understanding of the conservation and management issues associated with whale sharks. CALM recognises that stakeholders are an integral component in the education of visitors and is thus keen to support and promote relevant initiatives whenever possible. This season a Whale Shark Liason Officer was appointed to maintain communication and information flow between CALM, researchers and industry operators. Education and information for the public was also a priority.

3.1 Print media

Approximately 10,000 'Experiencing Whale Sharks in Ningaloo Marine Park' brochures were distributed to the public during the 2005 whale shark season. This brochure provides passengers participating in whale shark trips with a summary of whale shark biology and conservation together with an outline of the interaction code of conduct.

30 laminated whale shark Code of Conduct Posters were distributed to whale shark licence holders for display on vessels and at shop fronts. Also 30 Whale Shark Experience posters were printed and distributed to operators and major tourist facilities and organisations.

A series of information sheets were produced for operators to keep on their vessels for use by the guides as a way of educating passengers participating in whale shark trips. These included an information sheet, a FAQ sheet and a current research sheet. Three whale shark newsletters were produced throughout the season by Allison Richards as part of Whale Shark Watch, informing operators and the public about whale sharks that have been resighted this season. All information sheets and newsletters were available for the public to take away at every talk held throughout the season (Attachment A).

A series of updates were produced every two weeks throughout the paying season for all operators. These updates included information on whale shark sightings, size and sex; passenger numbers, CALM patrols, current research and whale shark events and information of relevance (Attachment B).

3.2 Model Whale Shark Head

It was decided last season to commission an actual size model of a whale shark head in order to give the general public a better reference in regards to their size (Figure 8). Brian Paskins, a local Exmouth fibreglass artist developed a wall mountable head to pectoral model with artwork by Bay Rigby. The work was first displayed at the Perth Royal Show in October 2004 and this season has been shown at the whale shark festival in Exmouth and travelled again to Perth for the whale shark conference in May. It has resided the rest of the year at Exmouth Visitor Centre along with whale shark information posters designed last year, to enhance the knowledge of ecotourists.

Figure 8: Actual size model of whale shark head

3.3 Whale Shark Festival

The annual whale shark festival was held on the 16th April at the Exmouth Oval. CALM staff and volunteers manned a stall to answer whale shark enquiries and to provide information on research and conservation along with CALM's role in the industry. The day was a great success with plenty of interest, especially with the model of the whale shark head. Information was available to read and take away.

3.4 Whale Shark Conference

The first ever International Whale Shark Conference was held in Perth from the 9th-12th May. It was opened by the Hon Judy Edwards Minister for Environment and Science. Over 60 presentations were given and 23 countries represented. Roland Mau (CALM) gave a presentation outlining the opportunities and limitations of logbook data in whale shark monitoring and research at Ningaloo Marine Park. Other presentations included two by Exmouth operators Branka King and Peter Lake, giving an operators view on the whale shark industry, their role and how the industry has changed over the years. A poster presentation was produced by Allison Richards (WWF) demonstrating how a model of an existing and successful species conservation program can be applied to implement and develop similar conservation programs for other threatened species such as the whale shark. CALM provided financial and administrative support for travel and conference costs for participating industry staff. The aim of the conference was to raise the profile of whale sharks around the world, exchange information and establish solutions to improve conservation, research and monitoring. For more information or to download presentation abstracts visit the website www.srfme.org.au/whaleshark/. Two conference summaries have been produced, one outlining the main outcomes from the conference written by Emily Wilson (CALM) and the other summarising all presentations given at the conference, by David Rowat (Marine Conservation Society of the Seychelles) (Attachment C).

3.5 Presentations

Four whale shark specific talks were conducted at Milyering Visitors Centre this season, two during the Easter holidays and two during the July mid year break. These talks were attended by approximately 20 - 40 people each time and covered information on whale shark biology, ecology, distribution, research and threats. Local whale shark information was given along with the latest international research and conservation projects that were presented at the whale shark conference.

In order to increase public awareness and education it was decided that a series of talks be given during the season. Talks were held every Tuesday night at the Pot Shot Resort by Emily Wilson (CALM) and volunteer Allison Richards (Whale Shark Watch). Talks ran from the 12th April to the 26th July. The aim of the talks was to give the public the opportunity to learn all the latest whale shark information from around the world along with what we know about the whale sharks at Ningaloo. The hope was to enhance people's whale shark experience and also explain how they can get involved with research and conservation. The talks proved to be a great success and over the 14 nights, 169 people attended the talks averaging at 12 people a night. The Northern Guardian ran an article on the weekly talks and the event was even filmed for a German TV programme.

Two talks for the public were held in Coral Bay on the 26th May and the 15th June in the outside area of the shopping mall. Thirty people attended over both nights and there was great support from whale shark operators A meeting was also held for operators in Coral Bay on the 25th May to give them a debrief on the whale shark conference. All operators were given a conference pack which included a summary, abstracts and media releases associated with the conference.

A conference summary evening was held at the Exmouth Recreation Centre on the 29th June for the Exmouth community, highlighting the main outcomes from the Whale Shark Conference. The evening went extremely well with around 40 people attending (Figure 9). Brad Norman of ECOCEAN discussed the latest research occurring internationally, including genetics, tagging and photo ID and aims for the future conservation of the species. Volunteer Allison Richards of Whale Shark Watch discussed how photo ID could work at Ningaloo through an integrated management approach involving stakeholders.

Figure 9: Conference Summary Evening at Exmouth Recreation Centre

3.6 Media releases

Two main stories were released locally in relation to whale sharks. One of these related to the Tuesday night whale shark talks for the public set up by Emily Wilson and Allison Richards. The second related to the whale shark conference highlighting the main outcomes and promoting the conference talk to be held for the local community.

Other media articles released this year include:

- a conference communiqué from all delegates to establish a common understanding that there is cause for concern over the state of global whale shark populations and that the current level of scientific knowledge in regard to whale sharks is insufficient to determine the precise level of threat to the long-term survival of this species. The Communiqué called upon governments, nations, organizations and individuals to ensure world wide protection of the whale shark and its habitat (Attachment D).

- A conference follow up entitled 'Threatened whale sharks draw calls to end exploitation' published in ECOS (Attachment E)

4 RESEARCH AND MONITORING

4.1 Whale Shark Interaction Logbook Analysis

The Whale Shark Interaction Logbook completed by operators is an important component for the monitoring of whale shark and swimmer interaction. By recording such information the industry can assist in the collection of useful observational and management data (Coleman, 1997). Log book records have limitations in deriving valid scientific data, however the data can provide information on the status of the industry, seasonal fluctuations and also provides essential feedback for the commercial operators (Coleman, 1997). The Logbook was reviewed in 2002 to improve the quality and usefulness of the data (Chapman, 2002) and a review of these changes is pending.

4.1.1 Response to swimmers

Observations of behaviours recorded on log sheets can assist management by identifying any long term changes in the reactions of whale sharks when approached by vessels and swimmers. However, this data is very subjective and therefore of limited use in management and research.

Recommendation 2: CALM to review whale shark log book records on behavioural response during interaction for 2002-2005 and make recommendations whether to continue with collection of this data following the 2006 season.

4.1.2 Contact with whale sharks

The total number of whale shark contacts this season has increased to the highest level since 1996 (Figure 10). The average number of interactions per tour has also increased from 1.2 to 1.5. These figures appear to indicate that whale sharks may be more abundant and available for interaction this year compared with previous years.

However, due to changes in levels of sharing spotter planes and whale sharks for interactions it is important to consider the unit search effort each season (e.g. flying hours of spotter planes) when assessing possible causes for fluctuations in abundance and interactions (section 4.2). Furthermore, the data analysed here is from the paying season only (1 April to 31 May). However, whale shark interactions occur outside the paying season both before and after this period so full season data must be used for interaction analysis.

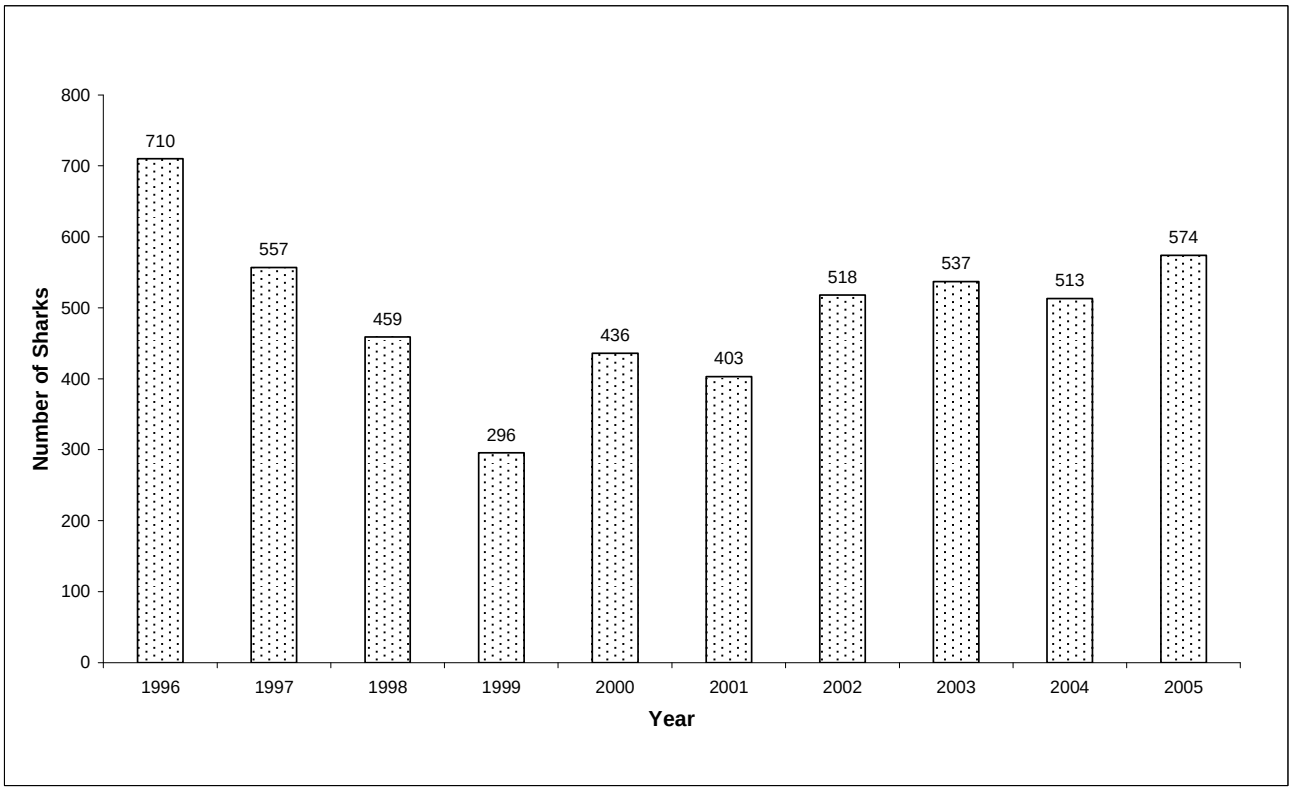


Figure 10: Total number of contacts with whale sharks during the paying season from 1996 - 2005.

4.1.3 Whale shark logbook size and gender data

Analysis of size and gender data must be treated with caution as recording of data has several sources of error. Logbook records show a high level of inter-observer variability for length and sex of the same sharks encountered. This data also represents the total number of encounters, as it does not take into account multiple encounters with the same shark by different vessels, either on the same day or on different days.

Since 1996 the majority of whale sharks encountered were male (Figure 11) with a sex ratio ranging from around 2:1 to 3:1. It is thought sexual maturity in both sexes may not occur until the sharks are between eight and nine metres in length (Coleman, 1997; Norman, 1999) therefore the majority of whale sharks encountered at Ningaloo are immature males. Immature males can often be mis-identified as females as their claspers are very small possibly explaining inter-observer variability of sexes.

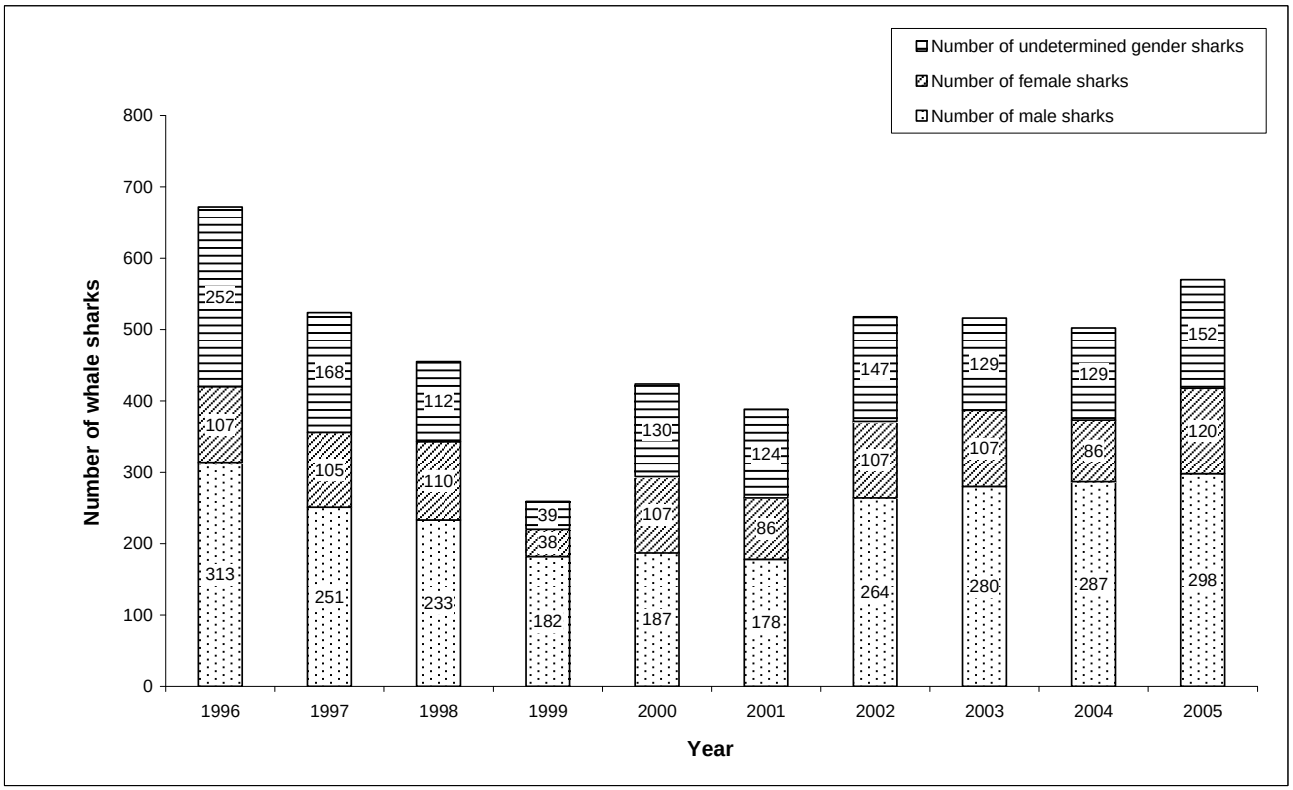


Figure 11: Total number of male, female and undetermined whale sharks during the paying season from 1996 – 2005

Average length of whale sharks has decreased by almost two metres since 1996, from around 7m to 5m. Male and female average lengths follow the same trend, with males being on average half a metre longer than females in 2005 (Figure 12). There has been a lot of conjecture as to what is happening to the larger individuals, with recent focus in the media on the hunting of whale sharks in other waters. However, it is possible the larger sharks may be in the area but remaining at depth and/or further offshore. This declining trend in size is being monitored as there are local and global implications. Photo ID, genetics and tagging research will hopefully uncover the reasons for the decline and provide evidence to further support international protection of the species.

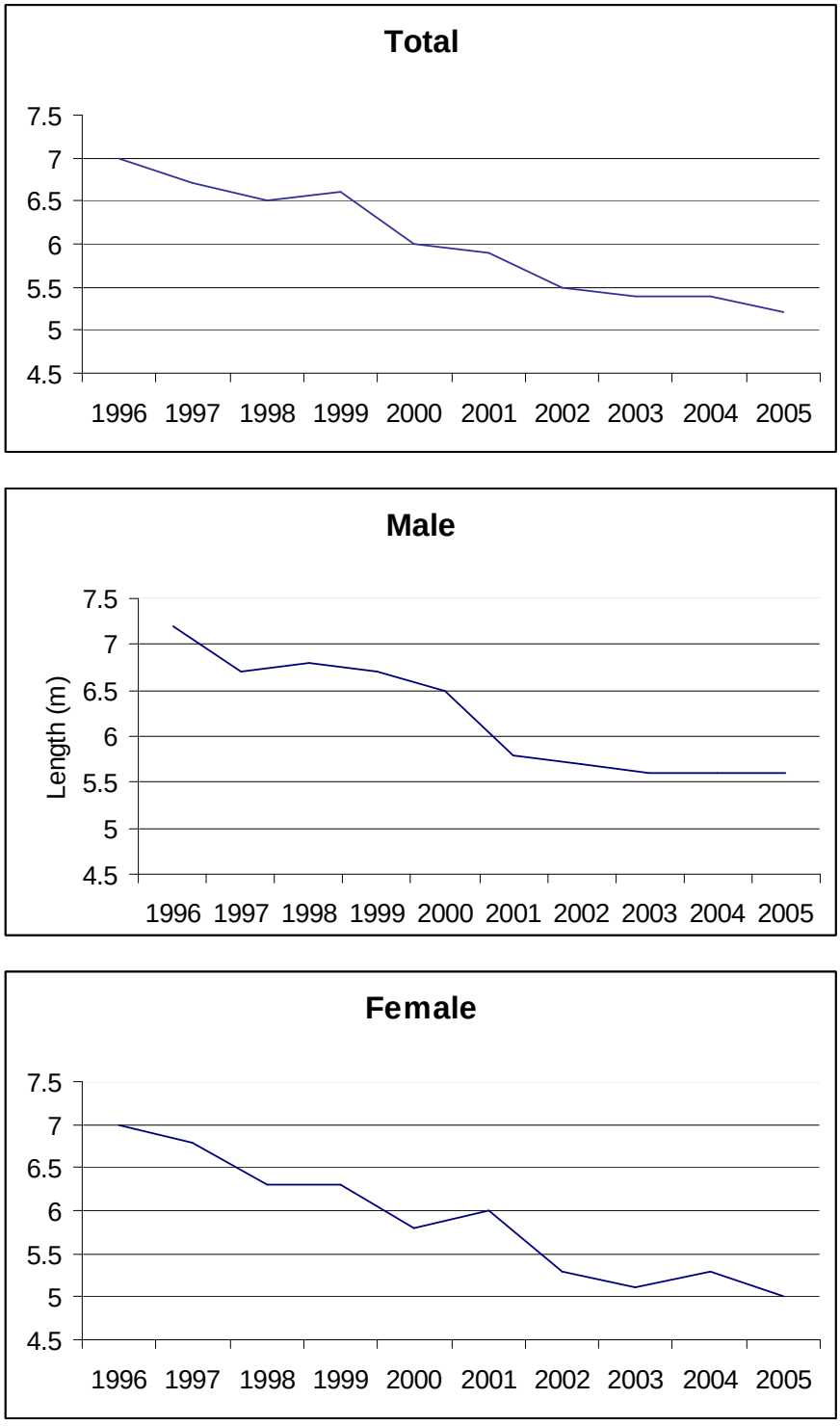


Figure 12: Average whale shark size from 1995 to 2005 from Industry Logbook data

4.1.4 Direction of Travel

Clear trends become apparent when the logbook data for direction of travel of whale sharks is plotted and compared across years 2001-2005. There is a very strong trend for direction of travel along the north-south gradient. This year showed a greater southward bound favour compared with a greater northward bound favour in previous years (Figure 13).

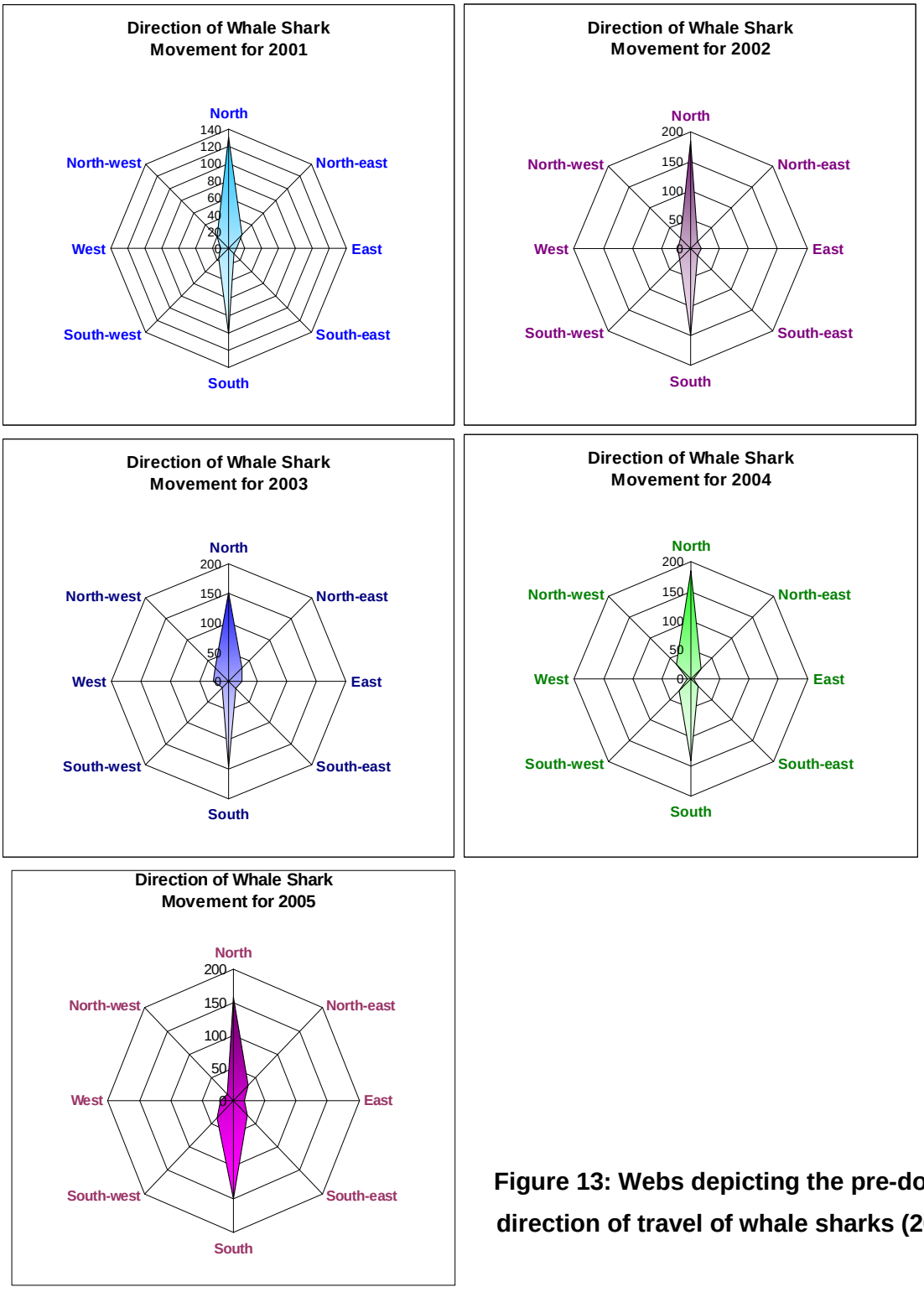


Figure 13: Webs depicting the pre-dominant direction of travel of whale sharks (2001-05)

4.1.5 Observation hour

From the log book data the majority of whale sharks are commonly encountered during the eleventh hour with a gradual decrease in encounters as the afternoon progresses (Figure 14). This trend is apparent throughout the paying season for 2002 - 2005. However the data trend is more likely to be caused because of operations rather than oceanographic factors. Firstly the plane is only up between 10am until 4pm due to glare obscuring vision outside of this time frame. Spotting conditions are maximised between 10am and 4pm due to increased light penetration and water clarity. Secondly, if a shark is encountered early, 10am or 11am, and passengers have a good swim with the shark, then they are more likely to send the plane home early and sharks that may be around later in the day will not be recorded.

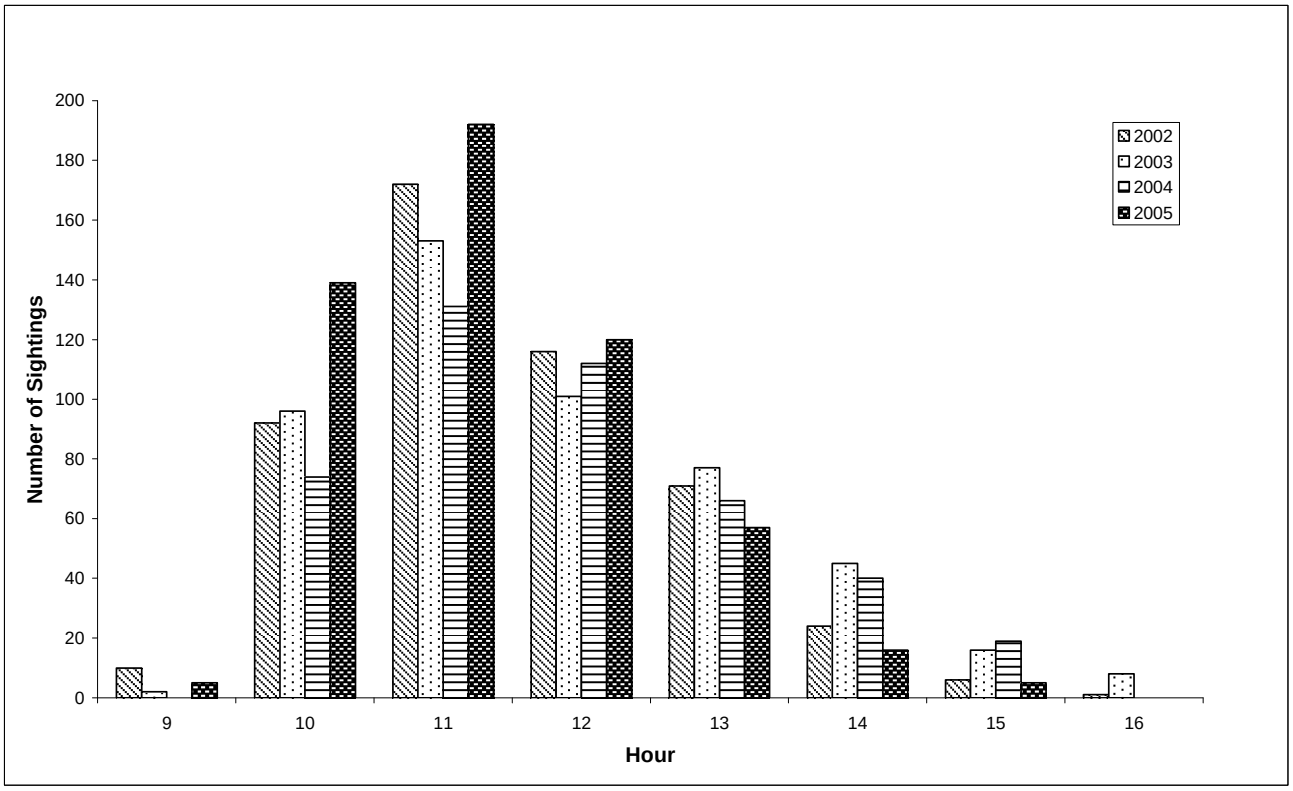


Figure 14: Most common hour of observation for the 2002 – 2005 paying seasons

This trend was also recorded during 1995 – 2001, with the most common time of contact occurring between 10:00 and 12:00 hours with the majority occurring at 11:00 (Chapman, 2002).

4.2 Whale shark search effort

The ratio of sharks sighted in relation to the time spent searching (i.e. search effort) is an important factor in monitoring whale shark populations, as increases or decreases in search effort over years may indicate interannual variation in abundance. To calculate search effort, spotter plane flying hours must be used as they are actively searching for whale sharks. Daily vessel activity time or vessel days are not indicative of search effort as they are not involved in actively "searching" for whale sharks and only occasionally come across whale sharks while in transit. Also vessels will only be out at sea should passenger

numbers allow them to. It is apparent that vessel hours reflect passenger numbers and not search time (Figure 15). Search effort per sighting was therefore calculated using spotter plane flying hours (Table 1).

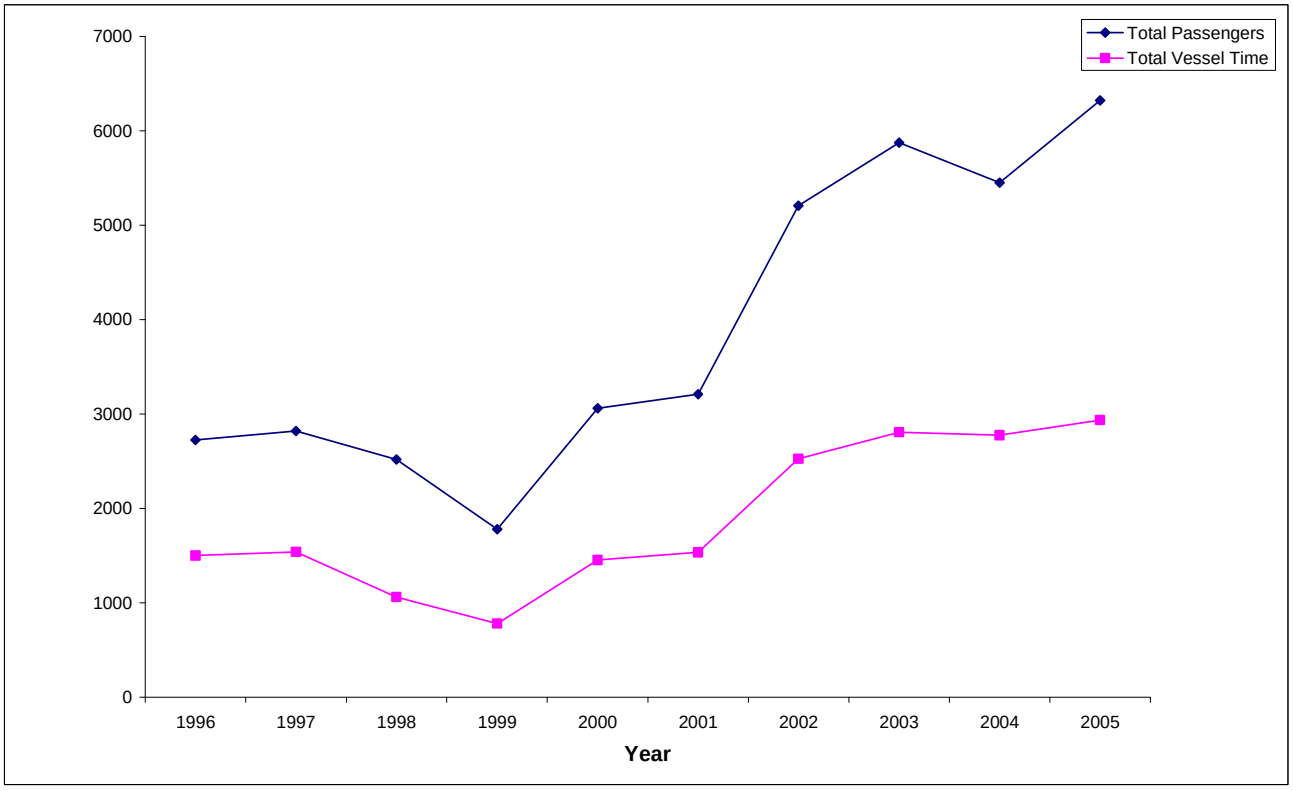


Figure 15: Comparison of total passengers participating in whale shark trips in relation to total vessel time based on operator logbooks.

Table 1: Comparison of search effort (flight time) per sighting from Exmouth

Year	Full Season (hours:minutes)	Paying season (hours:minutes)
2002	02:20	02:15
2003	01:40	03:30
2004	01:25	01:40
2005	01:00	01:10

NB: Data rounded to nearest 5 minute interval

Full season analysis, over the four years of flight data available, showed an inter-seasonal trend of reduced search effort per shark sighted (Table 1) and increased ratio of sharks to hours flown from 2002 to 2005 during the full season (Figure 16). However, when comparing this with the inter-seasonal search effort during the paying season (Table 1), it becomes apparent that in 2003 there appeared to be a considerable increase in effort per shark spotted. The 2003 season was unusual in that a large proportion of sightings were recorded outside the paying season. Less than one third of sharks were sighted in the paying season, even though the number of hours flown in the paying season was the highest recorded in the three years studied. For the purposes of determining changes in

whale shark abundance, search effort should be calculated for the entire season due to intra seasonal differences that may occur. 2003 data could indicate either a variable intra-seasonal geographical distribution (as search effort is focused between Tandabiddi and Turquoise Bay for Exmouth) and/or an intra-seasonal temporal abundance variation. These two variables must be considered whenever analysing logbook data for inter-seasonal trends in whale shark abundance.

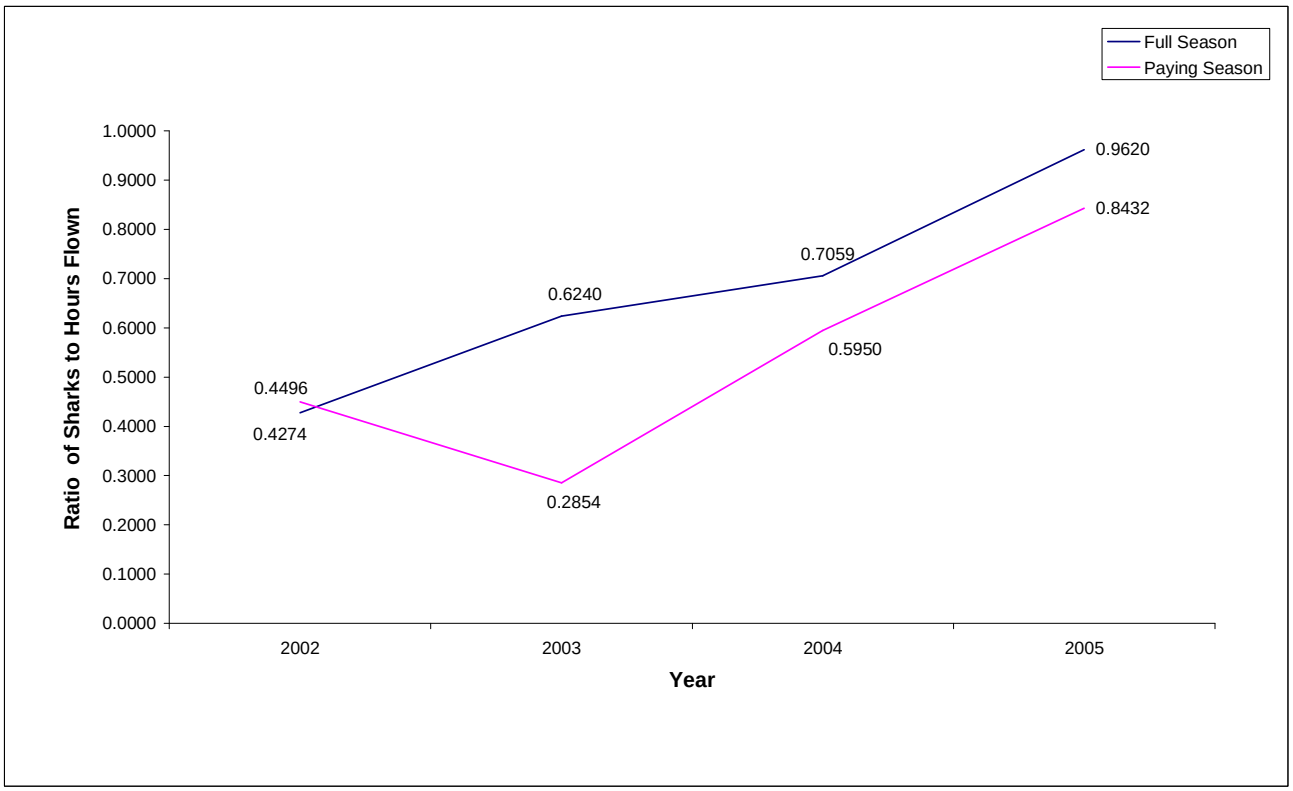


Figure 16: Ratio of sharks to hours flown (full season & paying season 2002-2005)

The 2005 full season recorded the highest total number of shark sightings and the second lowest hours flown of the four years analysed. This indicates that whale sharks were more frequently at or near the surface and therefore more available for spotting this season than previous years.

Changes in the inter-seasonal aerial survey effort as described in section 4.1.2 may be a causal factor for the apparent anecdotal reduction in whale shark abundance in the 1990's, however anecdotal reports that whale shark numbers are declining is not supported by analysis of the aerial spotter plane data for the last four years from 2002-2005. Instead interannual search effort indicates whale shark abundance is increasing but with some intra-seasonal variation. However, until daily whale shark dive patterns and behavioural responses are better understood, changes in abundance will be difficult to determine. By understanding dive patterns it would be possible to determine the proportion of time whale sharks spend at the surface, i.e. the 'spottable' whale sharks, and this along with understanding behavioural responses to oceanographic features and food availability, may explain the perceived fluctuations in abundance or in other words the variation in 'spottable' whale sharks. This emphasizes the need for research into Pop off Archival Tagging (PAT)

and tracking studies (section 4.5) and also understanding oceanographic processes and how they may influence whale shark behaviour (section 4.4).

4.2.1 Coral Bay

This season spotter plane data was available for Coral Bay (Table 2). Due to the full season finishing shortly after the end of the paying season, there is little difference in search effort.

Table 2: Search effort (flight time) per sighting, ratio of sharks to flying hours, total sharks and total flying hours in Coral Bay 2005 for the full and paying season

	Full Season	Paying season
Search Effort (NB: Data rounded to nearest 5 minute interval)	02:50	02:35
Ratio of sharks to flying hours	0.3598	0.3814
Total Sharks	78	77
Total Flying Hours	216.8	201.9

4.3 Aerial surveys

The importance of aerial survey data has been recognised by the CALM whale shark management programme. In 2004 an aerial survey method was investigated with the aim of implementing a comprehensive and sustained aerial survey programme through cooperation with the whale shark industry and NorWest Airworks. A hand held GPS is issued to pilots at the start of the season in order to record all whale sharks seen thoughout an entire season. These positions along with data the pilots record for company records, provides us with information such as:

- Total sharks sighted (Figure 17)
- Proportion of population subject to human interaction
- Search area (Figure 18)
- Search effort (Section 4.2)
- Inter-annual spatial and temporal variability

This season a pilot project involving the collection of track log data was also introduced in order to determine whether the circling of spotter planes affects the accuracy of search effort for interseasonal variability of relative abundance. Spotter planes are out searching everyday and follow a search pattern focusing in Exmouth from North Reef to Turquoise Bay, and in Coral Bay from Black Rock to Point Anderson. The only time planes are not searching is when a whale shark is sighted and circling above a shark commences. This continues until vessels arrive and pilots are informed to continue searching or head back to base. This circling time can be eliminated and a true search effort determined by the pilot's track log being recorded. These circles can be identified and removed from tracks once the data is loaded in ArcView GIS and search time recalculated (Figure 18). Over time it may be revealed that the circling time to search time remains constant, in other words it is a systematic error and will not have to be removed from the data in order to calculate search

time. However, should circling time vary significantly from year to year it will need to be removed. The aerial data shows the amount of effort required to find individual sharks over seasons and hence allow for monitoring change in the effort expended over years to measure interannual changes in abundance (see section 4.2). Furthermore, the collection of this data may assist in determining the natural variation in whale shark appearance.

Unfortunately, collection of GPS and track log data was delayed at the start of the season and therefore the data set for this season is incomplete. However using this data and the data from 2004 we can determine how useful the data is and establish a standard operating procedure in order to ensure data collection is standardised and sustained for forthcoming seasons.

Recommendation 3: CALM to produce a standard operating procedure for industry aerial spotter plane GPS data collection.

From flight tracks the search area covered by planes and areas that currently are not searched but may be of interest can also be determined (Figure 18). This data could also be used in conjunction with targetted aerial surveys to create a wider picture of whale shark distribution. Search effort for certain areas within Ningaloo Marine Park could be calculated and comparisons made intra-annually and inter-annually to determine seasonal geographical distribution.

Generally new pilots are used for spotting during the whale shark season every year and therefore it is imperitive that CALM staff have a preseason meeting with the pilots to discuss data collection and how it is secondary to their role of spotting for industry vessels. Pilots are informed that on sighting a whale shark all they have to do is press the mark button on the GPS. This should be done when convenient to do so and must not interfere with spotting operations. The meeting is also an opportunity for the pilots to learn more about whale sharks and their role in whale shark management. A post season meeting with pilots was also held this season to present to them the data they collected and information gained from the data.

The proportion of the whale shark population at Ningaloo that is subject to human interaction can be determined by comparing the total whale sharks sighted by planes with the total sharks encountered by vessels. However, vessel figures obtained from CALM logbooks represent the total number of encounters and do not take into account multiple encounters with the same shark by different vessels on the same day. This reiterates the necessity for recording whether a shark is handballed by an operator and to whom it is handballed to. This would allow for multiple entries to be removed from data with greater ease.

Recommendation 4: Season logbooks need to be modifed to enable recording to which vessel a whale shark was hand-balled.

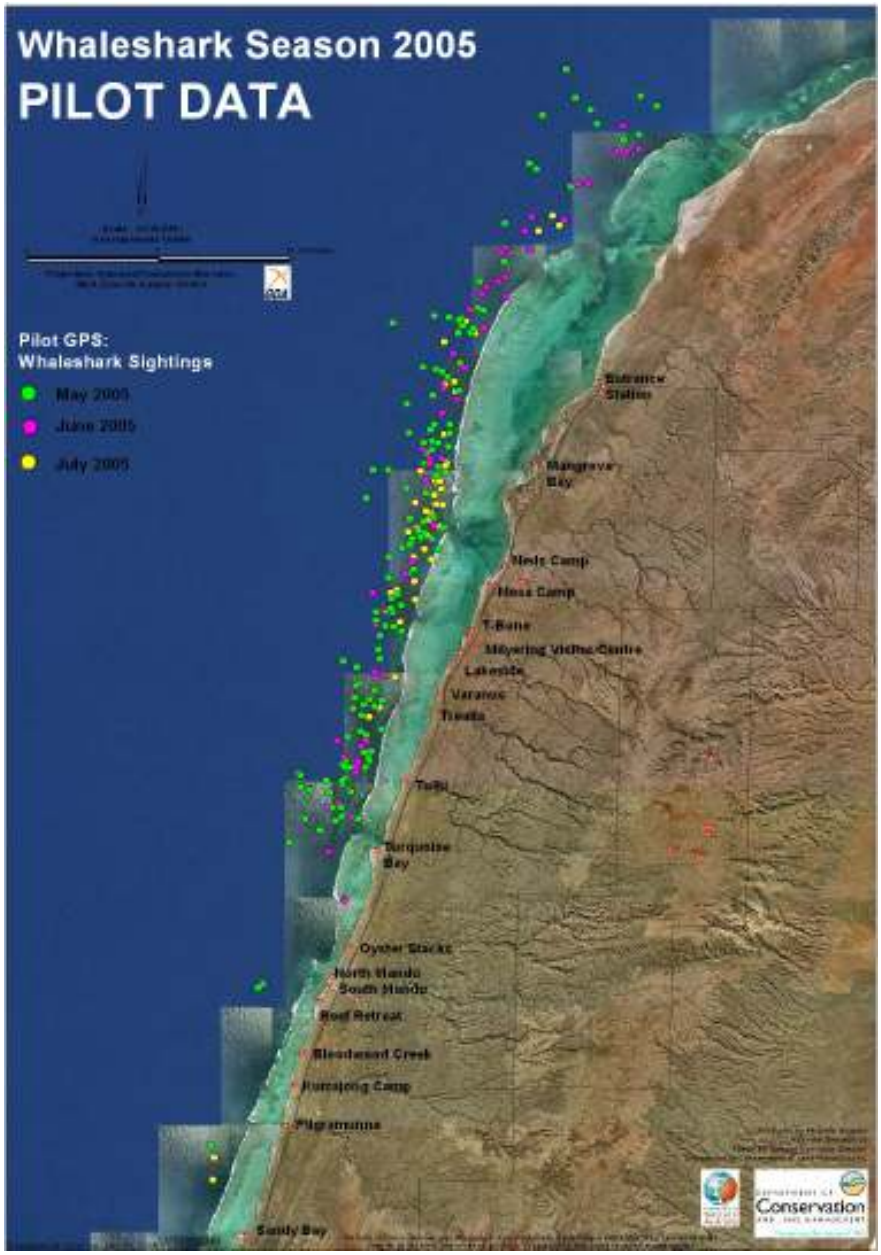


Figure 17: Pilot GPS whale shark sightings May – July 2005

4.3.1 Assessing the suitability of whale shark industry data to estimate whale shark abundance in Ningaloo Marine Park

Aerial survey programmes to monitor the distribution and abundance of whale sharks at Ningaloo have been conducted since the 1990's, but have proved costly and of limited use. It was decided last season that CALM fund a postgraduate student to investigate the application and limits of aerial spotter plane data for research and monitoring of whale shark populations at Ningaloo. At the start of this season, Sarah Patton, a postgraduate student from Canada, doing a master's of applied science at James Cook University under the supervision of Helene Marsh (Professor of Environmental Science), was commissioned to evaluate the usefulness of exisiting aerial data and to propose a scientifically valid aerial survey methodology that is either stand-alone or complements data gathered from spotter planes, and make recommendations whether aerial surveys are a cost-effective means for

future monitoring programs for whale sharks in the region. She undertook interviews with NorWest Airworks pilots, the owner Eric Roulston, boat owners and their crew, as well as CALM staff, to enable the constraints under which everyone operates to be understood, and to make sure that any suggestions made are practical. The report is expected by December 2006.

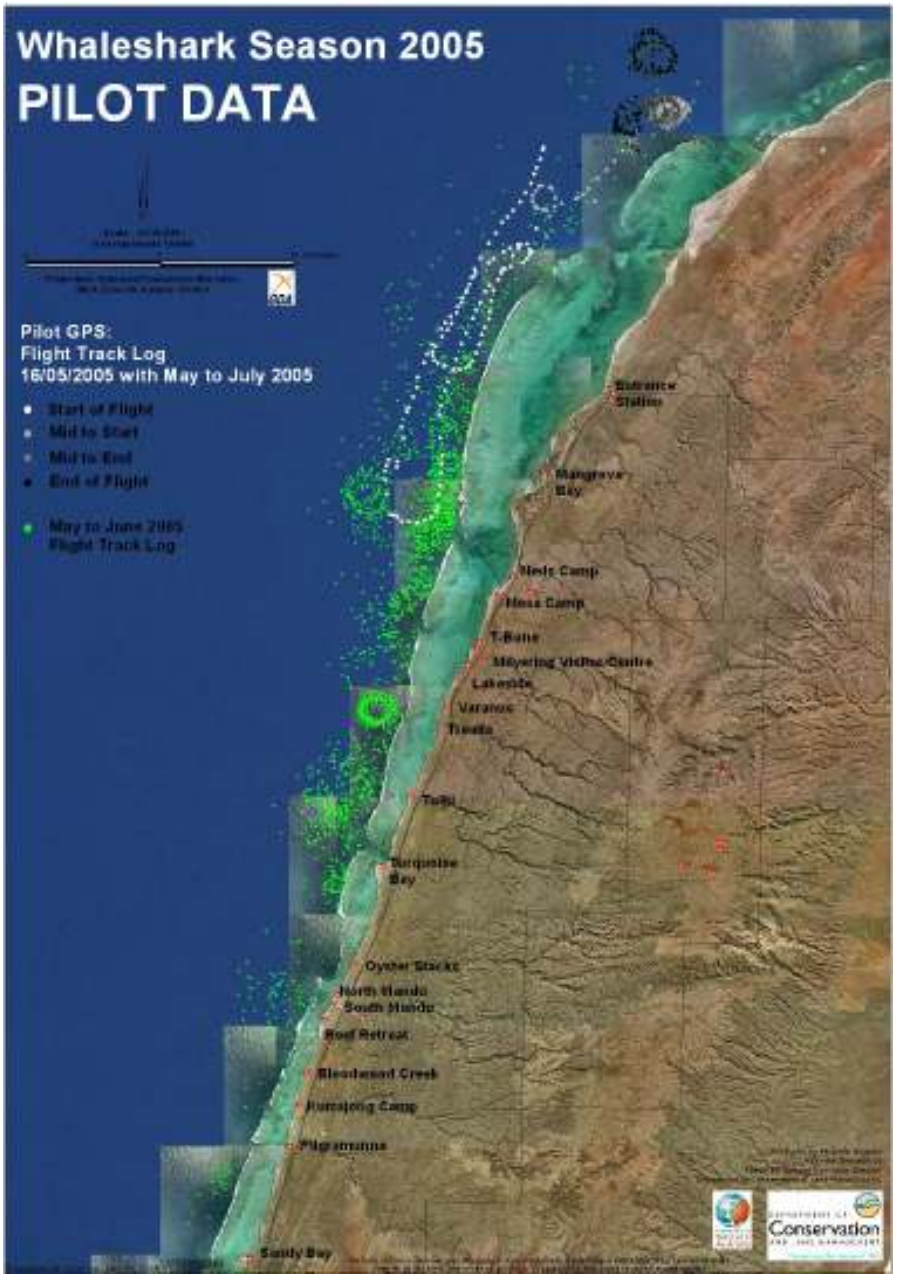


Figure 18: Pilot flight track log information showing search area and highlighting a single track.

4.4 Oceanographic surveys

Oceanographic data is proving to be of high importance in understanding whale shark aggregations around the world. At Ningaloo oceanographic data is being explored in the hope of learning more about how and why whale sharks come to Ningaloo. At the recent whale shark conference, Jeffrey Polovina from the Pacific Islands Fisheries Centre, NOAA, Hawaii, explained how using satellite remotely-sensed sea surface temperature, chlorophyll-a concentration and sea surface altimetry to produce geostrophic current gradients, along with data from sharks tagged (PAT) at Ningaloo, we would be able to describe the whale sharks habitat. It appears that movement patterns of sharks from the Ningaloo area may be influenced by persistent warm water eddies, chlorophyll blooms and current patterns (J. Polovina, pers. Comm.).

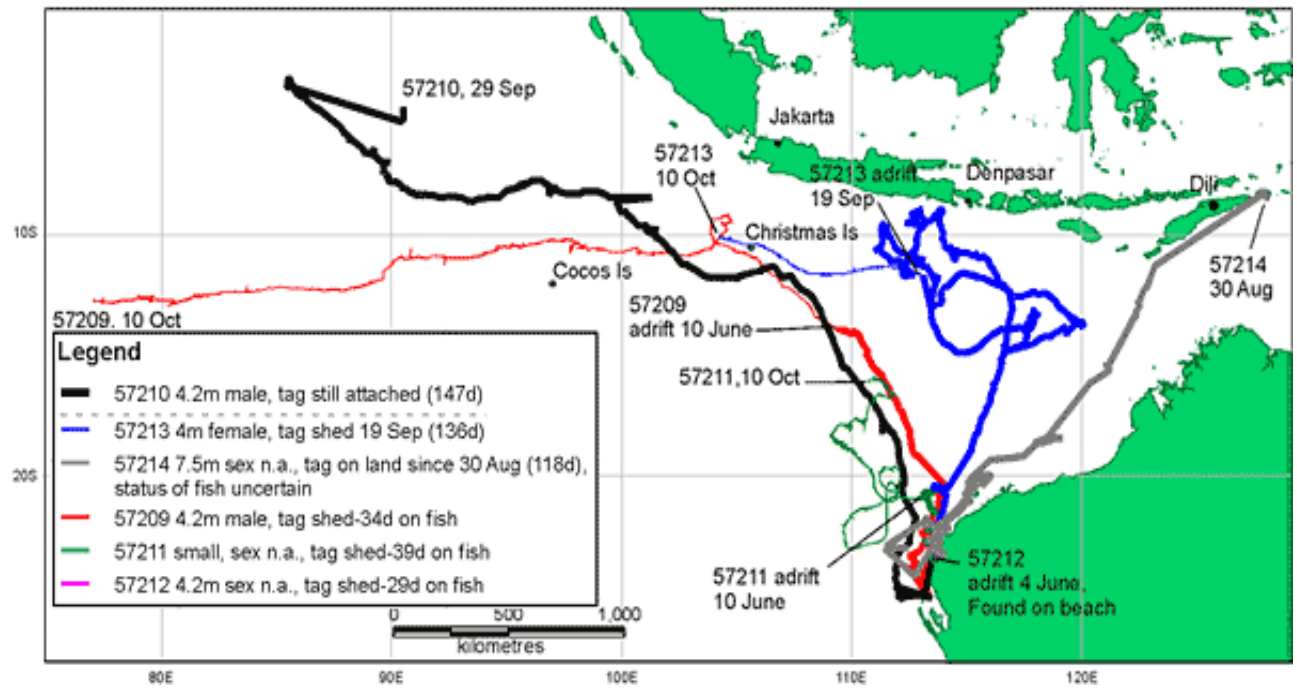
PhD candidate, Jai Sleeman from Charles Darwin University will be examining the relationship of whale shark occurrence at Ningaloo relative to oceanographic and atmospheric variables. Preliminary analysis has indicated that relative abundance of whale sharks was most strongly influenced by a combination of the El Nino Southern Oscillation Index (SOI) and sea surface temperature (SST), with SOI having the strongest effect. There is an indication that in La Nina conditions and higher SST, stronger Pacific trade winds drive the Leeuwin current southward and more whale sharks are observed.

4.5 Movement and behaviour studies

In 2005, CALM continued support of a collaborative study involving Dr S Wilson (University of New Hampshire), Dr Brent Stewart (Hubbs-SeaWorld Research Institute, CA), Jeffrey Polovina (NOAA Fisheries, USA) and Dr Mark Meekan (Australian Institute of Marine Science) and Dr John Stevens (CSIRO Marine Research). The project, initiated in 2003, aims to document the movements and behaviour of whale sharks that aggregate seasonally at Ningaloo Reef. A progress report from the 2005 data is attached (Attachment F), along with the final research paper from 2003/2004 data (Attachment G).

In summary, 15 tags were deployed, nine Pop-up Archival Satellite Transmitter tags (PAT tags) and six SPLASH® tags (towed satellite tags), in the vicinity of Black Rock and Norwegian Bay, Ningaloo Marine Park from the 28th April to 7th May 2005. PAT tags work by logging information on whale shark depth, movement and temperature for a set length of time after which they automatically detach themselves from the shark and transmit their data to a satellite. The tags are programmed to detach from sharks at five to eight month intervals. SPLASH® tags are the latest satellite tags from Wildlife Computers and the transmitters are contained in a small torpedo-shaped float that is attached to the shark's dorsal fin via a one-metre tether. They were programmed to sample and store measurements of hydrostatic pressure, water temperature, and ambient light levels every 60 seconds and to transmit data on maximum dive depth, dive duration, time at depth and time at temperature to satellites when the transmitter float was at the surface.

Tracks of the six whale sharks fitted with SPLASH® tags can now be followed on the CSIRO website http://www.cmar.csiro.au/research/sharks/whale/index.html (Figure 19), three of these tags have detached, one being found on the beach at Exmouth around the 15th May. These tags have been able to tell us that the three sharks dived fairly regularly to depths of 800 - 1000m (J. Stevens, pers. Comm.).



Whale shark tracks: The whale shark track are represented by coloured lines - these are thinner for the parts of the track when the tag is adrift [last update: 18/10/05].

Figure 19: Tracks of the 6 whale sharks fitted with SPLASH tags in 2005 courtesy of the CSIRO website

A number of photos of whale sharks with tags have been given to CALM from industry spotters who have resighted them through the season. These photos are of great value in assessing tag condition and may suggest a reason for tag failure. For instance, in previous years tags have been redesigned following images that have shown excessive fouling over time. On the 6th May 2005 a three metre shark was sighted in Coral Bay with two PAT tags and a towed SAT tag which was dragging weed (Figure 20). This information was useful in providing possible explanations for why a SAT tag may not transmit, or maybe why a tag might detach prematurely.

Figure 20: Photos of a 3m whale shark showing attached PAT and SAT tag towing weed

The collaborators will continue running the satellite tagging programme next year, however, the satellite tag attachment will need to be redesigned in order to improve deployment success, as three tags detached prematurely this season (M. Meekan, pers. Comm.). A liability associated with data from PAT tags (Figure 21) is that the locations provided are estimates that have a fair amount of error associated with them. Towed satellite tags (SPLASH® tags) provide much better locations that would allow for analysis of shark movements in relation to satellite imagery. Application of these tags is outlined in Attachment J.

All tagging undertaken by AIMS is carried out under permit and within animal ethics guidelines. The tags are placed in the tough dorsal surface layer of denticular skin which is the most insensitive part of the whale shark's body. Although the tagging is invasive, it is carried out with the intention of determining where Ningaloo sharks go once they leave the area and if and where they may be hunted (M. Meekan, pers. Comm.). It is imperative that tagging research continues in order to understand migration patterns and to determine the level of threat the whale sharks face in other waters, and in so doing collaborate with range states to ensure their protection.

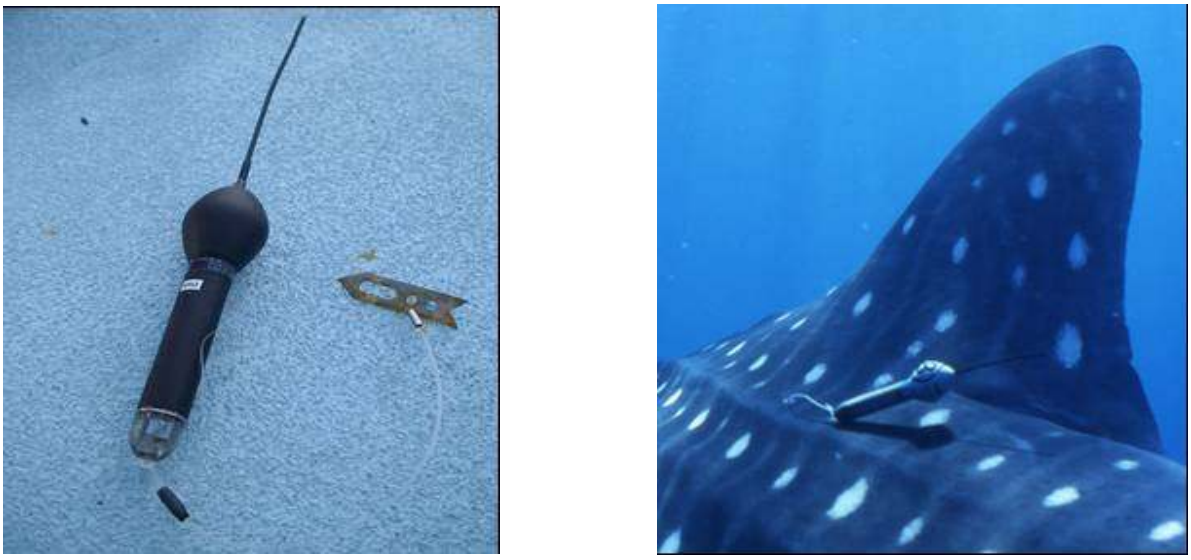


Figure 21: PAT tag and tether, PAT tag in situ

Work conducted since 1997, initially by John Stevens from CSIRO Marine Research and more recently by Hubbs-Sea World, has provided information on the regularity and percentage of time individual whale sharks spend near the surface (where they can be spotted by planes). The diurnal diving pattern of whale sharks is essential information for estimation of relative abundance by aerial surveys.

Tagging research carried out by Hubbs-Sea World on whale sharks at Ningaloo was presented at the conference. Data showed that 90% of the time was spent in waters of 23-28℃, 40% of time was spent in the top 15m while 30% was spent within 30m. Diving patterns were mixed but generally deeper dives were made at dawn and dusk and out in the open ocean (Steve Wilson, pers. Comm.).

This season Ningaloo Reef Dreaming made a personal donation of $650 to CALM in support of tagging research. This will be incorporated into tagging projects that are currently being discussed for next season.

4.6 Whale shark photo identification

The 2005 Season has seen an increased focus on the capability and capacity of photo identification of whale sharks as a research and monitoring tool, due to it being non-invasive and universally accessible (web based). We have seen the strongest indication yet that use of whale shark spot patterns are an effective way to establish estimates on whale shark numbers, their migration patterns, and morphological changes of individuals over time. At the international whale shark conference it was agreed that the whale shark photo ID project ECOCEAN be used as the global whale shark photo ID database, and through communication and cooperation whale shark researchers from around the world are now submitting their images to this project.

4.6.1 Ecocean whale shark Photo ID Library

The ECOCEAN photo ID library (www.ecocean.org) established in 2002 by Brad Norman, now contains over 660 individual submissions from more than 20 range states. Over 300 of the identified sharks at Ningaloo have been resighted the same year or in subsequent years. Tests run by Jason Holmberg, the information architect of ECOCEAN, have shown that the software used to match images has an 86% success rate. Over 100 previously undiscovered encounter matches have been made by the programme and confirmed. The software was developed by Zaven Arzoumanian (NASA) adopting similar techniques used to map stars in galaxies, but here rather applied to map the spots on the whale sharks skin.

At last month's Sun Microsystem's annual JavaOne Worldwide Developer Conference (USA), the ECOCEAN Whale Shark Photo identification Library, received a Duke's Choice Award for "*extreme innovation in the world of Java technology*". Past winners of the award include NASA (for Mars rover software), Orbitz, Avis, eBay and Boeing.

This season all operators were given a printed copy of the photo identification library containing a sample of Ningaloo Sharks along with simple 'how to take suitable photographs and collect sighting data' information sheets for handout to ecotourists (Attachment I). The aim was to get ecotourists to participate by submitting their photos to ECOCEAN.

By submitting images of the standard left-hand flank shot, whale sharks can be identified as a resight or a new individual. Feedback on the submitted shark is emailed to the image submitter along with constant updates whenever someone else submits an image of the same shark. Submitted sharks are given a location code, with Ningaloo sharks being 'A' followed by their encounter ID number (e.g. chompy = A076).

Currently ECOCEAN is managed by the creators but it has the ability to have a number of managers residing anywhere in the world, allowing a level of control at a local level, thereby empowering the stakeholders. CALM will aim to facilitate the systematic collection and collation of whale shark photos at Ningaloo for submission into the ECOCEAN photo ID library. This requires for instance, the cooperation of industry operators who could provide CALM with copies of whale shark footage which would allow a catalogue of images to be collected for each shark encountered during a season. This would allow population

estimates and movements to be monitored in order to develop an understanding on whether whale shark numbers in Australia are increasing, decreasing or stable. Relative abundance or trends in the number of whale sharks that appear at Ningaloo should be investigated rather than attempting to determine absolute population size. These trends may indicate the health of the Ningaloo population. These monitoring methods could then be implemented to other whale shark 'hot spots' in order to determine the level of pressure that the whale shark is being subjected to on a global scale. By undertaking population monitoring the aims of the Whale Shark Recovery Plan 2005-2010, developed by the Department of Environment and Heritage (Section 5.5), will be implemented by ensuring management provides long term conservation of the threatened whale shark.

Recommendation 5: Encourage videographers to provide CALM with a copy of daily whale shark footage for research throughout the season under licence condition.

A draft standard operating procedure for the collection, processing, management and submission of images, from DVD footage, to ECOCEAN is in progress. CALM volunteer, Martin Woodbridge, used DVD footage, taken by Leith Holtzman and supplied by Ningaloo Blue, to establish a draft standard operating procedure. Once images have been submitted, the ECOCEAN database has the ability to send multiple emails, to get feedback to the image providers on the sharks encountered.

4.6.2 Honour's Project Photo Identification of Whale Sharks in Ningaloo Reef

Michelle Press has recently completed her Honour's project at Charles Darwin University under the supervision of Mark Meekan from AIMS discussing photo-identification techniques used to gather information concerning the whale shark population in Ningaloo. The project involved manually categorising and comparing images of whale sharks 'by-eye' obtained from Geoff Taylor in the early 1990's and 2002 and from Allison Richards in 2004. By doing this, two sharks were matched that were photographed in 1992 and 2004, providing evidence that spot and stripe patterns appear to remain unchanged in sharks greater than 4m for a period up to 12 years (Figure 22). It also showed that many sharks are returning to Ningaloo on a number of successive years. Unfortunately the lengths of the 1992 sharks were not recorded, had they been this would have given great information on growth rates in the wild. A paper is in progress and should be available shortly.

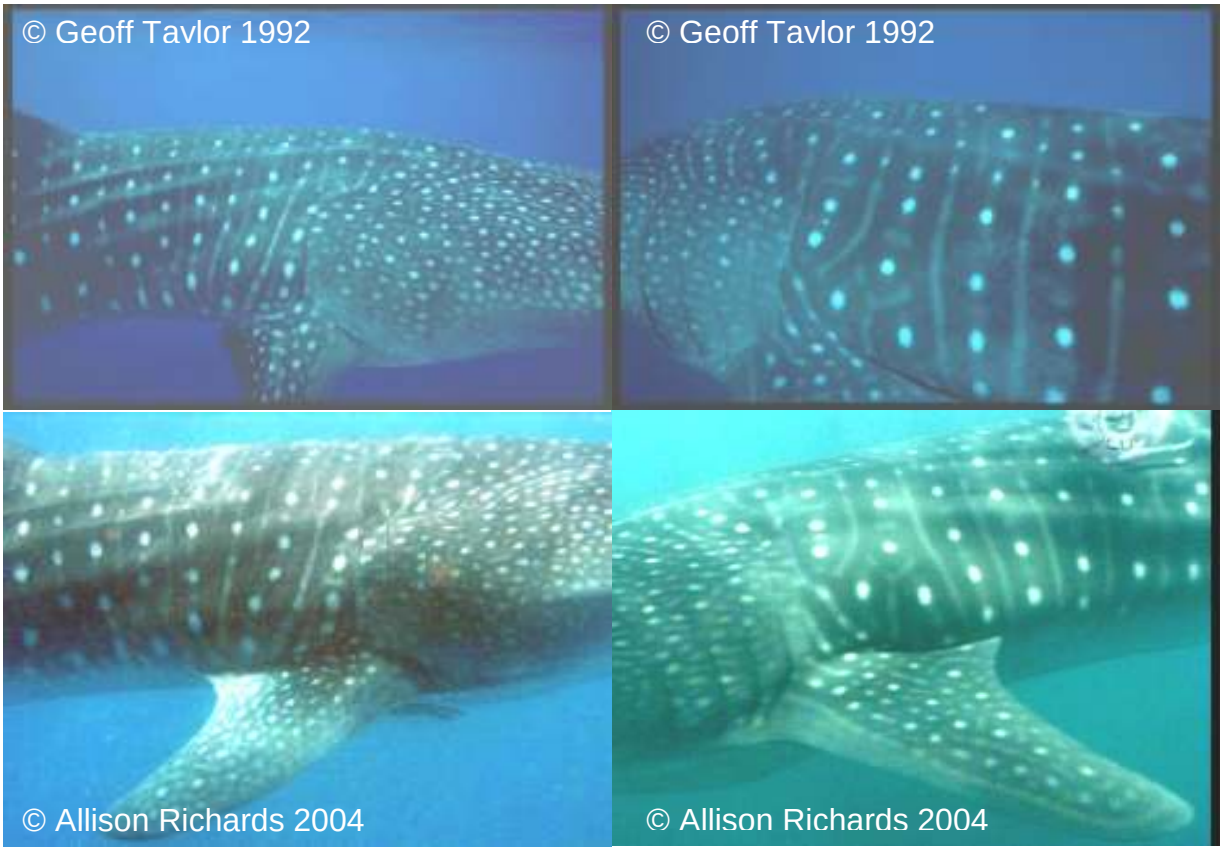


Figure 22: Photos of two whale sharks resighted after 12 years at Ningaloo

4.6.3 Ningaloo whale shark watch project

Following the successful 2004 season, Allison Richards continued this year with her project "Ningaloo Whale Shark Watch" developed in 2003. Although no longer working as a guide, Allison utilised photos for days in which she participated in tours or photos from other whale shark guides to gain information on the movements of sharks at Ningaloo. Allison then produced newsletters for the dive operators and the public as a means of providing feedback on the local whale shark population. Ningaloo Whale Shark Watch is a volunteer based photo monitoring program aimed at logging and identifying individual whale sharks that visit the Ningaloo Reef each year. All Allison's images are submitted to ECOCEAN to contribute local knowledge on a global scale. The project is supported by CALM and the Exmouth Cape Conservation Group.

Ningaloo Whale Shark Watch shows that many whale sharks remain in the area throughout the season and return to Ningaloo over successive years. Some examples of resighted sharks include the well documented shark A076 (Chompy) which was first sighted on 28/04/99 before the attack by a predatory shark, twice in 2003 when the attack first occurred, three times in 2004 showing remarkable healing of attack wounds and finally on 26/06/05. A return of six years. Another shark, A136, was first sighted on 15/5/01, returned on 15/5/04 and was seen this season on 15/5/05. A return of four years and always on the same day, perhaps with oceanographic data of the area we might be able to understand if there is some significance to this. Other sharks have been sighted on numerous occasions throughout a season such as one shark which was seen on 13

different occasions in 2004 from 30th March – 7th July and resighted this year on the 11th April.

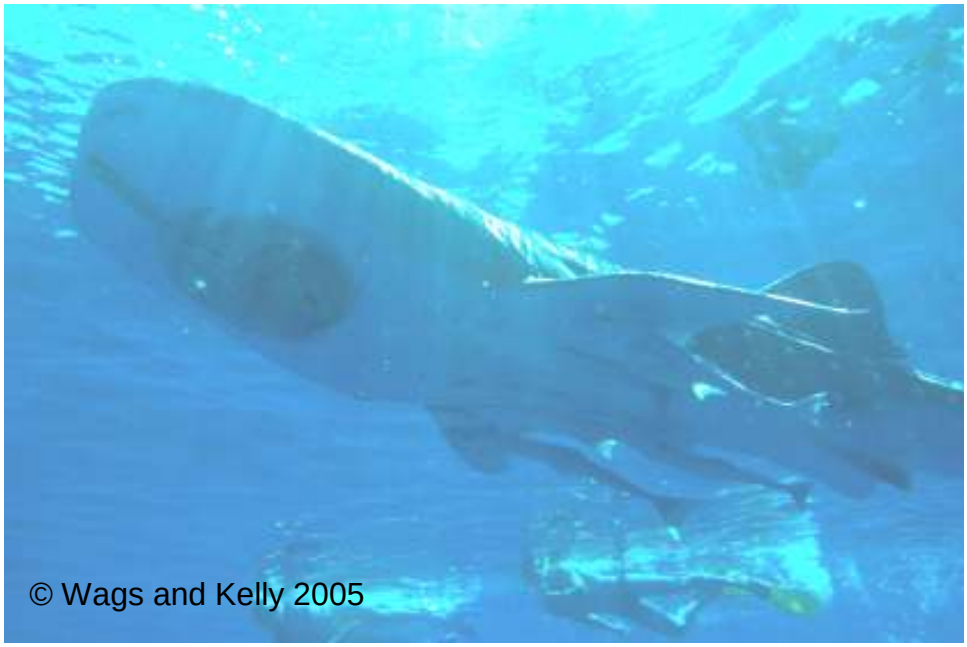


Figure 23: Photo of a whale shark with a significant wound

A shark was sighted this season with a circular gash on the underside of its head (Figure 23). Reports say the shark looked very emaciated. Opinions on the cause of the wound are split between a shark bite and a propeller scar, however the wound is consistent with those of predatory shark bites seen on marine mammals.

4.7 Genetics

Following on from the International Whale Shark Conference, Professor Jennifer Schmidt from the University of Illinois at Chicago, requested assistance from researchers around the world, to provide her with whale shark tissue samples. Early genetic studies are indicating a single global population of whale sharks, with movement between groups and interbreeding likely. However more samples are needed to support these findings. CALM have agreed to provide samples in the 2006 season.

Recommendation 6: CALM to assist Professor Jennifer Schmidt's global genetic study to determine whale shark population dynamics by providing tissue samples in the 2006 season.

4.8 Visitor satisfaction

Following the recommendation from 2004 to support a post graduate student research study into experiential aspects of the whale shark experience in relation to the existing management framework, James Catlin from Curtin University carried out a 'Visitor Satisfaction Survey' of participants on commercial whale shark tours. The survey was designed to provide a comparison to a similar survey carried out in 1995 by Davis *et al*., and will provide valuable information about visitor satisfaction of the whale shark

experience and what factors influence it. The aim was to ensure that the quality of the experience can be maintained for swimmers without detrimental impacts on whale sharks.

Questionnaires were handed out in Exmouth and Coral Bay and included demographic characteristics, economic and ecological aspects of the whale shark experience. Attention was paid to initial expectations and overall satisfaction levels, and to variations between the perceptions and satisfaction levels of Australians and international visitors.

Social surveys in 1996 labelled the whale shark experience a 'high quality' experience. Since then participation numbers have increased almost two-fold. Logbook data shows that since 1996 there have been significant changes to whale shark tours, primarily caused by the increase in passengers, including:

- an increase in the average number of passengers per tour from 10.6 to 14.5,
- total number of tours increasing from 258 to 372
- average number of whale shark encounters per tour decreasing from 2.5 to 1.5,
- average tour time increasing by two hours,

However, carrying capacity of the existing licensing system is still only 30% of its maximum potential, so has visitor satisfaction changed over the last ten years?

Preliminary results from the Visitor Satisfaction Survey were presented by James at the post season meeting. Changes in the demographic characteristics show a shift in the origin of participants from almost half Japanese in 1995 to half Australian in 2005. Around 1995 several operators were financing advertising to attract the Japanese market. These operators were not present this year which may explain this shift. The increase in Australian participants could indicate that less are travelling overseas. The other main change in participants since 1995 was in regards to age groups. 2005 saw a broader spread of participants through age groups with an increase in the 41-60 and 14-20 age groups (Figure 24).

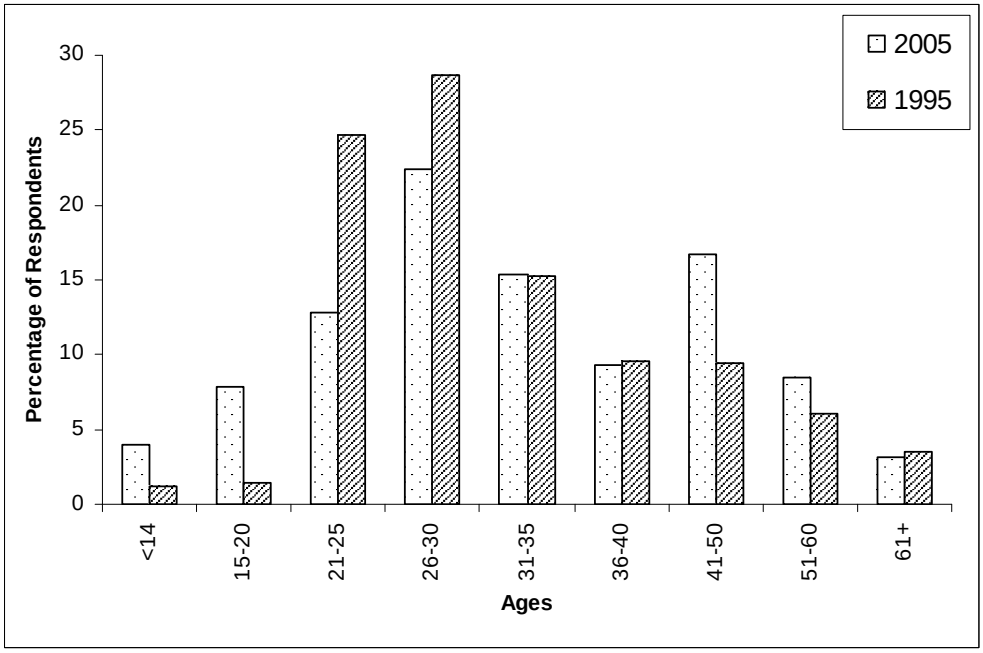


Figure 24: Percentage of respondents in each age group for 1995 and 2005

According to Davis *et al*., 1996 visitors indicated that their best experiences involved some type of interaction with whale sharks. James' results showed that in 2005 best experiences also included other activities such as SCUBA and snorkelling and also staff, food and operations were also important in good experiences. In contrast, when asked about their worst experiences, in water crowding emerged as a major area of concern among visitors in 1996 whereas in 2005 sea sickness and complaints about staff/operations were also detracting elements. However, in 2005 ten snorkellers in the water was seen as the maximum preferred level (Figure 25).

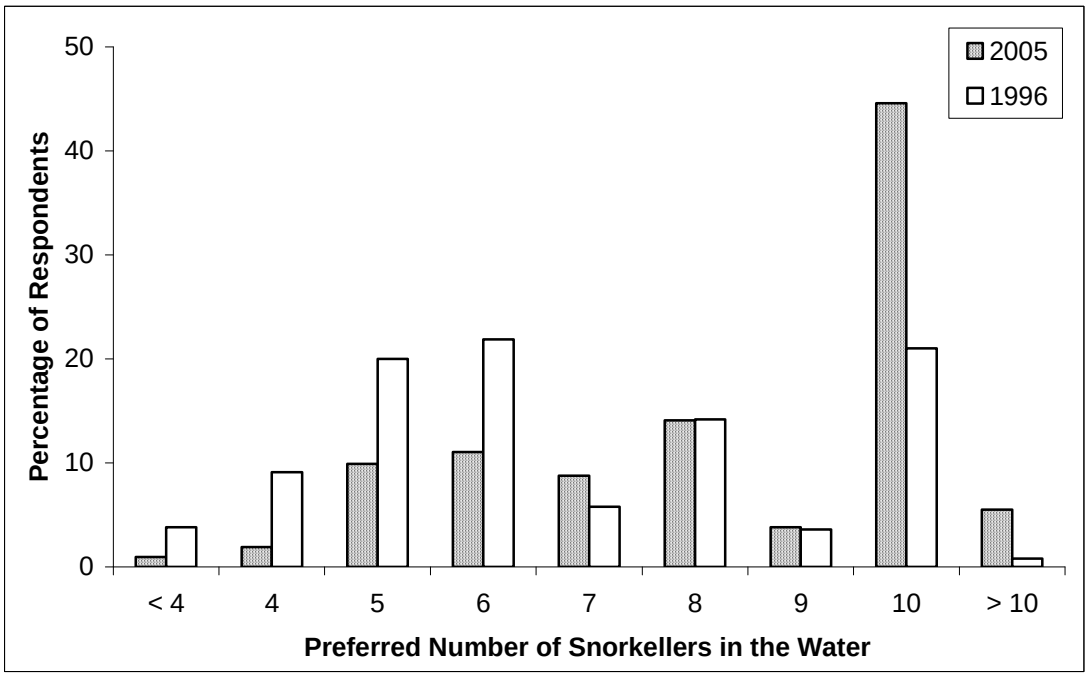


Figure 25: Preferred number of snorkellers in the water for 1996 and 2005

Generally people's expectations of their whale shark experience were met in 2005, however as the number of whale sharks encountered during a day increased, people's expectations were exceeded (Figure 26). Over 70% of participants said the amount of time spent swimming with a whale shark was what they expected and almost 90% said the level of interpretation was about right. In contrast, 22% said they would have liked more information on whale sharks in general. It has been suggested at the management team meeting that a whale shark guide program be developed to address this issue.

Recommendation 7: CALM to develop a whale shark guiding training program.

A full report of the Visitor Satisfaction Survey results will be available later this year.

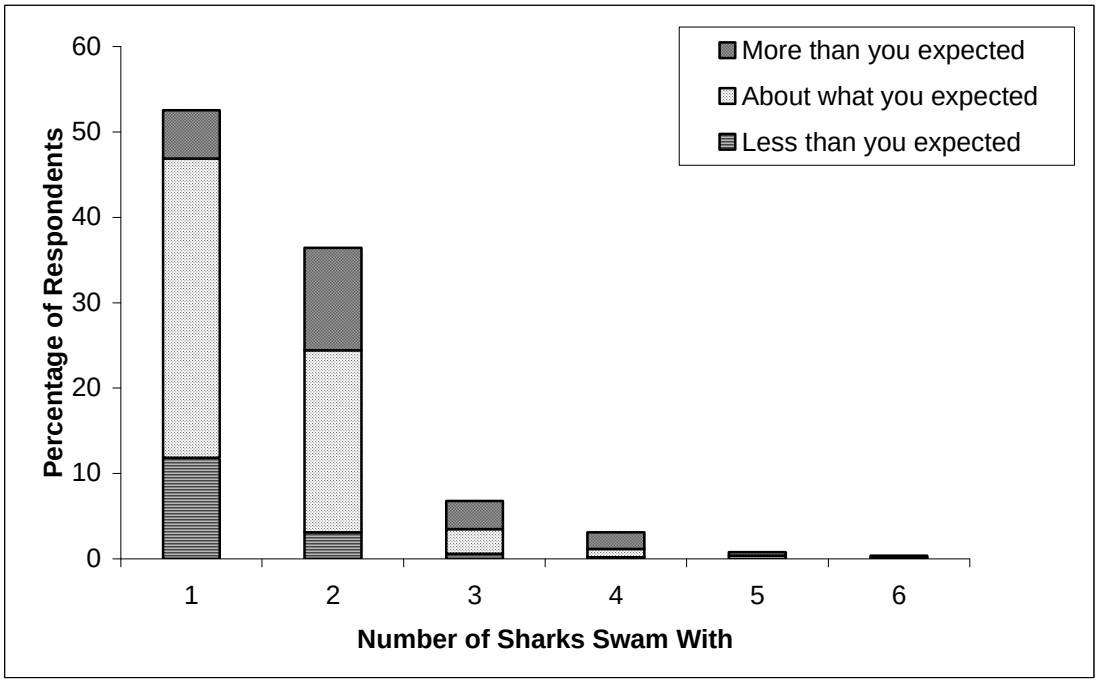


Figure 26: Expectations of respondents in regards to the number of sharks encountered during their trip

Coleman (1997) first identified the need for management to establish a monitoring program of visitor satisfaction and behaviour as the interaction industry grew and developed. Since then participation in the whale shark experience has rapidly increased. The latest Visitor Satisfaction Survey has showed that despite increases in passenger numbers, overall expectations are being met and sometimes exceeded, passengers are generally happy with all components of the trip and code of conduct and the experience itself.

Some reports of feeling crowded by vessels have been received this season. This could be an indicator that industry growth is having an effect on visitor satisfaction or may simply be the result of the 'crowded' situation in the contact zone reported by Wildlife Officers (see section 5.1.1). In previous years during the Easter holidays at the start of the whale shark season there are fewer whale sharks around and therefore more pressure by vessels on a whale shark. These issues of crowding need to be addressed as currently industry is operating at 30% of the maximum carrying capacity, so there is still room for considerable growth. One option may be to consider alternate departure ports, such as Yardie Creek. However, utilising such a site as Yardie has implications on existing use patterns and potential negative environmental impacts. This would need to be carefully evaluated before any such proposal could be approved.

Recommendation 8: CALM to include consideration of Yardie Creek as a departure point for whale shark interaction tours as part of the Parks and Visitor Services Plan for Ningaloo.

Visitor satisfaction shall continue to be monitored along with effects of industry growth on behaviour of whale sharks. To date CALM as a management agency has not been able to

identify any threat from the whale shark experience and to meet its objective of "*implementing a management framework to facilitate commercial operators to deliver quality experiences*" (Coleman, 1997), further research and monitoring of social carrying capacity must continue in order to guide decision-making.

Recommendation 9: Regular review of visitor satisfaction in consultation with whale shark industry operators and researchers should be considered to start before the five year licence period expires and at five year intervals thereafter.

5 MANAGEMENT MATTERS

5.1 Operations

As in previous years, CALM continued with its operational program which is a combination of boat ramp inspections, boat patrols, industry vessel placement, and aerial surveillance (Table 3). The CALM Exmouth District Office was supported by visiting Wildlife Officers. Operational effort decreased by 7 days from 2004 due to vessel safety issues.

Table 3: Comparison breakdown of operational field effort over season (1998-2005)

Primary Task	NUMBER OF DAYS					
	1998	2000	2001	2003	2004	2005
Field Research	6	8	8	18	10	11
Aerial Surveillance	3	4	2	2	4	4
On Industry vessels	0	7	5	8	8	11
Boat Ramp Inspections	0	36	42	22	21	10
Compliance Monitoring in CALM vessel	36	12	9	0	14	14
TOTAL	45	67	68	50	57	50

5.1.1 Wildlife Officer reports

Three Wildlife Officers spent time in the Exmouth and Coral Bay Districts to provide support and guidance to Exmouth Field staff. Unfortunately, there were several incidents which required further investigation and follow up during the 2005 season. These included: infringements being issued for failure to keep a record, failure to issue tickets, running with an un-authorized vessel as a substitute vessel without approval, exceeding the number of swimmers allowed in the water; and one Caution Notice being issued for exceeding the maximum number of passengers (20) allowed to be carried on a whale shark interaction. A number of minor issues were dealt with verbally.

Recommendation 10: CALM to increase its on-water presence during the 2006 whale shark season.

5.1.2 Exclusive contact zone

It is currently under consideration, after recommendation by Wildlife Officers, to make changes to licence condition 10.2 of the WCA Regulation 15 licence, to allow a second vessel within the 250m exclusion zone during the handballing procedure. This procedure does work extremely well and safely and is supported by CALM. Wildlife Officer reports have shown that the situation within the contact zone has become crowded and messy during the handover procedure and must be addressed before next season. Passengers

have reported that they feel crowded and unsafe, with too many boats in the vicinity of the whale shark.

5.1.3 Second supervisor

Following the post season meeting the whale shark industry raised the issue of allowing a videographer to act as a second supervisor in the water, (effectively increasing the ratio of staff to clients to 2:10 respectively). Benefits cited include added in water safety and in turn videographers would supply CALM with a copy of their daily footage for the purpose of photo ID.

5.1.4 Licensing of videographers

The licensing of videographers is an issue which is currently being addressed. Most licensee's now employ videographers/photographers who film participants during their whale shark experience. However, some of this footage is then used for the development of video's/DVD's which are offered for sale. As there is commercial gain, the activity requires a CALM Act license. All videographers/photographers taking footage for commercial gain in 2006 must hold a permit, which they can apply for at the Exmouth CALM office. For further information contact whaleshark@calm.wa.gov.au

Recommendation 11: Ensure that industry videographers/photographers filming on CALM lands (i.e. Ningaloo Marine Park) for commercial gain have a commercial filming permit.

5.1.5 Recreational boaters

There were no reports to CALM of non-compliance of recreational boaters with the Wildlife Conservation (Closed Season for Whale Sharks) Notice. It appears that this remains a minor compliance issue to be dealt with on an as-needed basis.

5.2 Industry Logbooks

Industry logbook data is required to be submitted to CALM every fortnight during the full whale shark season. On the whole regularity of submissions was maintained with some reminding by CALM staff, however compliance with this license condition needs to be improved. Regular collection allows CALM to monitor logbook data entry and ensure mistakes are picked up and rectified quickly in order to ensure data quality is maintained.

During the data interpretation and entry into the database, the following issues were identified:

- Some operators employ a number of different recorders that seem to be insufficiently informed about the correct way of filling out the Interaction Log**.**
- Not all operators are accounting for each day of the paying season.
- Confusion with issuing passes on no shark days and not recording repeaters. All paying passengers must be issued with a ticket on boarding a vessel regardless of whether a shark is sighted. Repeater passengers must be recorded as FOC and not issued another ticket.
- No depth recorded by Operators.
- Many recorders do not state whether 'Handballing' occurred or not.

- Some entries from different operators contradict each other in the interaction log about the sex and length of the shark.
- No contact information (amount of time with the shark and number of swimmers) given by operators on many occasions. Therefore it is often not clear whether any actual interaction occurred.
- Operators giving the total amount of interaction time with the whale shark and the total, added up number of swimmers, instead of stating contact times and number of swimmers separately.
- In case of no shark sightings, some operators do not state start and finish times on several occasions and do not give pass numbers and number of passengers.
- Operators log start and finish times as the actual interaction time with the whale shark and not as the total duration of the cruise.

It is apparent from these issues that some operators still need to ensure that their staff correctly fill in logbooks and that more time must be spent by CALM District personnel to ensure that data quality is maintained. Staff briefings and training can be offered to operators or their staff before the start of the season and at any time throughout the season, although in the past operators have not thought it necessary, continual errors in data recording show there is a need for extra assistance.

Recommendation 12: CALM to hold industry staff logbook training sessions and returned logsheets are checked following the first two weeks of the season.

5.3 Performance assessments

Following the meeting between Whale Shark Western Australia (WSWA) representatives Dave Hall (Exmouth Dive Centre), John Jenkin (consultant), Jim Sharp, Director, Parks and Visitor Services and Rod Quartermain from CALM in February 2004 the decision was made to review each individual licence holder's performance at the end of each season and provide operators with some feedback. This would allow all parties involved to ensure compliance with licence conditions are maintained over future years by following up any issues at the end of each season.

Performance letters for the 2005 season have been issued covering the following:

- Use of licences
- Logbook issues
- Compliance in the way of ticketing and payment of licence fees
- Public complaints
- Any warnings or breaches from the season

5.4 Department of Premier

In July 2004 the State Government unveiled a $21 million package for scientific marine research in western Australia, through the Strategic Research Fund for the Marine Environment (SRFME), a joint venture between CSIRO and the State Government. The Western Australian Marine Science Institute (WAMSI), a collaboration between CSIRO, the Australian Institute of Marine Science (AIMS) and WA universities, has been allocated

$5million for the Ningaloo Reef region, its ecosystems and the whale shark (Attachment J). The first ever international whale shark conference held in Perth in May 2005 was funded as a result of this financial contribution. This funding will drive research in the development of natural resources, conservation, and ocean systems forecasting.

5.5 Whale Shark Commonwealth Recovery Plan 2005-2010

The Commonwealth Department of Environment and Heritage has released the Whale Shark Recovery Plan, on the 28th April 2005. A copy can also be downloaded from the Department of Environment and Heritage website www.deh.gov.au by following the links to the whale shark, alternatively call the Community Information Unit on 1800 803 772. The plan's objectives are to:

- increase the level of cooperation with other range states to protect the whale shark;
- monitor the numbers of whale sharks visiting Australian waters.

5.6 Convention of Migratory Species

Whale sharks have been listed for their protection under the Convention of Migratory Species of Wild Animals (CMS) since 1999, however, there has been lack of progress towards a CMS whale shark agreement for a conservation strategy. Under CMS this agreement means that funding becomes available for research and conservation. Since the whale shark conference the development of an agreement has been given a jumpstart and a draft agreement has been drawn up (Attachment K).

5.7 Carry-over actions from 2004 Season Report

The following items from the 2004 progress report still require action:

1. That all skippers and staff are briefed by CALM personnel about how to complete logbooks and returned logsheets are especially scrutinised throughout the season.
2. To aid increased public awareness of interacting with whale sharks, CALM Exmouth should investigate the erection of signage at Tantabiddi Boat Ramp and Coral Bay.
3. CALM should consult the industry as to what amount of free diving on whale sharks is acceptable and whether this can be incorporated into the license conditions or code of conduct.
4. A review of the time operators can utilize sharks for interactions should be explored.
5. CALM needs to coordinate efforts at individual identification of whale sharks to reduce double up of effort.

5.8 Financial Statement

All licensed whale shark operators are charged a levy for each client participating in the whale shark experience. Ticket books are issued at the beginning of the season in March and operators are invoiced at the end of each paying season. Funds collected by CALM are used for whale shark conservation and industry management purposes. Adult participants are charged $20 and children $10. These funds have allowed CALM to implement many of the strategies of the Wildlife Management Program in collaboration with research institutes and not-for profit organizations. A balance of income and expenditure for the 2005 whale shark season is shown in Table 4.

Table 4: Levy Income and Expenditure for 2005 whale shark season

Management Strategy	Specifics	Credit	Debit
2004 season carry-over		+ $ 9,307	
2005 Management levy		+ $ 90,830	
Research	➢ Hubbs Sea World Project (Tagging) ➢ Visitor Satisfaction Survey ➢ Assessing the suitability of aerial surveys to determine relative abundance		-$34,350
Monitoring	➢ Aerial Data Collection Assessment Project ➢ Logbook data analysis, photo-id		-$15,334
Compliance	➢ Surveillance and patrols (vessels, flights, vehicles, additional staff); Investigations		-$14,082
Education	➢ Posters, brochures, ticket books, logbooks, Whale shark Festival, Display, Ecocean Brochures, Powerpoint presentations		-$12,850
Administration	➢ Licensing, meetings, EOI, Progress Report ➢ Whale shark conference		-$14,269
Total		+ $ 100,137	-$90,885
BALANCE			+$ 9,252

6 REFERENCES

Coleman J (1997) Western Australian Wildlife Management Program No. 27: Whale shark interaction management, with particular reference to Ningaloo Marine Park. Western Australian Department of Conservation and Land Management, Fremantle WA.

Chapman T (2002) Whale shark log sheet data 1995- 2001, Unpublished Report: Western Australian Department of Conservation and Land Management, Exmouth WA.

Davis, D., Birtles A., Valentine, P., Cuthill, M. and Banks, S. (1996). Whale sharks in Ningaloo Marine Park: Managing Tourism in an Australian Marine Protected Area. Report to the Department of Conservation and Land Management, WA.

Meekan, Dr Mark, pers. Comm., Australian Institute of Marine Science

Norman, B. M. (1999) Aspects of the Biology and Ecotourism Industry of the Whale Shark *Rhincodon typus* in north-western Australia, Masters thesis B.Sc. Murdoch University, WA.

Polovina, J. J., pers. Comm., Pacific Islands Fisheries Science Center.

Stevens, J., pers. Comm., CSIRO Marine Research, Hobart.

Attachment A: CALM public information sheets and Ningaloo Whale Shark Watch newsletters

Attachment B: CALM whale shark season updates 1-5

Attachment C: Whale shark conference summaries

Attachment D: Whale shark conference communiqué

Attachment E: ECOS publication – Threatened whale sharks draw calls to end exploitation

Attachment F: Hubbs Sea World progress report

Attachment G: Movements of whale sharks (*Rhincodon typus*) tagged at Ningaloo Reef, WA

Attachment H: SPLASH tag application design

Attachment I: ECOCEAN whale shark photo ID library ‘How to take photos’ sheet

Whale Shark Photo-identification Library

Which shark will YOU swim with today…

Shark A-030. Sighted once only in 1996. 10m male.

Shark A-052. Sighted on six different days in 1996, 1997, 1999. 8m male.

Shark A-076. Sighted on six different days in 1999, 2003, 2004. 6m male.

… a previously identified shark

…. or a NEW shark?

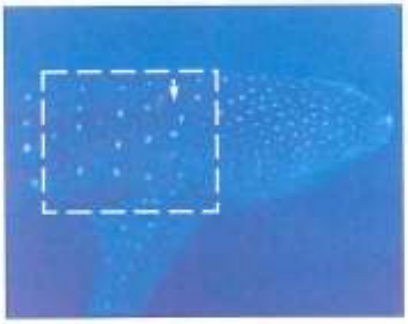
- **Each whale shark has a unique pattern of spots on its skin – directly behind the gill slits.**
- **We use accurate computer-matching software designed especially for this project to compare photographs of the spots on the skin of each shark.**
- **This 'bodyprint' behind the gills is like a fingerprint – no two sharks have exactly the same patterning.**
- **Fewer than 500 whale sharks may be visiting Ningaloo Marine Park (NMP) – the science used in the photo-identification project will help to determine this.**
- **In the *ECOCEAN Whale Shark Photo-identification Library*, 200 individual sharks have been recorded at NMP – and hundreds more from over 20 different countries where whale sharks are found.**
- **Most of these photographs have been taken by volunteers, keen to help the research on these 'gentle giants'.**

Whale sharks need your help
Please take photos of the shark/s you swim with and send these in to the online Library
(see www.whaleshark.org)

How to take photos that are used to identify individual sharks

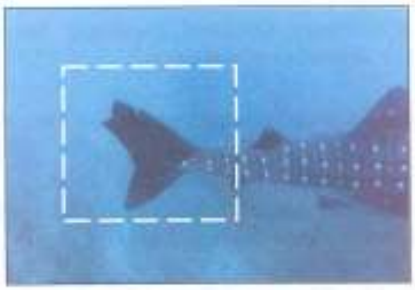
Left-side patterning

This is the first priority photograph (of most importance in the Library). It is this area on the left side that is used to identify individual sharks



Right-side patterning

This is the second priority photograph. It is used to confirm re-sightings when we already have a left and right side photo of a shark.



Scarring

This is the third priority photograph used to confirm a 'match'.

Useful information:

i) date of sighting _____ *iii) location (GPS where possible)* _____

ii) time of sighting _____ *iv) shark sex and estimated size* _____

Please go to: www.whaleshark.org to submit your photos and sighting information.

Thanks for playing a part in whale shark research!

Supported by:

Attachment J: Media Release - $5 million quest to learn more about Ningaloo Reef and save the whale shark

MEDIA STATEMENT
PREMIER OF WESTERN AUSTRALIA

26/07/2004

$5million quest to learn more about Ningaloo and save the Whale Shark

The State Government today unveiled a $5million package for scientific research into the Ningaloo Reef, its ecosystems and the magnificent but still relatively mysterious whale shark.

Premier Geoff Gallop said the State Government was passionate about ensuring whale sharks were properly respected and protected in Western Australia and to making sure this rare creature remained in the ocean and was not hunted and slaughtered for food, leather and other by-products.

"While it provides us with a multi-million dollar eco-tourism industry, we really know very little about the whale shark," the Premier said.

"This research package will help us find out more about the whale shark's conservation needs to guide what we do in WA.

"It will also help us play a leading role in whale shark research and conservation in our region."

The whale shark - the world's largest living fish at up to 12 metres - is listed as 'vulnerable' by the World Conservation Union. While it is protected in WA and Australian waters, the species is highly migratory and is exploited as food in several countries in South Asia and South East Asia.

The Premier also named Ningaloo Reef as the seventh WA heritage icon and said the research program was part of the State Government's commitment to ensuring the reef was protected and managed on a sustainable basis.

"The Ningaloo Reef is one of the State's great natural attractions," Dr Gallop said.

"It has both national and international importance - as the largest fringing coral reef in Australia and as one of the most diverse marine systems in the world.

"In recognition of this, the Government is planning to have the park boundaries amended to include the entire 290km stretch of the reef.

"We are also having the reef, and the adjoining Cape Range National Park, nominated for listing as a World Heritage Property.

"This research program is another important part of our plan to protect the Ningaloo Reef."

Key elements of the research program included:

. specific research into whale sharks, including their migratory patterns and why they visited Ningaloo so regularly;

. a survey of the biodiversity of the reef and the distinctive underground fauna of the Cape Range coastal plains;

. a study into the oceanography of the reef, in particular the Leeuwin current which acted as a 'hydraulic conveyor belt', transporting water-borne plants and animals along the reef;

. investigations into the reef's physical environment, especially factors that impact on coral ecosystems;

. an assessment of the impact of increased tourism on recreational and commercial fished species;

. an assessment of the best management strategies, including the use of sanctuary zones to protect the reef's biodiversity; and a specific program to determine the impact and risk of direct threats as a result of climate change.

The research program was developed by the Premier's Office of Science and Innovation in consultation with the Department of Conservation and Land Management; Department of Fisheries; Department of Environment; WA Museum; Department of Industry and Resources; CSIRO; the Australian Institute of Marine Science (AIMS); and the Gascoyne Regional Development Commission. The research program will be refined following input from relevant stakeholders.

State Government agencies, CSIRO, AIMS and universities will implement the program.

Premier's Office: 9222 9475

Attachment K: Convention of Migratory Species draft agreement