



Senator Peter Whish-Wilson  
Chair  
Environment and Communications References Committee  
PO Box 6100, Parliament House  
CANBERRA ACT 2600

Dear Senator Whish-Wilson

Thank you for your letter, dated 17 November 2017, to the Minister for Agriculture, Food and Fisheries, the Hon Leon Bignell MP, seeking further information relating to shark cage diving activities. I am responding as this activity falls within my portfolio responsibilities as Minister for Sustainability, Environment and Conservation.

I am advised that white shark cage diving tours in the Neptune Islands Group (Ron and Valerie Taylor) Marine Park in South Australia are conducted in accordance with the *South Australian White Shark Tour Licensing Policy* (the Policy). I have enclosed a copy of this policy for your information.

There are two techniques permitted to attract white sharks closer to the vicinity of tour vessels in South Australia. Two operators are permitted to use fish based attractant, both in a minced and unminced form. A third operator is permitted to use acoustic based attractant, which is essentially the playing of music through underwater speakers.

I am informed fish based attractant comprises fish by-product in a minced form that is dispersed into the water as a stimuli to attract sharks to swim near the tour vessels. In a minced form, this does not present as a food source for sharks. Once sharks are in the general vicinity of tour vessels, operators are permitted to use unminced fish (typically in the form of tuna gills) which are tethered to a rope in closer proximity to the shark dive cage. This is used in an attempt to have the shark swim close by the cage and it is a condition of licence that sharks must not be allowed to bite, take or ingest the tethered fish product.

The licence conditions govern the use of fish based attractant by:

- prohibiting the feeding of white sharks (this includes biting, taking or ingesting tethered fish product);
- requiring the constant physical observation and control of unminced fish based attractant while it is in contact with the water;
- restricting the amount of fish based attractant that may be used each day to 100kg per operator;

- requiring operators to stop using unminced fish based attractant (bait) for 15 minutes in the event that it is consumed by a white shark;
- requiring constant audio visual surveillance of tours; and
- requiring the establishment of training and accreditation for staff involved in the handling of fish based attractants during tours.

In permitting the use of fish based attractant, the Department of Environment, Water and Natural Resources (DEWNR) has evaluated the level of risk associated with this policy in consultation with white shark ecologists and concluded that the continuation of current white shark tourism practices does not present a risk to the public.

DEWNR carries out compliance activities to ensure that all shark cage diving operators adhere to licence conditions. I am informed inspections are carried out using a variety of methods that include overt and covert operations of varied frequency. All operations are overseen by a senior compliance officer. To further improve compliance capability, DEWNR is currently working with operators to have video surveillance cameras installed on the tour vessels. These will monitor the cage diving related activities of all tours.

A key element of the Policy is a formal monitoring programme to measure the residency period of white sharks around the Neptune Islands. I am advised that previous studies indicated that there was an increase in shark residency following an increase in tourism activity which led the State Government to introduce a number of controls in response to recommendations made by the CSIRO. To remain adaptive and responsive, the policy establishes a number of 'decision ranges' linked to shark residency levels, which in turn are linked to various policy responses concerning the number of days permitted for tour operations and amounts of attractant that may be used.


I am advised that DEWNR continues to work closely with leading shark ecologists from the CSIRO, Flinders University and the South Australian Research and Development Institute (SARDI) as part of continuing to learn more about the white shark and its behaviour and these learnings will assist contribute to the ongoing management of the white shark cage dive industry.

Thank you for taking the time to write to Minister Bignell and I trust this information is of assurance.

Yours sincerely

**IAN HUNTER MLC**

Minister for Sustainability, Environment and Conservation

 12 / 2017

Encl: South Australian White Shark Tour Licensing Policy  
Policy Annexure A - Guidelines for the adaptive management of white shark tour licensing

# South Australian White Shark Tour Licensing Policy

*An adaptive policy framework to guide licensing and to support a socially responsible, environmentally sustainable and economically progressive white shark tourism industry in South Australia.*



Government  
of South Australia

Department of Environment,  
Water and Natural Resources



# Foreword

South Australia's Neptune Islands are renowned internationally as the location for a thriving white shark tourism industry.

Through the efforts of tour operators, and the support of the South Australian Government, this industry now contributes an estimated \$11.3 million to the State economy annually, and supports approximately 70 jobs. It has helped to establish Port Lincoln and the Eyre Peninsula as one of our premier nature-based tourism destinations, and is helping to establish South Australia as a growing destination of choice for international and domestic travellers - a key economic priority for the State, and a priority action in the South Australian Tourism Plan 2020.

Tour operators, together with the South Australian Government and research partners have established the Neptune Islands as an international focal point for white shark research and have helped to raise awareness about white sharks and their conservation. The success and growth of white shark tourism illustrates the positive relationships that can be achieved between nature-based tourism and the environment.

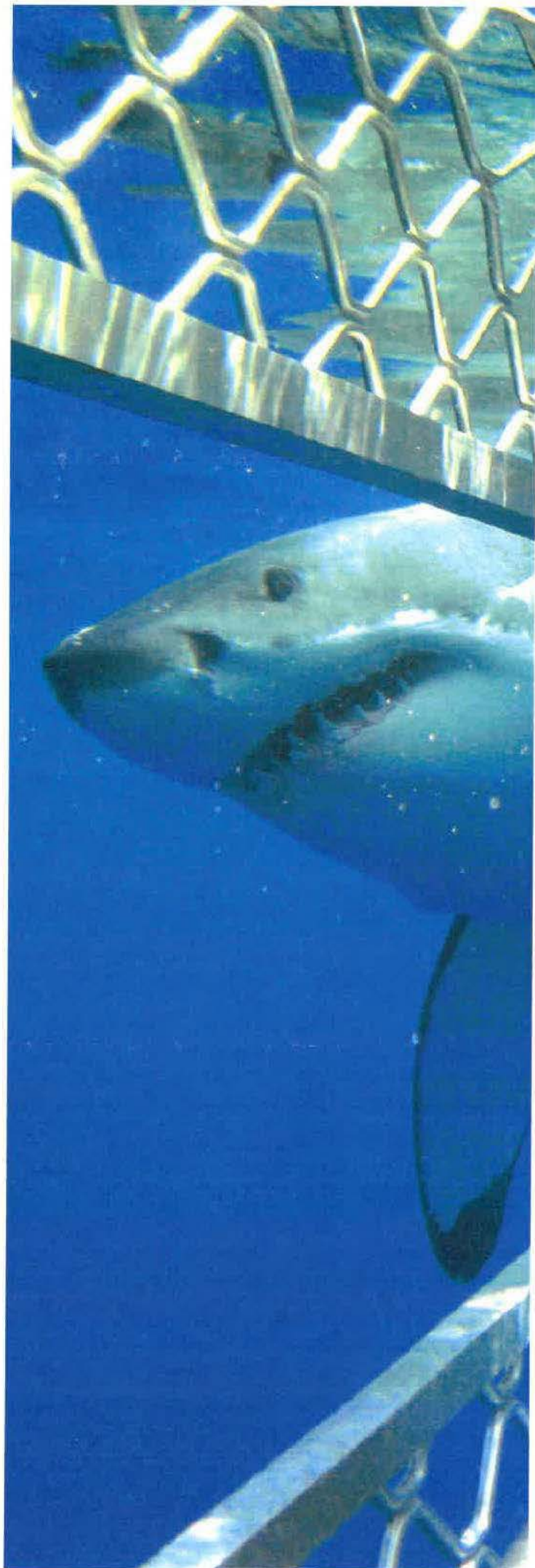
To ensure that white shark tourism continues to be a major contributor to the South Australian economy, it is essential that the activity continues to be environmentally sustainable and socially responsible in the long term.

This policy has been developed in consultation with licensed tour operators, relevant South Australian Government departments and the Australian Government's Department of the Environment and Energy. It sets out how the South Australian Government will work with licensed operators and other partners to ensure that tourism activities are safe, sustainable, continue to support conservation, and become a leading example of best practice in nature-based tourism.

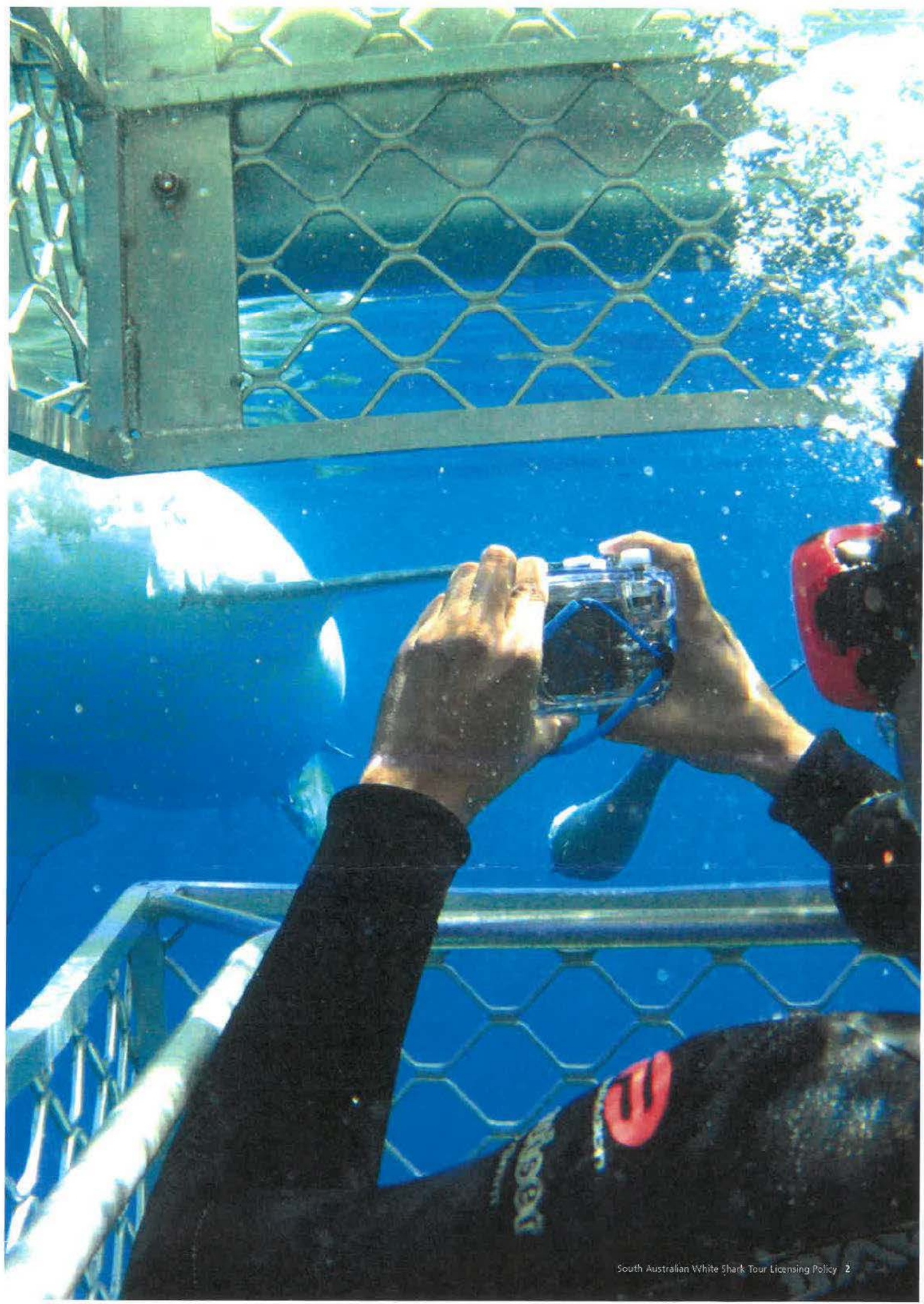
**Sandy Pitcher**

**Chief Executive**

**Department of Environment Water and Natural Resources**









# Legal basis

The Neptune Islands are located 60-70 km south of Port Lincoln at the entrance to Spencer Gulf (Figure 1). The Neptune Islands and their surrounding waters are proclaimed under South Australia's *National Parks and Wildlife Act 1972* as Neptune Islands Conservation Park.

A corresponding area is also proclaimed as the Neptune Islands Group (Ron and Valerie Taylor) Marine Park under the *Marine Parks Act 2007*. The waters around the North Neptune Islands are a sanctuary zone. By virtue of its proclamation under these Acts, the area is highly protected and managed primarily for conservation while also providing for public use and enjoyment.

Regulation 37 (1)(b) of the *National Parks and Wildlife Regulations 2001* requires that all commercial tours conducted in parks proclaimed under the *National Parks and Wildlife Act* are undertaken in accordance with a licence pursuant to the *National Parks and Wildlife Act*.

Regulation 8(3)(h) of the *Marine Parks Zoning Regulations 2012* requires that commercial tours conducted in a marine park sanctuary zone be undertaken in line with a permit pursuant to the *Marine Parks Act*. This rule does not apply when a licence under the *National Parks and Wildlife Act* is in place.

These provisions ensure that all tourism activities undertaken in parks are appropriately regulated and compatible with both park management and species conservation goals. Licences enable tour operators to undertake specifically defined activities, and require them to abide by certain licence conditions.

Commercial activities in parks must also be undertaken in a way that is consistent with any park management plan. The Neptune Islands Group (Ron and Valerie Taylor) Marine Park Management Plan applies, and was adopted in 2012<sup>1</sup>. This plan provides strategic direction for the management of the park and enables the continuation of white shark tours.

The white shark (or great white shark) is listed as Vulnerable on the International Union for the Conservation of Nature (IUCN) Red list<sup>2</sup>. It is also listed as Vulnerable and Migratory under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and is a protected species under South Australia's *Fisheries Management Act 2007*.

As a result of these classifications, the South Australian Government and tour operators have specific obligations for the protection of white sharks against impacts. These obligations are detailed in the Australian Government's *Recovery Plan for the White Shark (Carcharodon carcharias) 2013*<sup>3</sup>. The Recovery Plan's objectives and actions which relate to white shark tours in South Australia are summarised below.

## ***Recovery Plan for the White Shark (Carcharodon carcharias) 2013*<sup>3</sup> - objectives and actions relating to white shark tours**

**Objective 5** - Investigate and manage (and where necessary reduce) the impact of tourism on the white shark.

**Objective 9** - Promote community education and awareness in relation to white shark conservation and management.

**Action 5.1** - Investigate the impact of increased cage diving activity and develop appropriate management responses if required.

**Action 5.2** - Require daily logbook reporting of interactions by cage dive operators as a condition of licence to assist in the monitoring of tourism effects.

**Action 5.3** - Engage cage dive operators in shark research and education programs.

The white shark tourism industry plays a key role in supporting the recovery plan and improving knowledge about the ecology and behaviour of the white shark. This policy sets out how white shark tourism activities will be licensed and regulated consistent with relevant legislation.

All licensed tour operators in South Australia are obliged to abide by State laws relating to protection of the park, commercial activity, transport, and the safety of their clients. Licensed operators are required to hold public indemnity insurance specific to white shark tours, and have comprehensive policies and procedures in place to ensure the safety of their clients.

## Policy principles

This policy is based on the following principles:

**1. Ecological sustainable development** - The recovery plan requires that decisions affecting the species adopt the ecological sustainable development principles set out in section 3A(b) of the *EPBC Act 1999*. This means that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

**2. Transparency** - Policies should be clear and transparent.

**3. Evidence based** - Policies should be based on the best available scientific evidence and knowledge. Policies should adapt to new evidence and knowledge as it becomes available.

## Policy objectives

This policy has the following objectives:

**1.** Investigate and manage (and where necessary reduce) the impact of tourism on the white shark, as guided by Recovery Plan Objective 5 (see page 3).

**2.** Promote community education and awareness in relation to white shark conservation and management, as guided by Recovery Plan Objective 9 (see page 3).

**3.** Enable sustainable white shark tours within the park.

**4.** Avoid harm to white sharks and other marine species.

**5.** Avoid and minimise impacts on park values.

**6.** Ensure that white shark tours are licensed and undertaken in accordance with the provisions of all relevant State and Commonwealth legislation.

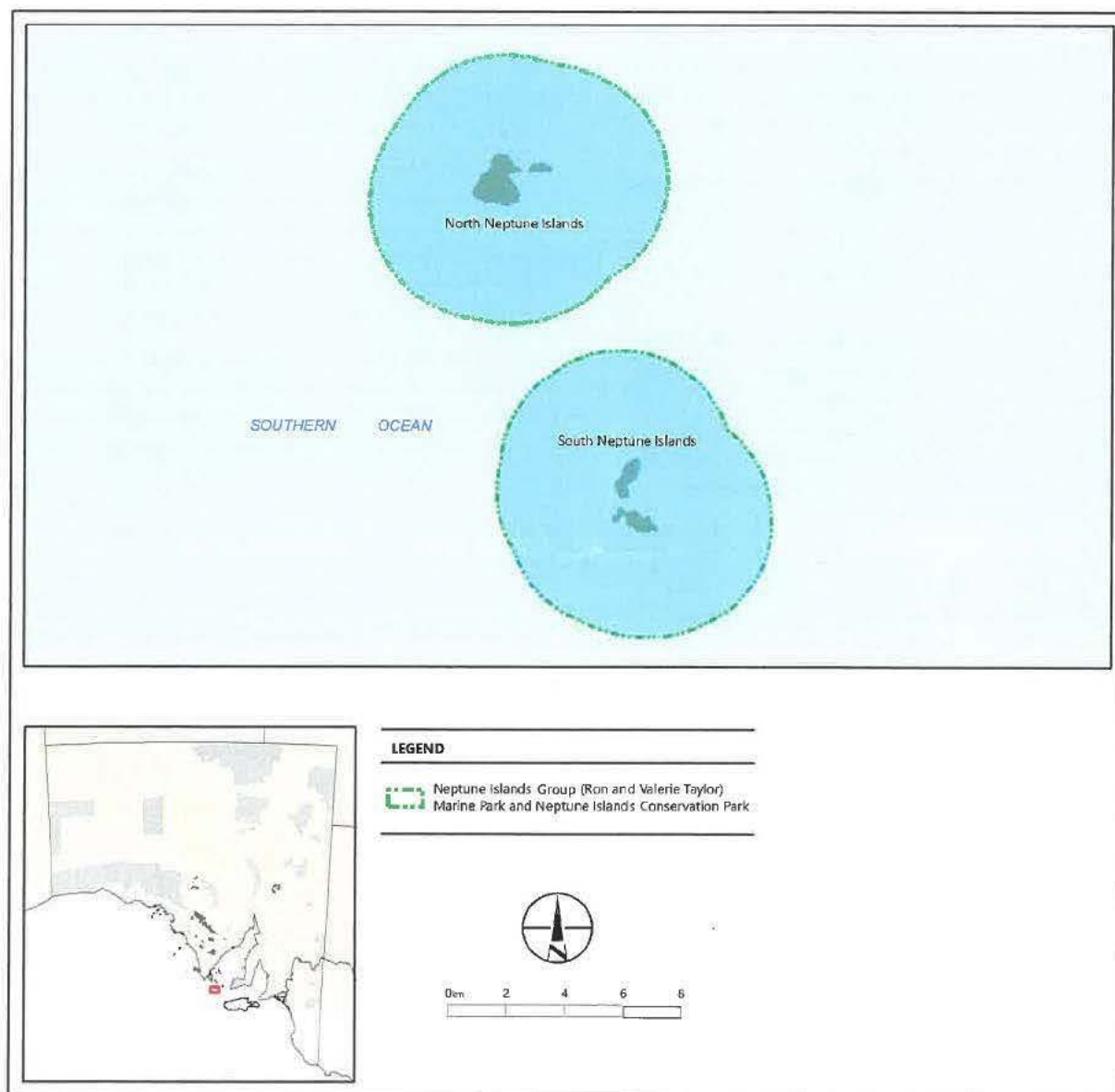


Figure 1– Neptune Islands Group (Ron and Valerie Taylor) Marine Park and Neptune Islands Conservation Park





## Background

The range of the white shark extends along the southern Australian coastline from central Queensland to North West Cape in Western Australia<sup>4</sup>. Many of the islands within these coastal waters including North Neptune Islands and South Neptune Islands (Figure 1), support large colonies of Australian fur seal, long-nosed fur seal and Australian sea-lion. As an important food source for white sharks, colonies including the Neptune Islands appear to be critical white shark habitat and are well known white shark aggregation areas.

In the 1960s, Rodney Fox pioneered the development of methods to attract and dive with white sharks. His campaign to demystify and promote the conservation of white sharks led to the establishment of South Australia's first commercial white shark tours. During the 1980s and 1990s several businesses conducted white shark tours at the Neptune Islands as well as a series of additional sites throughout the State.

Several fatal shark attacks in the early 2000s raised concerns in the South Australian community about the suitability of white shark tours in waters near other commercial and recreational marine based activities. In response, the South Australian Government prohibited white shark tours at all sites other than the Neptune Islands. The Neptune Islands is now the only established white shark tourism site in Australia, and is one of only a handful in the world.

Licensed operators are authorised to conduct white shark tours from vessels using purpose built cages. They are also authorised to use specific methods for the attraction of sharks. Depending on their authorisation, operators may seek to attract white sharks by projecting under water sound, releasing berley (referred to in this policy as minced fish based attractant) into the water column, or using pieces of fish tethered to a throw line (referred to in this policy as unminced fish based attractant).

Licensed operators offer a range of visitor experiences within the park including day trips, overnight trips, boat deck viewing, surface cage dives and sea-floor cage dives. These experiences are often complemented by on board facilities, catering, interpretation or

other authorised marine based tourism activities. While activities are authorised to occur throughout the park, the majority of activity takes place in a sheltered anchorage at the North Neptune Islands.

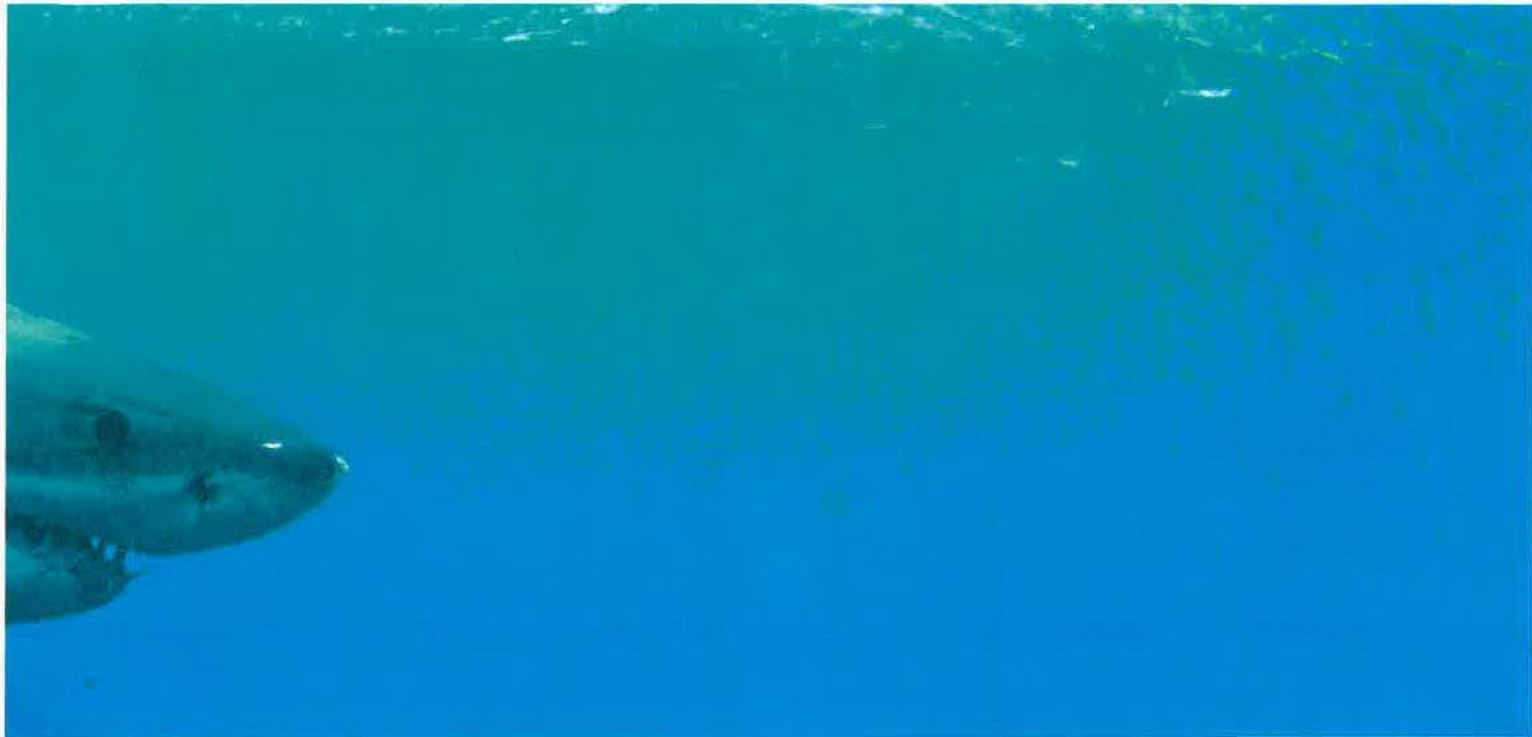
Steady growth in public demand for white shark tours has resulted in a substantial increase in the number of tours conducted. The total number of days when tours occurred increased from approximately 110 days per annum in 2001, to approximately 260 days per annum in 2011<sup>5</sup>. This has resulted in an increase in investment in the industry and major flow-on benefits to the South Australian economy.

In the late 2000s, shark ecologists researching white sharks at this site raised concerns about the potential impact of continued industry expansion on the white shark. In response to these concerns, the South Australian Department of Environment, Water and Natural Resources (DEWNR) commissioned Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) to investigate the long term effects (or impacts) of tours on white sharks at the site, and to provide any recommendations necessary to address any observed effects (or impacts).

This investigation, conducted between 2010 and 2011, concluded that the average period of time that white sharks occupied the primary tour site at the North Neptune Islands increased from an average of 11 days (in 2001-03) to an average of 21 days (in 2010-11)<sup>6</sup>. This investigation concluded that this change in residency was most probably caused by an increase in the frequency of white shark tours. The results of this investigation have significant implications for the economic and ecological sustainability of the industry.

It is unknown if this change is having a detrimental impact on the population or the welfare of individual white sharks. However, similar changes observed in a range of other species, (including shark species) indicate that this trend may be harmful in the long term unless addressed. As a precaution, the CSIRO made specific recommendations to address these effects<sup>6</sup>. These recommendations are summarized below. Recommendations provided by the CSIRO have been incorporated into the Australian Government's white shark recovery plan<sup>3</sup>.





These recommendations prompted the South Australian Government to review policies, commercial arrangements and operational practices for white shark tours, in conjunction with licensed tour operators. In 2012, the review culminated in the establishment of new policies to guide an appropriate level of industry expansion, a call for expressions of interest in white shark tours, and the granting of new licences to operators that were selected through the expression of interest process for a term of five years.

One of the main policy goals is to reduce berleying effort (see CSIRO recommendation 1 above). This goal is based on the assumption that the use of fish based attractants over a prolonged period may cause long term effects on white sharks.

The level of tourism activity will be maintained at the 2011 levels of 260 days per annum or less. The adoption of 2011 levels of activity as a benchmark is based on the assumption that any further increases in the level of tourism activity (i.e more operators, more days of activity, or the use of more attractant) is likely to pose a significant risk to the white shark.

Any further increase in tourism effort is now capped through the establishment of limits on: the number of white shark tour locations (Policy 1.1), the number of licences granted to conduct white shark tours (Policy 2.1), the number of vessels in operation (Policy 5.1), the number of days per week available for tours (Policy 6.1), the number of businesses authorised to use fish based attractants (Policy 7.1), and the amount of fish based attractant that may be used by authorised operators on each activity day (Policy 7.5).

Some people, particularly those involved in the abalone industry and aquatic recreational activities such as surfing or SCUBA diving, are concerned that the use of fish based attractants in the form of berley and bait is changing the behaviour of white sharks throughout their range and elevating the risk of attacks on humans. The changes in white shark behaviour observed at the Neptune islands have been cited by some as evidence for an elevated risk of shark attack.

There is currently no evidence to suggest that the changes in behaviour observed at the Neptune Islands have changed white shark behaviour elsewhere. There is also no evidence to suggest that the use of fish as an attractant at the Neptune islands could result in an increased risk of shark attack elsewhere.

The feeding of sharks is prohibited, however it is acknowledged that current practices have inadvertently resulted in the consumption of fish by sharks. DEWNR will continue to work with licensees to improve white shark attraction practices and will strive to establish practices that prevent any inadvertent feeding of sharks. In addition, the South Australian Government will continue to review available research and liaise with scientific specialists in this field to ensure that white shark tours do not comprise the safety of marine users.

### **CSIRO recommendations<sup>4</sup>**

**Recommendation 1** - Reduce berleying / provisioning effort at the North Neptune Islands.

**Recommendation 2** - Conduct ongoing monitoring of shark behaviour.

**Recommendation 3** - Implement an education and awareness program about the risks posed to sharks by excessive berleying or provisioning and the key tactics used in mitigating the negative impacts of tourism.

# Policies *(effective 1 July 2017)*

## Policy 1 – Location

**1.1** Licences pursuant to the *National Parks and Wildlife Act 1972* for white shark tours will only be granted for the Neptune Islands Conservation Park.

**1.2** In support of licensees, Government may develop contingency plans in conjunction with affected stakeholders in response to extraordinary events that prevent white shark tours in the park for a prolonged period.

This policy has been established since the early 2000s. It aims to avoid any conflict with other marine users by confining tours to a remote location where potential conflict with other aquatic activities is minimised. This policy contributes to Recovery Plan objective 5 (see page 3) by avoiding the additional impacts that could arise through the ongoing exposure of white sharks to tourism activities at additional sites.

## Policy 2 – Number of licences

**2.1** A maximum of 3 businesses may be licensed to conduct white shark tours pursuant to the *National Parks and Wildlife Act 1972*.

**2.2** Licences pursuant to the *National Parks and Wildlife Act 1972* for white shark tours will be offered to those business entities that were authorised in 2012 to conduct white shark tours at Neptune Islands Conservation Park.

This policy was established in 2012. It is based on a benchmark of 3 businesses which were operating in 2011. The businesses that were initially authorised to conduct white shark tours in 2012 were selected via an expression of interest process in accordance with standard Government processes for the allocation of commercial opportunities. This policy aims to contribute to Recovery Plan objective 5 (see page 3) by avoiding the escalation of effects which could be expected to arise as a result of additional tourism operations.

## Policy 3 – Transfer of licences

**3.1** Licences granted pursuant to the *National Parks and Wildlife Act 1972* may be transferred with the approval of the Minister for Sustainability Environment and Conservation. Transfer will not be unreasonably withheld.

The *National Parks and Wildlife Act 1972* specifies that licences cannot be transferred without consent from the Minister for Sustainability, Environment and Conservation.

## Policy 4 – Licence term

**4.1** Licences pursuant to the *National Parks and Wildlife Act 1972* with a term of up to 10 years will be offered to those business entities that were authorised in 2012 to conduct white shark tours.

**4.2** Licensees will be advised about opportunities for the granting of new licences as soon as possible prior to the expiry of licences.

In November 2014 the South Australian Premier announced that the South Australian Government would make a change to policy in order to support additional investment in the industry by increasing the term of existing licences from 5 years to 10 years. In support of this commitment, Government has made regulatory amendments to enable berleying authorisations to be extended from 1 year to 10 years, and encompassed in a licence pursuant to the *National Parks and Wildlife Act 1972*.

## Policy 5 – Number of vessels in operation

**5.1** Licences granted pursuant to the *National Parks and Wildlife Act 1972* will authorise each licensee to conduct direct interactions with white sharks using only one vessel at any point in time.

This policy was established in 2012. It is based on a benchmark of 3 vessels which were operating in 2011. It aims to contribute to Recovery Plan objective 5 (see page 3) and CSIRO recommendation 1 (see page 6), by avoiding the increased impact that could arise as a result of more vessels conducting tours. This policy also seeks to prevent overcrowding at the site. It does not preclude multiple tours on one day, or the use of additional vessels for the transport of clients.

## Policy 6 - Number of activity days

**6.1** Tourism activity will be limited to 12 days per fortnight. In addition, licences granted pursuant to *National Parks and Wildlife Act 1972* will require each licensee to adhere to a limit of 10 days of tourism activity (tourism activity days), per fortnight. These limits may be subject to change in accordance with Policy 9.

A limit on activity days was initially established in 2012. An initial limit of 10 activity days per fortnight capped the level of activity at approximately 260 activity days per annum, which was the level of activity occurring in 2011.



This limit was established following advice from experts recommending the introduction of regular breaks in tours, in order to minimise the exposure of sharks to stimulation. After the consideration of trends in white shark residency this limit was revised in 2016 in order to accommodate a broader range of tour itineraries. This policy aims to contribute to Recovery Plan objective 5 (see page 3) and CSIRO recommendation 1 (see page 6), by avoiding the impacts that could arise as a result of continued increases in the frequency of tours each year.

## **Policy 7 – The use of fish based attractants**

**7.1** A maximum of 2 businesses may be permitted to use fish based attractants through licences granted pursuant to the *National Parks and Wildlife Act 1972*.

**7.2** Licences granted pursuant to the *National Parks and Wildlife Act 1972* that provide permission to use fish based attractants will be offered to business entities that were initially authorised to use berley in 2012 pursuant to the *Fisheries Management Act 2007*.

**7.3** Licensees are not allowed to harm white sharks, deliberately feed white sharks, leave unminced fish based attractant in the water unattended, or dispose of any fish based attractant in the park.

**7.4** Licensees will be encouraged to develop a white shark attraction code of conduct within 12 months. The code will set out how operators will minimise the use of fish based attractant, prevent harm to white sharks, and prevent the consumption of fish based attractant by white sharks.

**7.5** Each licensee will be subject to a 100kg daily limit on the amount of fish based attractant that may be used. Licensees will be required to maintain a daily log book and regularly report on the quantity of minced and unminced fish based attractant used each day. This daily limit may be subject to change in accordance with Policy 9.

**7.6** Licensees will be required to cease the use of all fish based attractant and review white shark attraction tactics for a review period of 15 minutes in the event a white shark bites, takes or ingests any unminced fish based attractant or makes forceful contact with the underwater enclosure, equipment or vessel. This limit may be subject to change.

**7.7** Licensees will be required to develop and implement accreditation standards for crew involved in the use of fish based attractants within 12 months.

Unless specifically authorised through a licence, the use of blood, bone, meat, offal oil or skin of a fish (referred to in this policy as fish based attractant) is not allowed in parks proclaimed under the *National Parks and Wildlife Act 1972* by virtue of Regulation 33(c) of the *National Parks and Wildlife Regulations 2001*. Similarly, the use of berley in a marine park sanctuary zone is not allowed by virtue of Regulation 8(3)(l)(iv) of the *Marine Parks Zoning Regulations 2012*.

Regulation 23(1) of the *Fisheries Management (General) Regulations 2007* also prohibits the use of berley within 2 nautical miles of the South Australian coastline and within 2 nautical miles of South Australian islands. These restrictions on the use of berley do not apply to licensees that are authorised to use fish based attractants at the Neptune Islands in accordance with licence conditions.

A limit of 2 on the number of businesses that may be permitted to use fish based attractant for white shark tourism in South Australian waters (Policy 7.1) has been in place since the early 2000s, when the South Australian Government initially adopted this position. This policy position will be continue to be maintained in order to reduce berleying effort from those levels that were reached in 2011.

In 2012, Government called for expressions of interest from businesses interested in conducting white shark tours at Neptune islands Conservation Park. Through this process, two businesses were selected, and then authorised to use fish based attractants. As this competitive allocation process was conducted relatively recently, these businesses will continue to be authorised to use fish based attractants (Policy 7.2).

The feeding of any wild animal has potential to disrupt normal patterns of behaviour that are necessary for survival. Therefore, the feeding of white sharks as a part of tours is prohibited and policies are in place to prevent the consumption of unminced fish based attractant by white sharks.

Policies include the establishment of an industry code, the establishment of accreditation standards for staff, and the establishment of a daily limit on the amount of fish based attractant that may be used. In addition, the use of unminced fish as an attractant will cease in the event that any unminced fish is consumed by a white shark. This will enable licensees to review white shark attraction methods. These policies will contribute to Recovery Plan objective 5, Recovery Plan actions 5.2 and 5.3 (see page 3), and CSIRO recommendations 1 and 3 (see page 6).

# Policies *(continued)*

## Policy 8 – The use of acoustic attractants

**8.1** Acoustic attraction devices and methods will be individually assessed and will require approval prior to their use. The licensee will be required to limit acoustic attraction devices to those that are sufficiently robust, protected by a housing that is unlikely to be ingested and do not replicate the appearance of a potential food source.

**8.2** The licensee will be encouraged to develop a white shark attraction code within 12 months. The code will set out how acoustic attractants will be used to ensure that any environmental impacts detected are managed (and where necessary reduced).

**8.3** The licensee will be required to remove any acoustic attraction device from the water for a period of 15 minutes in the event a white shark bites the device. This limit may be subject to change.

Unless specifically authorised through a licence, the use of a loudspeaker or similar device is not allowed in parks proclaimed under the *National Parks and Wildlife Act 1972* by virtue of Regulation 38(1) of the *National Parks and Wildlife Regulations 2001*. One operator is currently authorised to conduct white shark tourism and projection sound through underwater speakers.

There is no evidence to suggest that the current amplitudes, frequencies and projection methods are likely to cause any significant harm to marine life. However, knowledge about the effects of acoustic attractants on white sharks and other marine species is limited. Therefore a precautionary approach is warranted, and practices will be reviewed if additional knowledge becomes available.

All acoustic attraction equipment and methods will require approval prior to their use. This will ensure that the risk of ingestion by white sharks is minimised. This policy will ensure that the use of acoustic attractants does not impact on visitor experiences. It will also contribute to Recovery Plan objective 5 (see page 3).

## Policy 9 – Adaptive management

**1.** Changes in the residency of white sharks at the North Neptune Islands will be monitored.

**2.** A significant increase in mean white shark residency at this site is defined as the 'Response range'. Restrictions outlined in Policy 6 (number of activity days) and Policy 7.5 (daily fish based attractant limit) may be strengthened should the mean white shark residency at North Neptune Islands fall within the Response range.

**3.** A significant decrease in mean white shark residency at this site is defined as the 'Target range'. Restrictions outlined in Policy 6 (number of activity days) and Policy 7.5 (daily fish based attractant limit) may be relaxed should mean white shark residency at North Neptune Islands fall within the Target range.

**4.** An insignificant or inconclusive change in white shark residency at this site is defined as the 'Caution range'. Restrictions outlined in licence conditions that place limits on Policy 6 (number of activity days) and Policy 7.5 (daily fish based attractant limit) may remain unchanged should white shark residency at North Neptune Islands fall within the Caution range.

In 2013 the South Australian Government initiated a program to monitor white shark residency at Neptune Islands Conservation Park. This program requires the tagging of white sharks and the installation of acoustic receivers that record the arrival and departure patterns of individual sharks. This method enables the estimation of annual trends in white shark residency at the site.

Residency data is compared annually with baseline data collected in 2001-03. For the purposes of this policy, it has been assumed that residency levels recorded in 2001-03 were unaffected by tours, and do not pose a significant risk to the white shark population. Therefore, the 2001-03 levels of mean white shark residency at North Neptune Islands have been adopted as a 'Target range' for management.

Based on the CSIRO's recommendations, it has been assumed that the maintenance or exacerbation of residency levels recorded at the North Neptune Islands in 2010-11 are a risk to the white shark population. Therefore, the 2010-11 levels of mean white shark residency at North Neptune Islands are indicative of when a management response may be necessary. This level of mean white shark residency has been adopted as a management 'Response range'.

Each year, the results of white shark residency monitoring will be reviewed and adjustments made to policies if required. This process will enable the policy to adapt to new knowledge while also providing the opportunity for a relaxation or modification of restrictions should this be prudent. This policy will contribute to; Recovery Plan objectives 5 and objective 9; Recovery Plan actions 5.1, 5.2 and 5.1 (see page 3); and CSIRO recommendations 2 and 3 (see page 6).



## References

- <sup>1</sup> Department of Environment, Water and Natural Resources (DEWNR), *Neptune Islands Group (Ron and Valerie Taylor) Marine Park Management Plan Summary*: DEWNR, Adelaide 2012.
- <sup>2</sup> Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), *Appendix 11 Listing of the White Shark (revision 1)*. [www.environment.gov.au/coasts/publications/gwshark-appendix-2.html](http://www.environment.gov.au/coasts/publications/gwshark-appendix-2.html)
- <sup>3</sup> Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), *Recovery Plan for the White Shark (Carcharodon carcharias)*, SEWPAC, Canberra 2013.
- <sup>4</sup> Last, P. R., & Stevens, J. D. (2009). *Sharks and Rays of Australia (Second Edition)*. CSIRO Publishing, Collingwood, Victoria.
- <sup>5</sup> Department of Environment, Water and Natural Resources unpublished tour records, Adelaide.
- <sup>6</sup> Bruce, B. D., & Bradford, R. W. (2011). *The effects of berleying on the distribution and behaviour of white sharks, Carcharodon carcharias, at the Neptune Islands, South Australia*. Final report to the Department of Environment and Natural Resources. South Australia.
- <sup>7</sup> Department of Environment, Water and Natural Resources (DEWNR) 2016 *Annexure A - Guidelines for the adaptive management of white shark tour licensing*. DEWNR. Adelaide.

## Acknowledgements

This policy has been developed with the assistance of Barry Bruce (CSIRO), Paul Rogers (South Australian Research and Development Institute), Charlie Huveneers (Flinders University), Rodney Fox Shark Expeditions, Calypso Star Charters, Adventure Bay Charters, the Australian Department of the Environment, Primary Industries and Regions SA (PIRSA) and the South Australian Tourism Commission (SATC).



**For further information please contact**

Department of Environment, Water and Natural Resources phone information line (08) 8204 1910,  
or see SA White Pages for your local Department of Environment, Water and Natural Resource office.



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# Policy Annexure A

## Guidelines for the adaptive management of white shark tour licensing

### Introduction

South Australia's White Shark Tour Licensing Policy 2016 establishes a framework for the adaptive management of white shark tour licensing. An adaptive management approach ensures that white shark tours do not impact on white sharks by enabling policies for white shark tour licensing to be refined over time.

This approach is informed by a scientific monitoring program which is undertaken at the Neptune Islands Conservation Park by the South Australian Government. This program records the arrival and departure of white sharks from the Neptune Islands. The comparison of data between years enables trends in the effects of white shark tours to be determined.

As outlined in South Australia's White Shark Tour Licensing Policy 2016, refinements to licensing arrangements may be triggered should these trends reach predetermined 'decision ranges'.

### Measuring the effects of white shark tours on white sharks

The annual mean white shark residency at North Neptune Islands is an indicator of the effects of white shark tours on white sharks. White shark residency is defined as the number of days between the first and last detection of a white shark, without any gaps in detection exceeding five consecutive days (Bruce and Bradford 2013).

Information about white shark residency is collected through the tagging of white sharks and the installation of acoustic monitoring receivers at the Neptune Islands. These receivers record the identification number, time and date each time a tagged white shark enters the detection range of a receiver. This data enables the residency of each tagged white shark that visits the Neptune Islands and the annual mean residency of all tagged white sharks to be determined (Bruce and Bradford 2011).

Any effects that may have occurred as a result of white shark tours prior to 2001-03 cannot be quantified because the residency of white sharks at the Neptune Islands was not studied before this period.

It is assumed that data collected when white shark tours were less frequent, between 2001 and 2003, provides the best available representation of 'natural' residency levels at the Neptune Islands. It is also assumed that the 24 white sharks monitored between 2001 and 2003 were representative of white shark residency at North Neptune Islands at that time.

### Analysis of white shark residency

As outlined in South Australia's White Shark Tour Licensing Policy 2016, changes in licensing arrangements will be considered when there is clear scientific evidence that warrants a response. Therefore it is necessary to identify statistically significant trends in residency while also discounting the influence of the natural variations in mean residency which can be expected to occur from year to year.

This is achieved by analysing the mean and standard deviation of annual white shark residency each year using a method based on the central limit theorem. The central limit theorem states that independent variables tend to be normally distributed, and such data have known properties. For example, normally distributed data have about 68 per cent of their values within one standard deviation of the mean, and about 95 per cent of their values within two standard deviations of the mean.

The properties of a normal distribution curve are used to estimate the probability that the annual residency recorded in any given year has occurred as a result of natural variation, or is reflective of an effect arising from tours or some other factor. Each year data collected is analysed and compared with the 2001-03 baseline data. This enables conclusions to be made about trends in white shark residency at the site.

White shark residency data collected to date are not normally distributed. To enable comparison of results between years, data can be normalised using a  $\log^{10}$  transformation. Consequently, mean residency will be expressed as a  $\log^{10}$  value. Unless otherwise indicated, all  $\log^{10}$  values are presented as  $\pm$  one standard deviation.



## Decision ranges

### Target range $\leq 0.70 \log^{10}$ days

The Target range is the range of mean white shark residency values which are thought to represent an insignificant effect from tours. It is based on the assumption that baseline residency levels in 2001–03 are optimal for the recovery of the white shark. The Target range includes annual assessments of white shark residency that are similar to those observed 2001–03 ( $0.65 \log^{10}$  days). More specifically, it includes all white shark residency values that are less than, or equal to 0.1 of a standard deviation above the 2001–03 baseline mean white shark residency.

A comparison between the Target range and the 2001–03 baseline is depicted in Figure 1 below. The South Australian White Shark Tour Licensing Policy 2016 provides direction should mean white shark residency fall within the Target range.

### Response range $\geq 1.20 \log^{10}$ days

The Response Range includes all mean white shark residency values which are thought to impact on white sharks. It is based on the assumption that mean white shark residency values that are significantly above those observed in 2001–03 may impact on white sharks. The Response range includes annual assessments of white shark residency that are significantly above the 2001–03 baseline. More specifically, it includes all white shark residency values that are more than 1 standard deviation above the 2001–03 baseline.

The Response range is triggered when:

- 1) Level 1 - the mean white shark residency at the North Neptune Islands is between 1 and 2 standard deviations of the 2001–03 baseline ( $1.20$ – $1.76 \log^{10}$  days)
- 2) Level 2 - the mean white shark residency at the North Neptune Islands is more than 2 standard deviations above the 2001–03 baseline ( $\geq 1.76 \log^{10}$  days)

A comparison between the Response range and the 2001–03 baseline data is depicted in Figure 1. The South Australian White Shark Tour Licensing Policy 2016 provides direction should the Response range be achieved.

### Caution range $0.70$ – $1.20 \log^{10}$ days

The Caution range includes annual assessments of white shark residency that are above the Target range and are below the Response range. A comparison between the Caution range and the 2001–03 baseline data is depicted in Figure 1. The South Australian White Shark Tour Licensing Policy 2016 provides direction should the Caution range be triggered.

## References

Bruce BD, Bradford RW (2013), The effects of shark cage-diving operations on the behaviour and movement of white sharks, *Carcharodon carcharias*, at the Neptune Islands, South Australia. Marine Biology 160: 889–907.

Bruce BD, Bradford RW (2011), The effects of berleying on the distribution and behaviour of white sharks (*Carcharodon carcharias*), at the Neptune Islands, South Australia. Final Report to the Department of Environment and Natural Resources, South Australia.

Figure 1

