



SGP 2020: Cabbage Tree Bay Aquatic Reserve

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Introduction

Background: Sydney is Australia's largest city, with more than 5 million residents and growing rapidly at a rate of 1.89% per year. The growth of huge cities often have severe consequences for the biosphere as unsustainable development destroys habitat and the human consumption of animals and plants often leads to massive declines in populations. However, Sydney has an example of an area which has not only survived but flourished in the face of increasing human activity right on its doorstep. Cabbage Tree Bay Aquatic Reserve is one of the most biodiverse areas on the Sydney coast and is a sanctuary for iconic New South Wales species which are threatened in other places such as the Blue Groper, Giant Cuttlefish and Weedy Seadragon. The reserve gives us hope that with proper management, the biosphere can not only survive but thrive alongside humanity.



A Southern Eagle
Ray glides past the
underwater
motorbike in
CTBAR.

Photo taken by Author

Topic

Cabbage Tree Bay Aquatic Reserve (CTBAR) is a marine protected area spanning 20 hectares from the south end of Manly Beach to the northern end of the Shelly Beach headland. It was declared a marine protected area in 2002, augmenting the intertidal protected area which existed at Shelly Beach from 1993. The reserve contains a sandy seafloor made up of biological matter such as shell fragments, rocky reef, seagrass beds, intertidal rocky shores, soft coral and sponge reefs and even tropical hard corals. The reserve's underwater topography is consistent, with a median depth of 8 metres and a maximum of 20. The reserve was established to protect the endangered *Posidonia* seagrasses as well as rare New South Wales species such as the Blue Groper, Black Cod, Weedy Seadragon and Grey Nurse Shark. The beach front and parklands on the boundaries of the reserve are managed by the Northern Beaches Council while the marine boundaries and rocky shores of the reserve are managed by the New South Wales Department of Primary Industries.



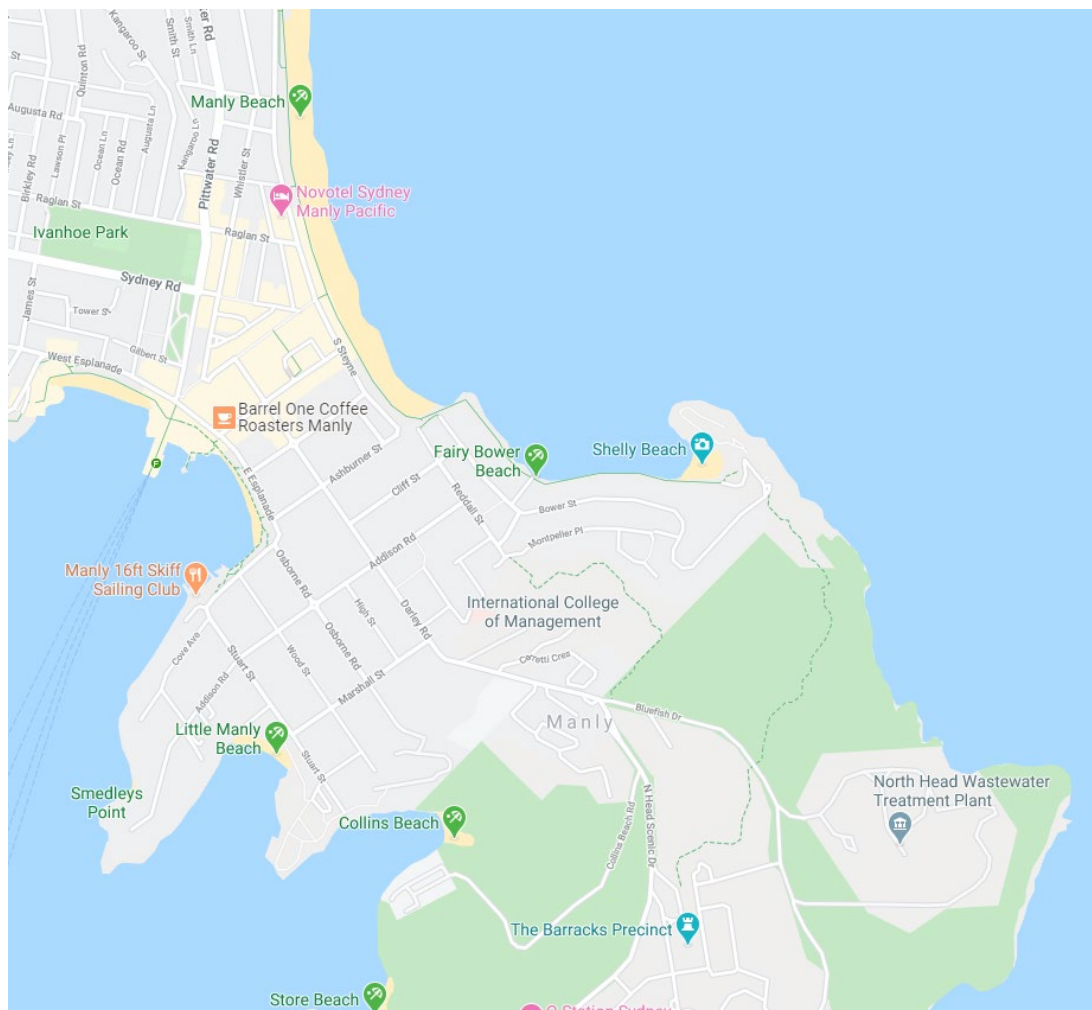
A Spotted Wobbegong sleeps inside a section of discarded piping. *Photo taken by Author*

Scope

The scope of the report is Cabbage Tree Bay Aquatic Reserve and the surrounding businesses and community.

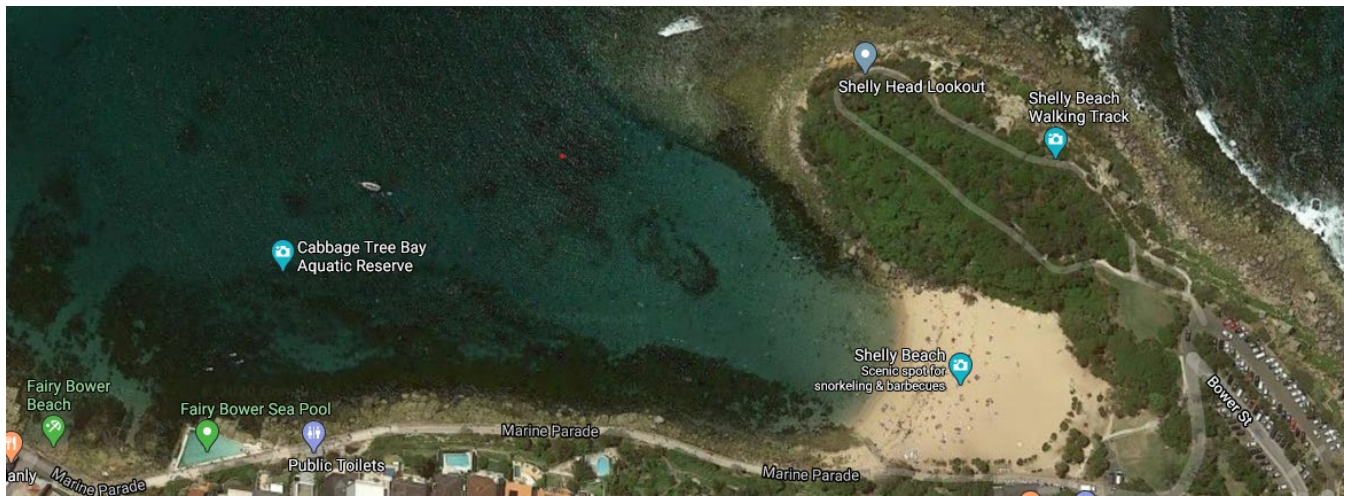
Location

Address: 1 Bower Lane Manly.



Street view Manly Peninsula taken from Google Maps

Scale: 2cm=500m



Vertical Aerial Shot of Cabbage Tree Bay, taken from Google Maps

Scale: 2cm=100m

Aims

This report investigates three inquiries which were chosen as the research basis for the report:

Inquiry 1:

- Discuss the nature of Cabbage Tree Bay Aquatic Reserve

Inquiry 2:

- Analyse the reserve restrictions.

Inquiry 3:

- Evaluate the response of individuals, community and government to the reserve.

Hypothesis

Inquiry 1:

Cabbage Tree Bay Aquatic Reserve is enjoyed by a range of users. It's sheltered location from strong easterly, southerly and northerly winds and its subtidal range of habitats has resulted in rich biodiversity.

Inquiry 2:

The reserve restrictions have allowed Cabbage Tree Bay Aquatic Reserve to become an important site for pelagic species as a nursery ground. In addition, the restrictions have allowed large species to grow when compared to other sites. Moreover, the reserve due to its restrictions is less polluted than other sites. However, the eastern boundaries of the reserve are poorly defined and vulnerable to illegal fishing and would benefit from improved signage.

Inquiry 3:

Due to its status as a popular site for viewing iconic species, Cabbage Tree Bay has become important to the local community as well as benefiting nearby watersport, ecotourism, eating places and retail businesses.

Methodology

Primary data includes:

1. Observations of keystone species, measurement of water temperature and facilities in CTBAR.

Purpose and rationale: To undertake an observation count of species, scrutinise behaviour of species, and measure water temperature. Purpose was to test whether CTBAR had observable keystone species, which can be an indicator of ecosystem health. Water temperature was also checked, which is another feature of the reserve. Species was also observed in Clifton Gardens. Clifton Gardens was chosen as a comparison site for this research, given it is also protected from most ocean swell, and it is easily accessible.

When: 17/4/20 11am – 2pm; 26/4/20 11am – 2pm, 3/5/20 11am – 2pm, 6/6/20 11am-2pm and 13/6/20 11am – 2pm.

Where: Conducted within the boundaries of the reserve.

Method: Observations were conducted underwater using SCUBA equipment (Photo 1), using a dive slate to tally species, an Olympus TG5 with underwater casing to take photographs and film marine life, and an oceanic geo 2 dive computer to gauge water temperature. Photos and film were downloaded to a laptop and species tallies data was transferred to an excel worksheet.



Photo 1: Author in SCUBA gear with Olympus Camera

2. Mapping of research sites

Purpose and rationale: Maps were completed of North Harbour, CTBATR and Clifton Garden to illustrate topography of research sites.

When: May 17th.

Where: Map sites and home.

Method: Map content was based off scuba dives, observation and online maps. Maps were drawn with pencils.

3. Surveys of users of research sites

Purpose and rationale: Questionnaires obtaining quantitative and qualitative data identifying demographics of reserve users, use of/and attitudes towards the research site of CTBAR and comparison site of Clifton Gardens.

When: Survey was opened on May 7 for CTBAR survey and May 17 for Clifton Gardens. Surveys were closed on June 16th.

Method: Survey created on google forms and was distributed to users of the Facebook groups Dive Centre Manly Dive Club and Sydney Dive Visibility Group and had 60 respondents and 11 respondents respectively.

4. Interview One



Richard Nichols, business owner of Dive Centre Manly, environmentalist and lobbyist (Photo obtained from Manly Dive Centre website)

Purpose and rationale: This interview was with Richard Nichols, business owner of Dive Centre Manly, environmentalist and lobbyist. The aims of this interview was to understand the history of the reserve, the main ecological and business changes that have been observed, including major threats.

Where: Part one was conducted at Dive Centre Manly, 10 Belgrave Street, Manly. Part two was conducted via the phone

Method: First part of the Interview was conducted face to face and recorded on the report author's phone and later transcribed. Part two was via a telephone call and recorded, and later transcribed.

5. Interview Two

Purpose and rationale: This interview was with Nays Baghai, an environmentalist, independent filmmaker and underwater cameraman. The aims of this interview was to understand if the reserve had the depth of fish density and biodiversity suitable for underwater filmmaking.

When: 17th May.

Where: Via Facebook messenger.

Method: Questions sent and received via Facebook messenger.



A Crested Horn

Shark at CTBAR.

Photo taken by Author

Secondary Data includes:

6. Report 1

Report Title: Cabbage Tree Bay Management plan, published in October 2000

Retrieved: Personal copy of Richard Nichols, provided on loan for the purpose of this report.

Purpose: To review the background and reasons behind the establishment of the Cabbage Tree Bay Aquatic reserve including the restrictions in place. Report provides a marine species list as at 2002. To be used to compile species list (Appendix A, Table 3) comparison and research findings and conclusion.

7. Report 2

Report Title: Cabbage Tree Bay Aquatic Reserve Draft Fisheries Management (Aquatic Reserve) Regulation 2009 and Implementation Strategy, published in March 2010

Retrieved: NSW Department of Planning, Industry and Environment website

Purpose: To review the recommendations for fishing restrictions for CTBAR. Provides updated summary of threats to the reserve. To be used in research findings and conclusion

8. Report 3

Report Title: Harbour Watch State of the Beach Report

Retrieved: NSW Department of Planning, Industry and Environment website

Purpose: To examine sewerage levels and water quality at CTBAR. To be used in research findings and conclusion

9. Report 4

Report Title: Northern Beaches Annual Report 1st July – 30th June 2019

Retrieved: Northern Beaches Council website

Purpose: To assess the impact of CTBAR on costs and revenue for local government. To be used in research findings and conclusion

10. Report 5

Report Title: Implementing a triple bottom line approach to monitor the impacts of tourism in Manly.

Retrieved: Western Sydney University Website

Purpose: To examine the infrastructure required to manage the CTBAR. To be used in research findings and conclusion

11. Report 6

Report Title: Manly Tourism Precinct: Visitor Profile

Retrieved: Destination NSW Website

Purpose: To assess the profile of visitors to Manly for the year ended (YE) March 2019, as well as visitation trend information for Manly. To be used in research findings and conclusion

12. Media Article 1

Article Name: Illegal Fisherman Confronted over Illegal Dusky Whaler Death

Retrieved: 1/7/20 from Daily Telegraph Website

Purpose: Discusses illegal fishing at CTBAR. To be used in research findings and conclusion

13. Media Article 2

Article Name: The Story Behind Australia's Marine Reserves, and How We Should Change Them.

Retrieved: 20/3/20 from The Conversation Website

Purpose: Discusses Australia and New South Wales's marine reserve model and the flaws of the model. To be used in research findings and conclusion

14. Media Article 3

Article Name: Marine Parks Phase 3 Consultation Commences: Local Changes Detail.

Retrieved: 15/4/20 from Pittwater News Online website

Purpose: Reports on the consultation period initiated by the NSW Government to extend the Cabbage Tree Bay Aquatic Reserve to include Blue Fish Point

15. Article 1

Article Name: Best Fishing Spots Sydney

Retrieved: 5/3/20 from The Urbanlist Website

Purpose: Discusses Sydney's best recreational sites highlighting the inclusion of Clifton Gardens and also emphasising the popularity of recreational fishing

16. Article 2

Article Name: Cabbage Tree Bay

Retrieved: 5/3/20 from the Sydney.com website

Purpose: This site gives recommendations for tourists on best destinations, and summarises CTBAR's attractions

17. Marine Park Report Extracts and Websites 1

Report Extract: Cabbage Bay Aquatic Reserve

Retrieved: 5/3/20 from NSW Department of Primary Industries Website

Purpose: Outlines CTBAR's park purpose, boundaries and restrictions.

18. Marine Park Report Extracts and Websites 2

Report Extract: Aquatic Reserves

Retrieved: 5/3/20 from NSW Department of Primary Industries Website

Purpose: Lists Marine Protected Areas in Sydney

19. Marine Park Report Extracts and Websites 3

Website: Fish of Cabbage Bay Tree Aquatic Reserve

Retrieved: 4/3/20 from Cabbage Tree Bay Aquatic Reserve Website

Purpose: CTBAR website was created in 2002 and has lists all marine species that have been observed at CTBAR. Using a network of Marine biologists and local experts it also identifies unknown species. The marine species identification was used to assist in completing a species table (Appendix A, table 3), supplementing information found in the Cabbage Tree Bay Management plan, Observation of Key Species and information compiled from the surveys

20. Marine Park Reports Extracts and Websites 4

Species Profile: Dusky Whaler, *Carcharhinus Obscurus*; Eastern Blue Groper, *Achoerodus Viridis*; Spotted Wobbegong, *Orectolobus Maculatus*

Retrieved: 4/3/20 from Australian Museum Website

Purpose: Gain scientific information on the species used in this research

21. Marine Park Reports Extracts and Websites 5

Species Profile: Banded Wobbegong, *Orectolobus Halei*

Retrieved: 4/3/20 from Fishes of Australia Website

Purpose: Gain scientific information on the species used in this research

22. Marine Park Reports Extracts and Websites 6

Website: Sharksmart NSW beaches

Retrieved: 20/3/20 from Sharksmart NSW Website

Purpose: This site lists the NSW shark mitigation strategy for NSW. Its relevance for this report is that removal of sharks from their natural habitat can be a threat to marine reserves.



A “ball of
Striped
Catfish
*Photo taken
by author*

Research Findings

Inquiry 1

Background: The reserve was declared on 22 March 2002 under section 194 of the Fisheries management Act 1994, following recommendations taken from the Cabbage Tree Bay Management Plan-Supporting Document (2000). The reserve is approximately 20 hectares in size and was declared for the purpose of conserving biodiversity. The Cabbage Tree Management plan listed the following objectives:

1. Enhance the conservation and marine biodiversity
2. Reduces risks to identified habitats of the bioregion
3. Promote marine ecotourism in the bio region
4. Enhance the intrinsic benefits derived by the community from the marine estate
5. Reduce Conflicts between users of the marine estate
6. Enhance opportunities for scientific research, education and learning
7. Provide baseline monitoring areas (scientific reference sites)
8. Promote stewardship of the marine estate

Cultural Heritage: Cabbage Tree Bay Management Plan-Supporting Document (2000) states that CTBAR has important heritage significance for both Indigenous and European people. The plan goes onto conclude that there is evidence of occupation of Indigenous people (Guringai tribe) in the area with a shell midden (accumulation of shell used by Indigenous people to collect food) being found in the park area. The name Cabbage Tree Bay was named by the European settlers after the Cabbage Tree palms which grow around the beach.

Geographical Context: CTBAR is located in the suburb of Manly. It spans from the South Steyne of Manly to Dead Man's Point. From the Manly Wharf to Shelly Beach it is 1.6 kilometre walk, and to the other end of the reserve South Steyne, it is a 600metre walk.

There is a carpark at Shelly Beach, and a road to Fairy Bower Beach.

The facilities at Shelly Beach include benches designed for divers and recreational visitors, cafes and public toilets and showers.

Observation and research (Diagram 1) found the reserve contains sandy seafloor, seafloor made up of biological matter such as shell fragments, rocky reef, seagrass beds, intertidal rocky shores, soft coral and sponge reefs and even tropical hard corals. The location of the headlands provides protection; it is sheltered from strong easterly, southerly and northerly winds. In addition to natural features, man- made items have also been assimilated into the reef. There is a man- made saltwater pool located at Fairy Bower Beach. As shown in Diagram 1 there is a motorbike located in eight metres of water in the middle of the bay.

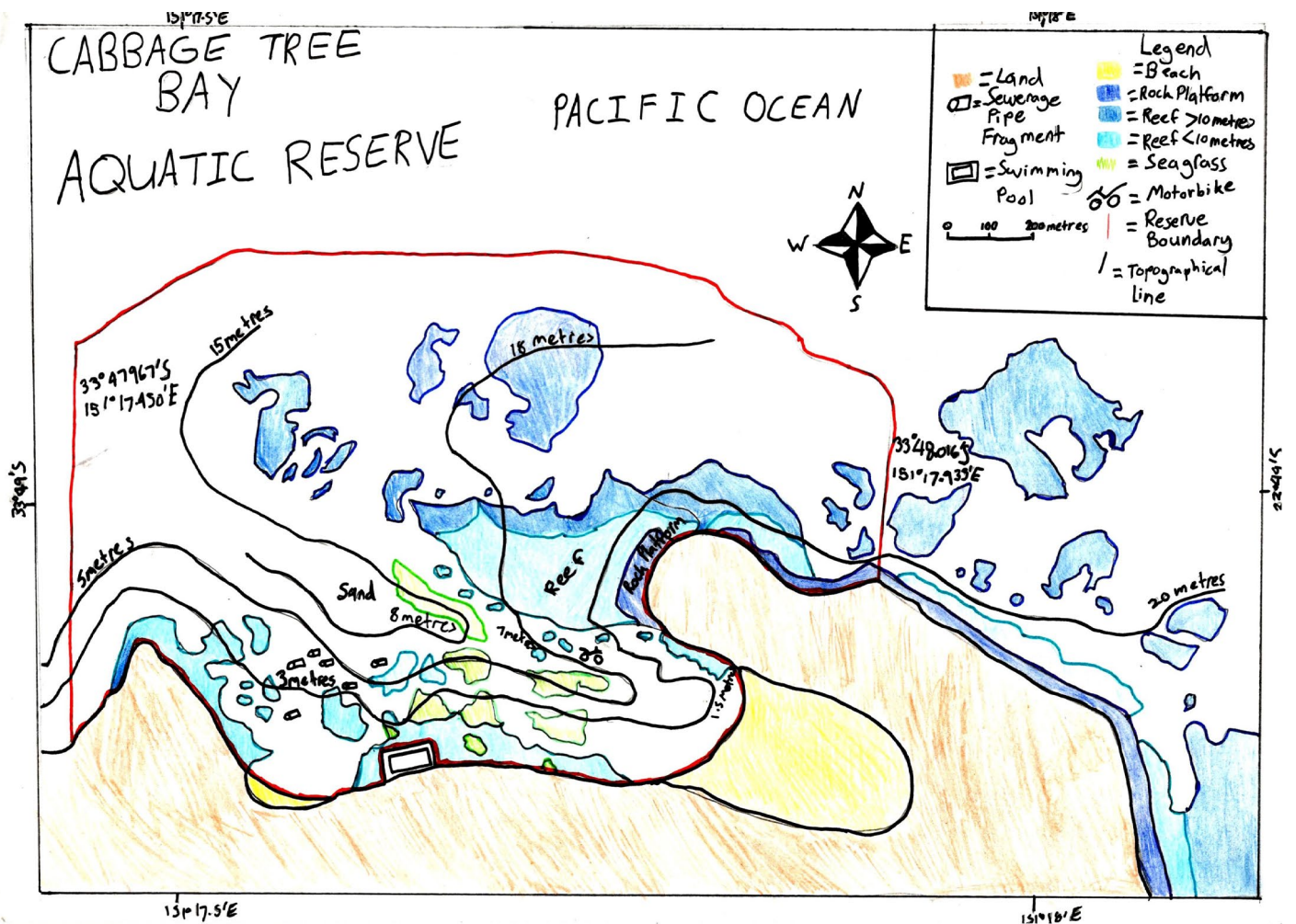


The Shelly Beach motorbike.

Photo taken by author

The reserve's underwater topography is consistent, with a median depth of 8 metres and a maximum of 20.

Diagram 1: Map illustrating Cabbage Tree Bay Aquatic Reserve

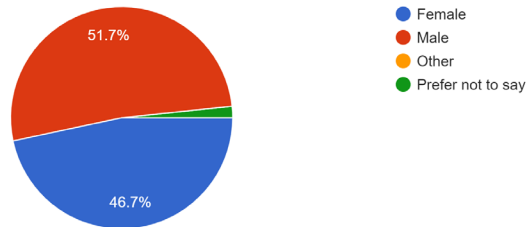


Data collected in Observations of keystone species and measurement of water temperature in CTBAR (Appendix A, Table 2) indicated the water temperature readings ranging from 17-23 degrees Celsius.

Marine Life: According to Cabbage Tree Bay Management Plan-Supporting Document (2000) there were 160 species of fish that were present when the reserve was created. Research indicates that there are now 303 fish species present (Appendix A, Table 3)

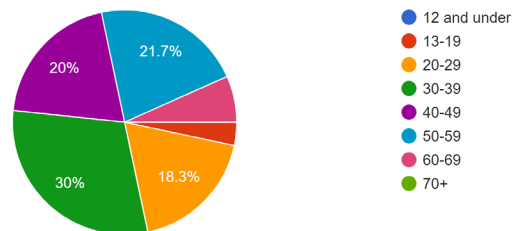
Who uses CTBAR: Surveys of users of research sites found the following:

Gender
60 responses



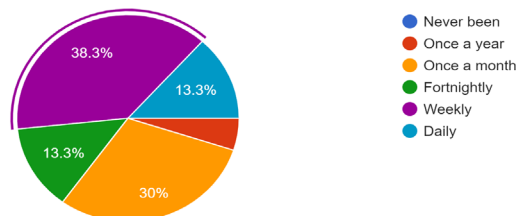
Survey data indicates that the gender split of visitors was slightly skewed to males

Age
60 responses



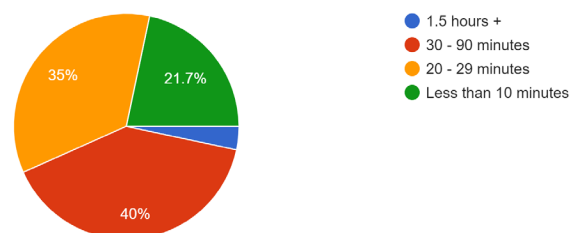
50% of survey respondents were aged between 30-49 years

How often do you use Cabbage Tree Bay Aquatic Reserve?
60 responses



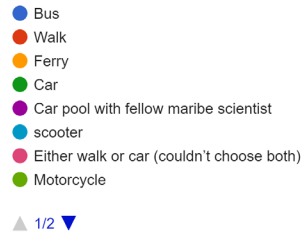
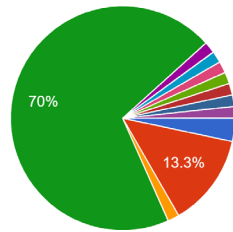
Over 80% of survey respondents visit the reserve at least monthly or more frequently

Do you live nearby to Cabbage Tree Bay ?
60 responses



Nearly all survey respondents lived within 1.5 hours of the reserve

How do you get to Cabbage Tree Bay?
60 responses



70% of respondents
drove to the reserve;
less than 10% used
public transport

Inquiry 2

CTBAR has a boundary which runs from 100 metres off South Steyne of Manly Beach to 100 metres off Deadman's Point.

Table 1: Cabbage Tree Bay Aquatic Reserve Permissible Activities, taken from Cabbage Tree Bay Management Plan (2000)

	Boating	Anchoring	Line Fishing	Spear Fishing	Lobster Fishing	Abalone Fishing	Scuba Diving and Snorkelling	Hand Gathering	Collecting Marine Vegetation	Commercial Fishing
2002	A	A	A	A	A	A	A	A	A	A
2020	A	NA	NA	NA	NA	NA	A	NA	NA	NA

A=Allowed
NA=Not Allowed

As shown in Table 1, the reserve restrictions prohibit all forms of recreational and commercial fishing, collection of intertidal and marine organisms, anchoring and touching and feeding of any marine creatures. However Aboriginal cultural activities are still allowed.

Data gathered from interviewees and survey respondents indicated changes in species density and biodiversity since the reserve restrictions were put in place.

Richard Nicholls commented:

“The change has been very dramatic. Certainly with the amount of large fish there so the fish density, was extraordinary in Shelly Beach now, basically there is 20 times more larger fish, the fish are 20 times larger but the density is 20 times more than any other comparable place in Sydney, and also because it is serving as a breeding ground now there is huge biodiversity there because the edible fish, the flatheads, the breams, that aren’t being fished out there is a much more balanced eco system. “

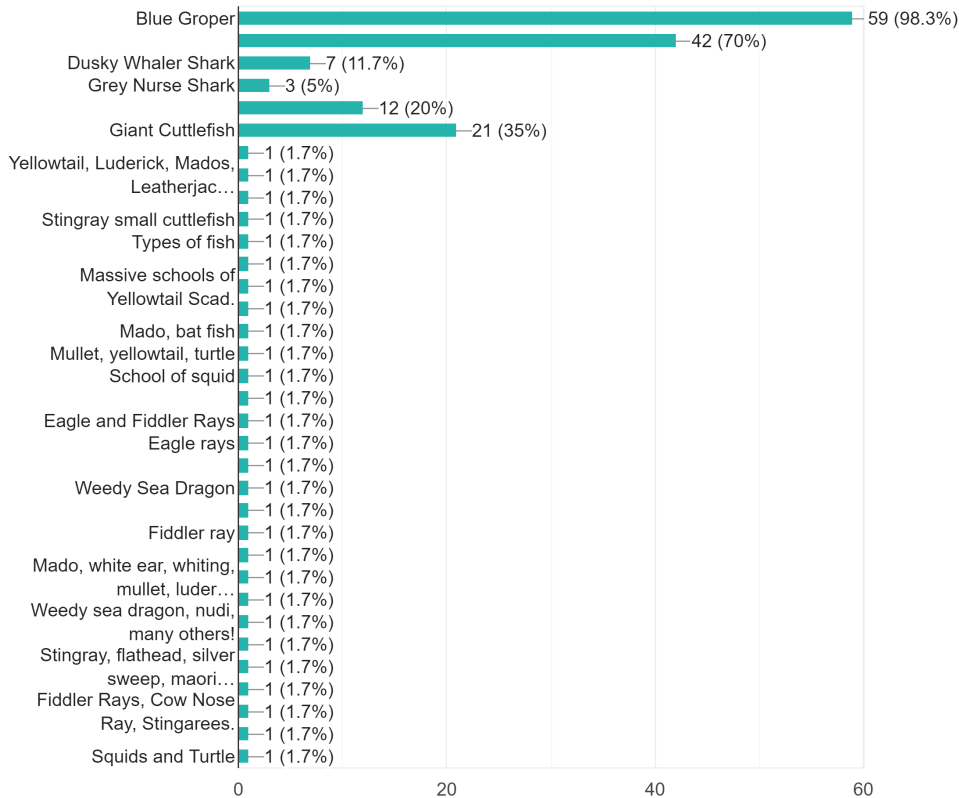


A large male Blue Groper.

Photo taken by author

If you are a scuba diver, swimmer, freediver or snorkeler which of these species did you see when you last visited the reserve?

60 responses



98% of survey respondents sighted a Blue Groper on their last visit to the reserve and 74% had stated they had seen a Wobbegong species.

A species list

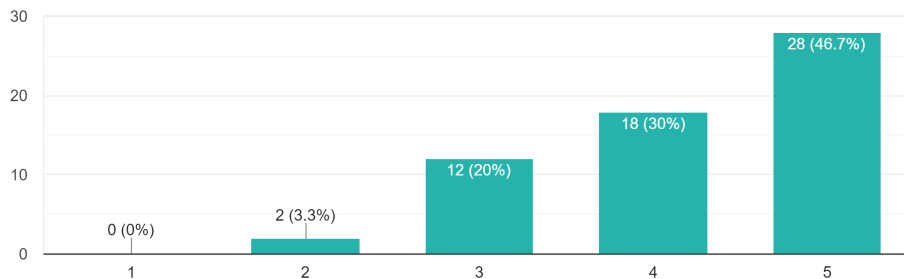
was compiled (Appendix A, Table 3) using data from Cabbage Tree Bay Management plan (2000) surveys, Observations of Keystone Species , and fish sightings compiled in the Cabbage Tree Bay Aquatic Reserve ecology web site In 2002 there were 160 species recorded at the site, in 2020 this has grown to 303, a 190% increase. This species list also highlighted that there has been an increase in pelagic and tropical fish families; notable examples are the 15 species of *Chaetodontidae* (Butterflyfish) and the 9 species of *Carangidae* (Trevally).

The reserve has become a nursery ground for pelagic species; all dusky whalers (a pelagic species) observed were below 2.6 metres long (the size at sexual maturity).

Richard Nicholls stated:

“Because there is large populations of yellow tail scad there, which is their natural food, you see those (Dusky Whalers) and you see more sightings of grey nurse sharks than we have done since the mid 80s.”

To what extent do you agree with the statement "Cabbage Tree Bay has superior marine biodiversity to other coastal marine sites in Sydney"
60 responses



Survey respondents also indicated biodiversity was superior at CTBAR compared to other sites.

Research also encompassed a comparison site, Clifton Gardens in Chowder Bay. This was chosen because it is a calm, easily accessible site. Research also indicated this was a popular fishing site. Urban list listed Clifton Gardens in their top fishing site recommendation as shown below.

Excerpt from April 2018's Urbanlist "Top 11 fishing Spots in Sydney"

Clifton Gardens

PORT JACKSON

One of the most picturesque spots in Sydney to fish has to be [Clifton Gardens](#). The huge public pool attracts hordes of beachgoers, so our advice is to head out on the jetty and past the pool in the early morning, then cast off into the deep waters. Another option is to set up along the parklands, esky by your side (obviously).

Type: Bank and jetty fishing

Catch: Trevally, Bream, Yellowtail, Kingfish

Best time: Early morning



Small animals
like this
Nudibranch sea
slug are
common at
Clifton Gardens.

*Photo taken by
author*

Richard Nicholls observed:

"Correct. So, there is a balanced ecosystem so there is different types of predators for all the fish there so the population is really balanced. Like other places for example like Chowder

Bay would be a fantastic example where there is amazing macro life but that is because all of the predators have been taken. So even though it is a great site to go and see small stuff it is really a good indication of an ecosystem that is actually completely out of control. Because there is a lot of fishing pressure there because it is a very easily accessible site and safe so it is very popular with fisherman, so although some people tend to blame the fisherman, you can't blame them, because it is a very safe and easy site for them to go compared to the dangers of rock fishing."

There was zero large fish species identified in the research at Clifton gardens.

Research also indicated that pollution was a serious issue prior to the reserve's creation.

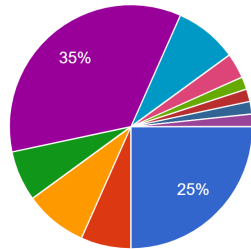
Richard Nicholls commented:

"First before it was a Marine Reserve there was very little marine life, there was an area that was heavily fished, and also we had a lot of pollution from North Head, because in those days, there was the North Head Sewerage Plant, pumped raw sewerage straight into the ocean, it used to sweep all round North Head and be at the front of Manly beach and also very high levels of sewerage in Cabbage Tree bay."

In the Harbour Watch State of the Beaches report (Appendix A, Figure 2) sewerage levels lowering was reported. The report indicated that Sydney Water and Manly Council had completed works to disconnect illegal sewer connections to the stormwater system and had diverted overflow points to prevent discharge entering Cabbage Tree Bay.

Survey respondents also indicated other forms of pollution, such as plastic and shark nets to be a threat to the reserve.

What do you believe is the biggest threat to the reserve?
60 responses



- Plastic Pollution
- Other pollution (sewerage, ash, toxins)
- Overcrowding
- Illegal fishing
- Potential loosening of reserve restricti...
- Climate Change
- Nearby shark nets and drumlines
- Over fishing

25% of survey respondents indicated plastic pollution was a threat

Secondary research indicated that illegal fishing still occurs, with Dusky Whalers among other species being targeted. This was ratified by Richard Nicholls:

“Well the threats to the reserve is undoubtedly fishing pressure, so it is illegal fishing in the reserve is really it’s biggest threat, and the other threat in a way is its size of the sight. Because it is only really very small, considering there is very little marine protection in Sydney. It would be a great benefit to the whole community if it was larger.”

Cabbage Tree Bay Aquatic Reserve Draft Fisheries Management (Aquatic Reserve) Regulation 2009 and Implementation Strategy (2019) also highlights climate change as a threat to the reserve due to higher ocean temperatures, rising sea levels and ocean acidification. However, they were not able to assess the impact of climate change on the smaller scale that exist for CTBAR.



Yellowtail Kingfish,
a species in the
Carangidae family,
now common in
CTBAR.

Photo taken by author



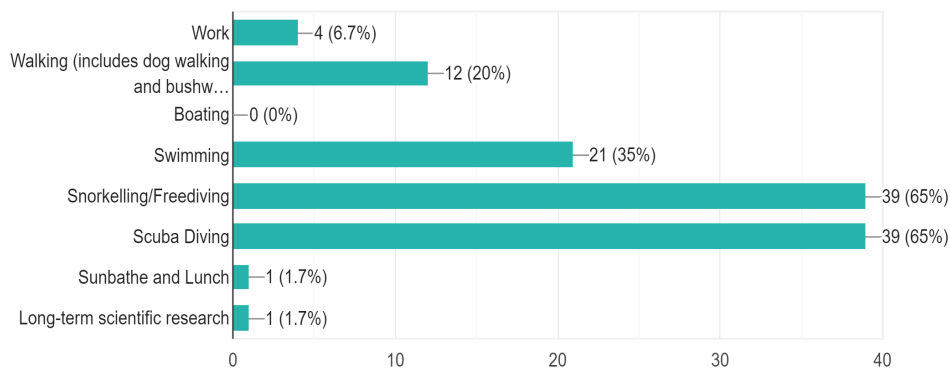
Tropical
Butterflyfish have
become a common
sight at CTBAR.

Photo taken by author

Inquiry 3

Research indicated that CTBAR is used by the community for many activities

Why do you visit Cabbage Tree Bay?
60 responses



Survey respondents indicate that water activities were the popular activities

Tourism delivers economic and social benefits, as shown in a 2007 study by The University of Western Sydney (Appendix A, Figures 4, 5 and 6) which interviewed 5000 residents in Manly to understand the social and economic impacts of tourism in Manly. Furthermore, the survey found that overall tourism delivers economic and social benefits. Furthermore, it also found that the activities that are enriched by having an aquatic reserve, such as snorkelling and scuba diving, were highly valued amongst Manly residents and visitors.

The number of tourists visiting the area is growing. Data sourced from Destination NSW (Appendix table 3) indicated that on average, the total number of visitors to Manly over the past four years was 2.4 million per annum. The total number of visitors to Manly in YE

March 2019 was above its 4-year average (8% higher). Over the last four years, the total number of total international and domestic visitors to Manly increased by 18%.

Richard Nichols said of the impact of CTBAR on tourism and local business:

“It’s more than just diving; Shelly Beach is also big for snorkelling. Diving wise, oh my God, what % of divers would be tourists? I’m trying to give you an accurate answer. For courses probably 50% of the courses, are run for tourists. I’d probably say half. Obviously at this point 100% of the divers are local. It does attract divers from interstate, so they think while they are here they will dive at Shelly Beach. Maybe about 5%; there are people there who dive there because it is a marine reserve who wouldn’t normally dive there.

Yeah, there are two flourishing cafes there that weren’t there before , there is a very big club which swims in the bay, and does it mainly because it is a protected area and it is so fantastic, there is a pop up café in the surf club and there are a couple of stand-alone snorkelling businesses that weren’t there beforehand . And there is obviously a spin off if it is bringing people to Manly for the day. That’s take away food or cafes and things, cups of coffees, increased revenue from the carpark.”

Nays Baghai confirmed that CTBAR is popular for underwater filmmaking:

“1. Very important. The abundance of marine life is crucial for underwater filmmaking. If a site is overfished, it quickly drops down in the ranking of good dive sites to film at.

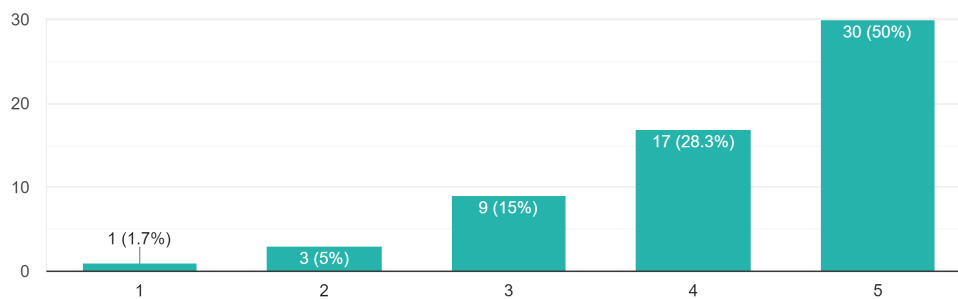
2. CTB is a very accessible dive site. It’s a short drive, you don’t need a boat, the surface swim is short, there’s a variety of landscapes and marine life, and it directly faces the Pacific Ocean.”

Understanding some of the indirect financial benefits of supporting tourism is also indicated upon analysing the financial reports for northern beaches council (Appendix A, Table 4, page

122), which indicates that income \$14m a year is earned from parking in the Northern Beaches area

Research through surveys indicate that response to the reserve is positive.

To what extent do you agree with the statement "the marine reserve is economically important and supports local businesses"
60 responses



Over 70% of respondents believe that the reserve is economically important and supports local businesses

Research also indicated that the community is also lobbying for the expansion of CTBAR as evidenced in interviews as well as the community consultation process which is being run by the NSW government. The New South Wales government's response to the reserve has been less consistent. The perceived danger of shark attacks has caused the New South Wales government to respond by placing shark nets and drumlines along Manly beach, which has somewhat been caused by the increased number of sharks visiting nearby CTBAR. However, the shark mitigation equipment also threatens sharks which live in CTBAR due to its vicinity to Manly Beach and was highlighted as a risk to the reserve by survey respondents. However, the NSW government has continued to maintain the reserve

boundaries and signage, as well as enforcing those boundaries as seen through the DPI (Department of Primary Industries) website.

Conclusion

Inquiry 1

Inquiry: Discuss the nature of Cabbage Tree Bay Aquatic Reserve.

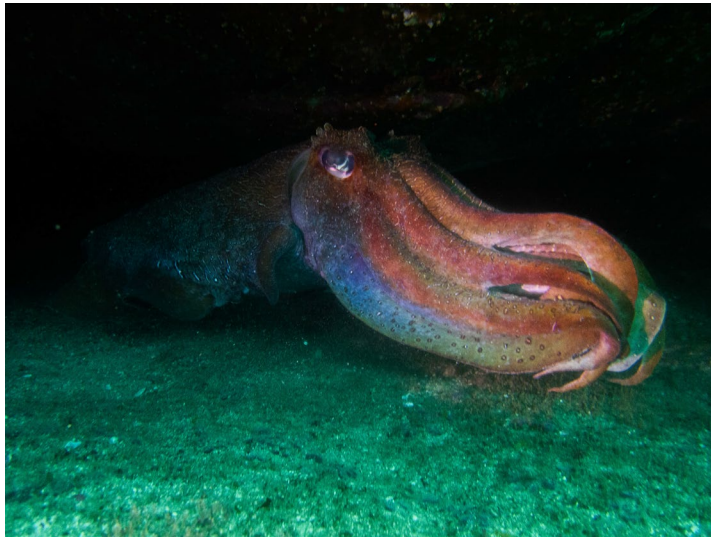
Hypothesis: Cabbage Tree Bay Aquatic Reserve is enjoyed by a range of its users. It's sheltered location from strong easterly, southerly and northerly winds and its subtidal range of habitats has resulted in rich biodiversity.

Conclusion: The research findings indicated that CTBAR is thoroughly enjoyed by the community. It is not as accessible as thought, with public transport not being used by most survey respondents to get to the reserve. This raises concern for less able members of the community wanting to visit the reserve. Interviewees and survey respondents praised CTBAR for its safe and protected aspect from southerly, easterly and northerly winds. The reserve was found to have a diverse range of habitats. The habitats are very diverse for a 20-hectare area. Sandy seafloors, comprised of both silicone and shattered shells, intertidal rocky shores, seagrass meadows made up of the rare *Posidonia* genus, rocky reefs which contain a rich range of brown kelp and crayweed species, deeper rocky reefs with a

covering of ascidians, soft corals, sea fans and sponges and even a bed of tropical hard corals establishing a foothold far south of its normal range. Human influence is also present in these habitats with a large number of former sewerage pipe assimilating into the rocky reef surroundings. There is even a trail bike suspended in 8 metres of water in the middle of the bay. There are a fabled three motorbikes, however only 1 was found in the research. These habitats and artificial reefs support a huge biodiversity, with 303 species of fish being recorded in research. These species contain some of the most iconic and threatened species in New South Wales, the Blue Groper, Black Cod, Grey Nurse Shark, Elegant Wrasse and Weedy Seadragon. As well as iconic fish sea turtles are regularly sighted within the reserve, as well as perhaps the world's most iconic Cephalopod, the Australian Giant Cuttlefish. This huge range of species is a massive draw to visitors of the reserve, especially the large and curious Blue Gropers of the reserve.



Green Sea Turtle at CTBAR.



The iconic Australian Giant
Cuttlefish.

Photo taken by author

Inquiry 2

Inquiry: Analyse the reserve restrictions.

Hypothesis: The reserve restrictions (boundaries and rules) have allowed Cabbage Tree Bay Aquatic Reserve to become an important site for pelagic species as a nursery ground. In addition, the restrictions have allowed large species to grow when compared to other sites. Moreover, the reserve due to its restrictions is less polluted than other sites. However, the eastern boundaries of the reserve are poorly defined and vulnerable to illegal fishing and would benefit from improved signage.

Conclusion: The boundaries of Cabbage Tree Bay Aquatic Reserve have allowed for a healthy ecosystem to develop. The keystone species used for the research were all common. The presence of keystone species are an indicator of good biodiversity. Compared

to the other research site, Clifton Gardens which had a complete absence of keystone species and has no reserve restrictions, Cabbage Tree Bay Aquatic Reserve has an extremely healthy ecosystem. Keystone species are usually large slow growing species vulnerable to fishing and also occupy a position high on the food-web. The reserves restrictions have allowed these species to grow to adulthood in a safe area. One of the keystone species, the Dusky Whaler is a mainly pelagic species. It is a large, generalist apex predator, growing up to 4.2 metres long. In order to reach its size at sexual maturity, 2.6 metres, it must live for at least 17 years. The slow growing nature of the Dusky Whaler means it is extremely vulnerable to fishing. However, CTBAR has been utilised by the species as a nursery ground, the reserve boundaries making it possible for the species to use it as a safe haven. CTBAR is also a clean beach, its restrictions helping to prevent the discarded fishing gear which so often plagues other beaches. The restrictions at CTBAR have been mostly successful, however its eastern boundaries are poorly defined, and illegal fishing does take place within the reserve. The reserve could benefit from more signage around Deadman's Point, as it is located close to popular rock fishing and spearfishing spots at Bluefish Point. Evidence also indicated that the restrictions have successfully reduced sewerage pollution but plastic pollution is still a threat.



Juvenile Dusky Whalers use CTBAR as a nursery ground. *Photo taken by author*

Inquiry 3

Inquiry: Evaluate the response of individuals, community and government to the reserve.

Hypothesis: Due to its status as a popular site for viewing iconic species, Cabbage Tree

Bay has become important to the local community as well as benefiting nearby water sport, ecotourism, eating places and retail businesses.

Conclusion: CTBAR has become an extremely popular site for water-based recreation, and thus the community has responded very positively. The community has made the reserve a very important factor for businesses which surround it, the cafes and water sports businesses that are nearby to the reserve benefit greatly from the high visitor traffic within the reserve. Interviewees and survey respondents stated that the reserve is a high draw for local and visiting divers and a popular training ground for scuba divers. The reserve is a factor in the popularity of visitors to the Manly area. The local government has gained financial and social benefits from the reserves creation and thus has maintained a highly positive response to the presence of the reserve. However, the response of the state government who oversees and is responsible for the protection of the reserve has been mixed. While they have continued their commitment to policing the reserve, they have deployed shark nets and drumlines very close to the reserve, which jeopardises the otherwise safe haven that sharks are given by the reserve

Evaluation

The collection of data for this report was interesting and enjoyable. The conclusions formed in the report are based on the primary and secondary information that was collected and investigated. This process was not without its challenges which included:

Research Process: While much of the research process was problem free, the counting of keystone species would have benefitted from more dives and an improved counting system to avoid repeated sightings of individual animals, as without this system much of the data may be considered invalid. Further, the nature of wild animals made it difficult to get accurate numbers as animals which live in the reserve can move in and out of it, making it difficult to get accurate data without a tagging system. Additionally, it was easier to sight the more courageous species, shy and skittish species, such as the Dusky Whaler were more difficult to observe. Furthermore, it was impossible to observe all species that may have been present in CTBAR, due to factors such as the duration of dive and seasonal migrations. For example, some species are easier seen at night. Considering these factors, it was essential to augment and further validate the observation and survey primary research with the fish species observations sourced through secondary research sources such as Department of Primary Industries and the Fish of Cabbage Tree Bay Aquatic Reserve information website.

COVID 19 restrictions: During the first stage of the quarantine period, it was very difficult to collect data because there were Council Rangers patrolling the area, limiting activities and time spent at the Reserve. In addition to this, the research comparison site was changed

from Long Bay to Clifton Gardens as a result of the restrictions on travel during the quarantine period. This did not impact the final research outcomes as Clifton Gardens proved to be a reliable comparison site, due to its accessibility, its sheltered location and absence of any marine protection laws. This enabled a comparison of the impacts of marine reserve restrictions.

The pandemic made it impossible to survey reserve users on site as social distancing guidelines at the time of research prohibited this. Initiating online surveys partly mitigated this, however the survey respondents were heavily skewed towards divers. Long form interviews, and the use of secondary sources such as tourism and council data allowed other community responses and attitudes towards the reserve to be incorporated in the report evaluation.

No response to requests for information: The NSW Department of Primary Industries, Manly Chamber of Commerce, Manly Environment Centre and Northern Beaches Council all did not respond during the Step four research period. All but the Manly Environment Centre did respond, however none of the research questions were answered by them, with only the NSW Department of Primary Industries giving useful information. This had minimal impact on the report conclusions, however it had a major impact on the research plan and scheduling. As it became more certain that their responses could not be relied on, a second interview was organised with Richard Nichol to obtain more information as part of the primary research plan.

Ethical Considerations

The research process and approach to the compiling report writing took the following ethical factors into consideration:

Private Data Collection: The ethical concern of privacy of data collected about survey respondents was addressed. Only senior IGS (International Grammar School) staff members and the author had access to the email addresses of respondents, and this was made aware to the respondents. If they were not comfortable with this, they could choose to omit private information. Additionally, it was optional for respondents to leave personal details such name and gender on the survey. The use and purpose of their responses was also clearly disclosed to them.

Safety of Animals and Respect of Marine Reserve Rules: No animals during the course of the research were harmed by the author. As per the rules of CTBAR no animals were killed, removed from their habitat, fed or touched. Additionally, no animals were chased, intimidated or harassed during the course of photography and filming for research. The sea floor beds were not disturbed, and no rubbish was left on site and all reserve restrictions were fully complied with. Safe diving procedures were followed.

Respecting COVID 19 Guidelines: During the course of research social distancing guidelines were followed.

Pre obtained Information and bias: Findings were limited only to information and viewpoints gained throughout the course of this research project, while excluding pre obtained knowledge, biases and information. All conclusions were drawn from data obtained from this research.

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Note: All pictures in report are taken by the author unless otherwise stated.

Appendix A, Detailed research outputs:

Table 1: Summary of Inquiries and Research Methods Used

Inquiry	Primary	Secondary
Discuss the Nature of Cabbage Tree Bay Aquatic Reserve	<ul style="list-style-type: none"> • Observation tracker of key species and water temperature. (Table 1) • Photo diary of Key Species • Maps of Cabbage Tree Bay Aquatic Centre (Diagrams 1, 2) • Survey of Cabbage Tree Bay Aquatic Reserve Users (survey 1) • Interview with Richard Nicholls (Interview 1) 	Cabbage Bay Tree Management Plan Summary (Summary A)
Analyse the reserve restrictions	<ul style="list-style-type: none"> • Map of Chowder bay (Diagram 3) • Survey of Cabbage Tree Bay Aquatic Reserve Users (survey 1) 	Cabbage Bay Tree Management Plan Summary (Summary A) Faecal Coliforms and Enterococci levels from Shelly

	<ul style="list-style-type: none"> • Survey of Clifton Gardens visitors (survey 2) • Interview with Richard Nicholls (Interview 1) • Comparison of Fish Species between Cabbage Tree Aquatic Reserve and Chowder Bay, and the changes in species numbers since the reserve creation (table 2) 	<p>Beach, taken from Harbour Watch State of the Beach Report (Figure 1)</p> <p>Urbanist's top fishing spots (Article 1)</p>
<p>Evaluate the response of individuals, groups and governments to the reserve</p>	<p>Interview with Richard Nicholls (Interview 1)</p> <p>Interview with Nays Baghai (Interview 2)</p>	<ul style="list-style-type: none"> • Northern Beached Council Financial Report 1st July – 30 June 2019 Summary (Table 4) • Destination NSW Tourism Report (Table 3)

- University of Western Sydney Report on (Figure 2, 3 and 4)

Table 2: Observation count of keystone species and water temperature

17/4/20 Cabbage Tree Bay Aquatic Reserve

Keystone Species	Quantity	Temperature (Centigrade)
Blue Groper	7	20
Dusky Whaler	2	20
Spotted Wobbegong	4	20
Banded Wobbegong	1	20

26/4/20 Cabbage Tree Bay Aquatic Reserve

Keystone Species	Quantity	Temperature (Centigrade)
Blue Groper	6	23
Dusky Whaler	2	23

3/5/20 Cabbage Tree Bay Aquatic Reserve

Keystone Species	Quantity	Temperature (Centigrade)
Blue Groper	20	18
Spotted Wobbegong	3	18

Clifton Gardens 13/6/20 and 20/6/20

No Keystone species were sighted.

Photo Diaries of CTBAR Pictures 1-7:

Dusky Whaler, sighted 26/4/20



Dusky Whaler, sighted 17/4/20



Blue Groper, sighted 3/5/20



Blue Groper, sighted 17/4/20



Banded Wobbegong, sighted 3/5/20



Spotted Wobbegong, sighted 17/4/20



Spotted Wobbegong, sighted 17/4/20



Maps

Diagram 1: Map Identifying location of Cabbage Tree Bay Aquatic Reserve

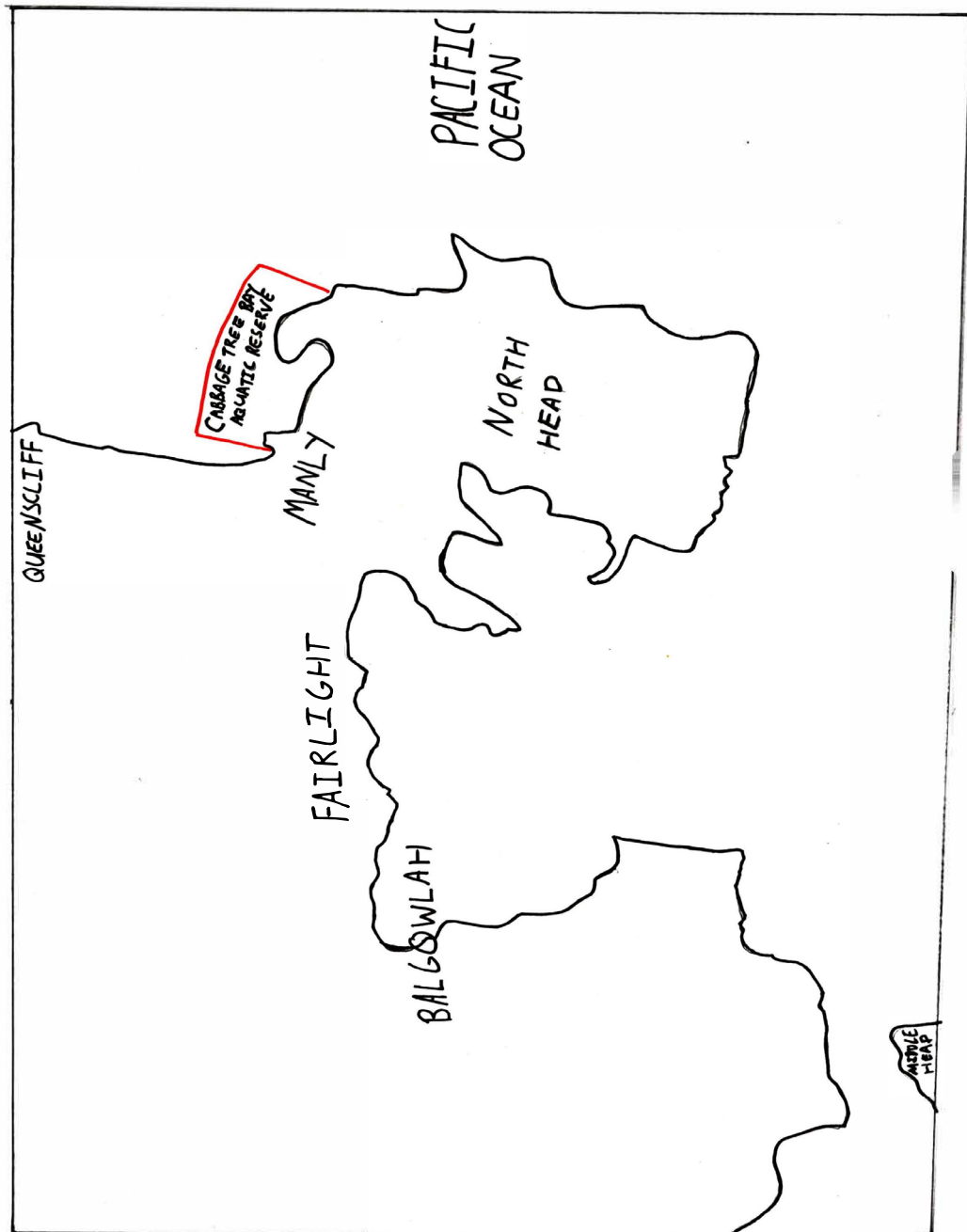


Diagram 2: Map illustrating Cabbage Tree Bay Aquatic Reserve

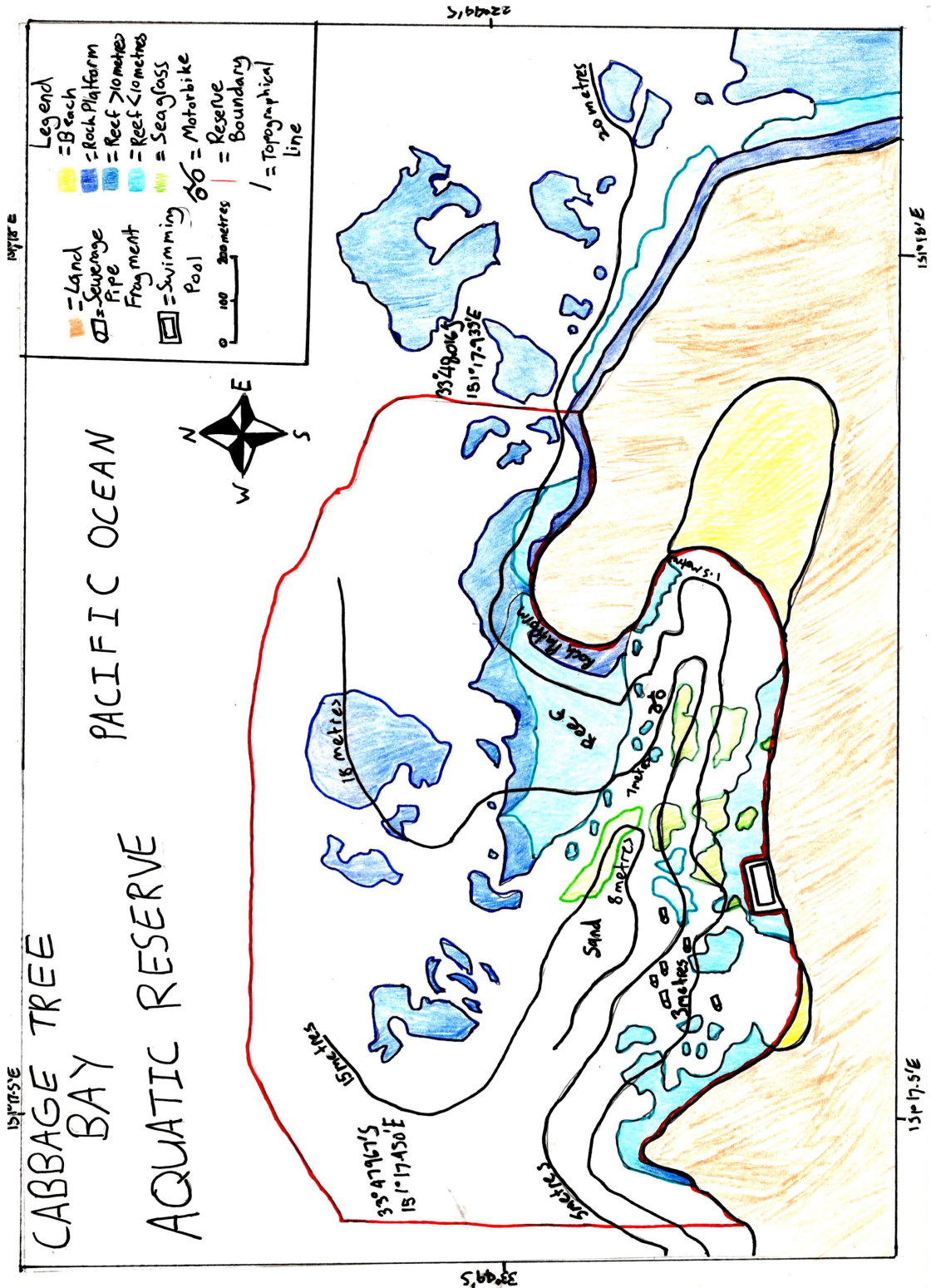
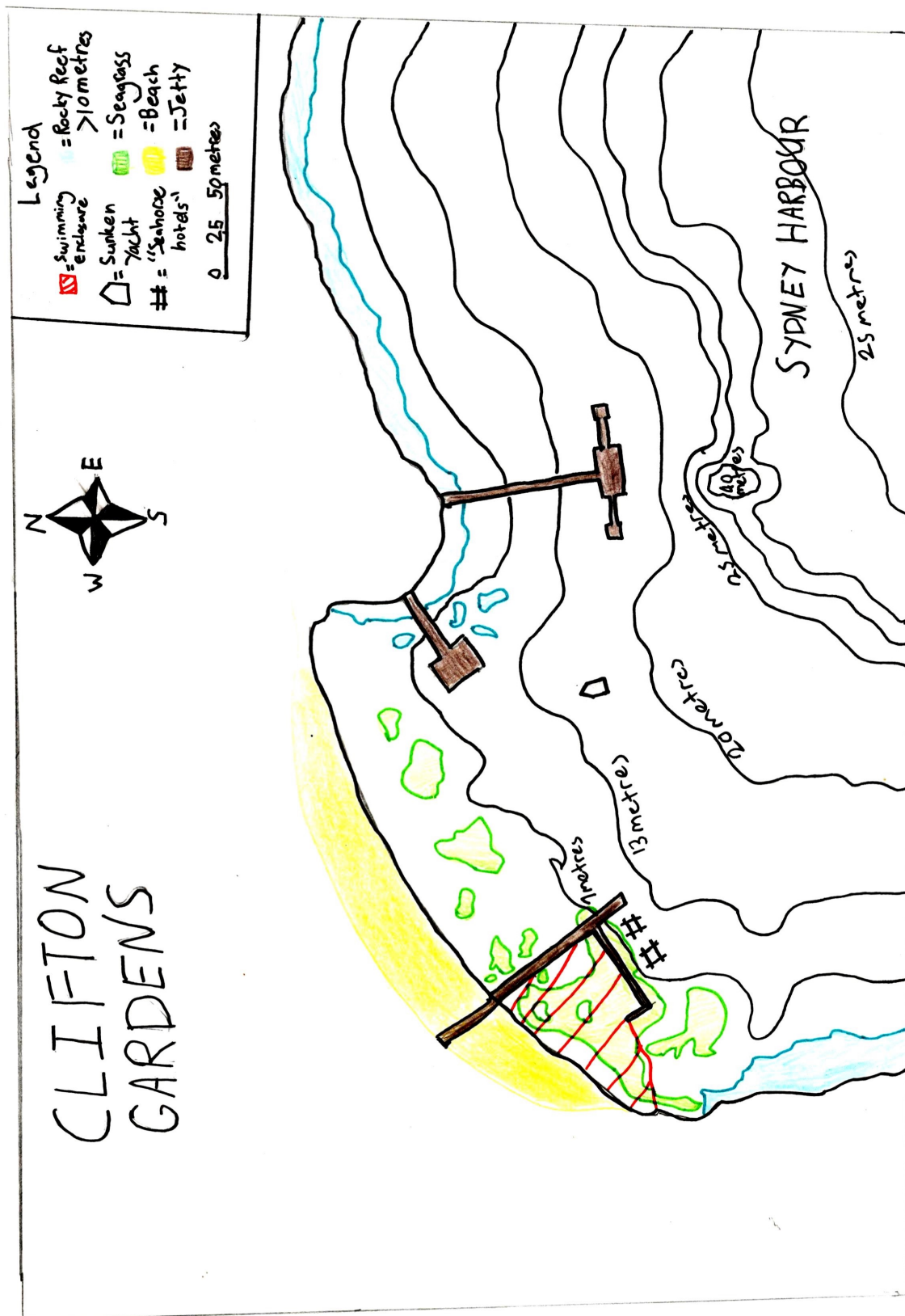


Diagram 3: Map illustrating Clifton Gardens.



Surveys:



Cabbage Tree Bay Survey

Thank you for completing my survey.

Purpose: I am in year 11 at International Grammar School and I intend to use this data as primary research for a geography assignment I am completing about Cabbage Tree Bay.

Duration: It should take no longer than 5-10 minutes.

Ethical considerations: The information collected will be shared with relevant International Grammar School staff. You may choose not to answer any questions of a personal nature.

*** Required**

First name

Your answer

Surname

Your answer

Gender

- Female
- Male
- Other
- Prefer not to say

Age

- 12 and under
- 13-19
- 20-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70+

How often do you use Cabbage Tree Bay Aquatic Reserve? *

How often do you use Cabbage Tree Bay Aquatic Reserve? *

- Never been
 - Once a year
 - Once a month
 - Fortnightly
 - Weekly
 - Daily
-

Do you live nearby to Cabbage Tree Bay ? *

- 1.5 hours +
 - 30 - 90 minutes
 - 20 - 29 minutes
 - Less than 10 minutes
-

How do you get to Cabbage Tree Bay? *

- Bus
- Walk
- Ferry

Ferry

Car

Other: _____

Why do you visit Cabbage Tree Bay? *

Work

Walking (includes dog walking and bushwalking)

Boating

Swimming

Snorkelling/Freediving

Scuba Diving

Other: _____

If you are a scuba diver, swimmer, freediver or snorkeler, when was your last visit to the reserve?

Your answer _____

If you are a scuba diver, swimmer, freediver or snorkeler which of these species

If you are a scuba diver, swimmer, freediver or snorkeler which of these species did you see when you last visited the reserve?

- Blue Groper
- Spotted and Banded Wobbegongs
- Dusky Whaler Shark
- Grey Nurse Shark
- Port Jackson and Crested Horn Sharks
- Giant Cuttlefish
- Other: _____

What is your favourite thing about the marine reserve? *

Your answer _____

To what extent do you agree with the statement "Cabbage Tree Bay has superior marine biodiversity to other coastal marine sites in Sydney" *

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

Why do you believe this?

Your answer

To what extent do you agree with the statement "the marine reserve is economically important and supports local businesses" *

1 2 3 4 5

Strongly disagree Strongly agree

Why do you believe this?

Your answer

To what extent do you agree with the statement "the marine reserve important to conserve the environment" *

1 2 3 4 5

Strongly disagree Strongly agree

Why do you believe this?

Your answer

What do you believe is the biggest threat to the reserve? *

- Plastic Pollution
- Other pollution (sewerage, ash, toxins)
- Overcrowding
- Illegal fishing
- Potential loosening of reserve restrictions
- Climate Change
- Nearby shark nets and drumlines
- Other: _____

Any other general comments?

Your answer

Submit

60 responses



Accepting responses

Summary

Question

Individual

First name

52 responses

Paul

Narelle

Nicholas

Elaine

Kate

Ra

Ken

Surname

47 responses

Cochrane

Vanderkooi

de Jager

Ahmad

Ma

Nolan

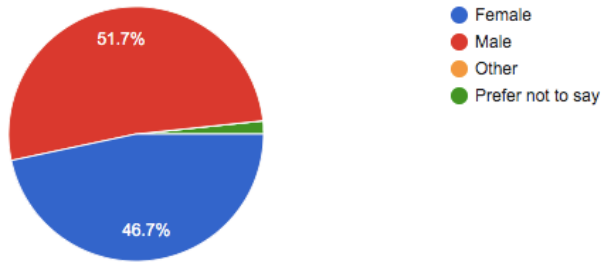
Brunton

Anon

Rooney

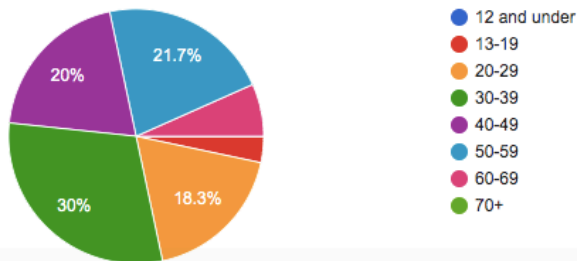
Gender

60 responses



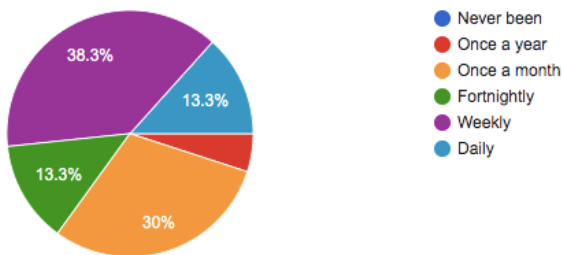
Age

60 responses



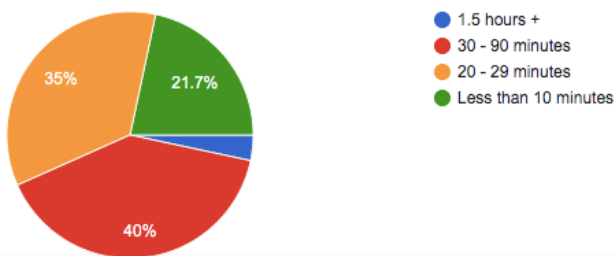
How often do you use Cabbage Tree Bay Aquatic Reserve?

60 responses



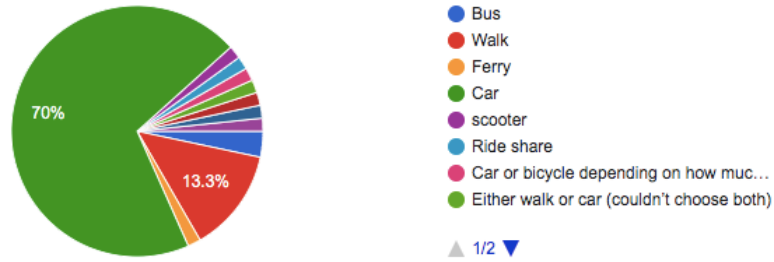
Do you live nearby to Cabbage Tree Bay ?

60 responses



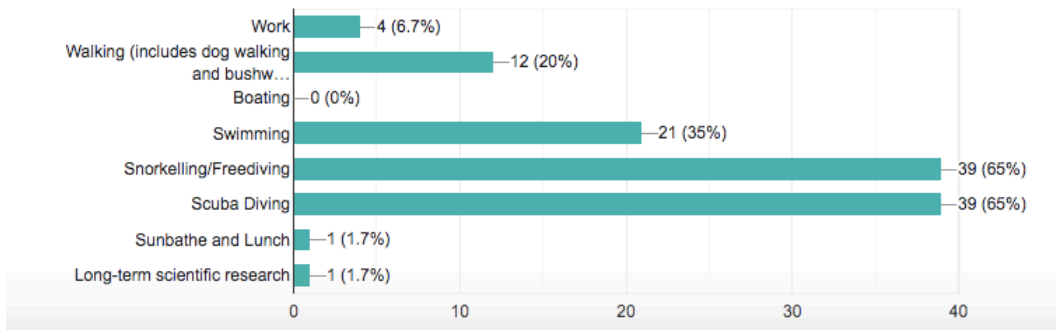
How do you get to Cabbage Tree Bay?

60 responses



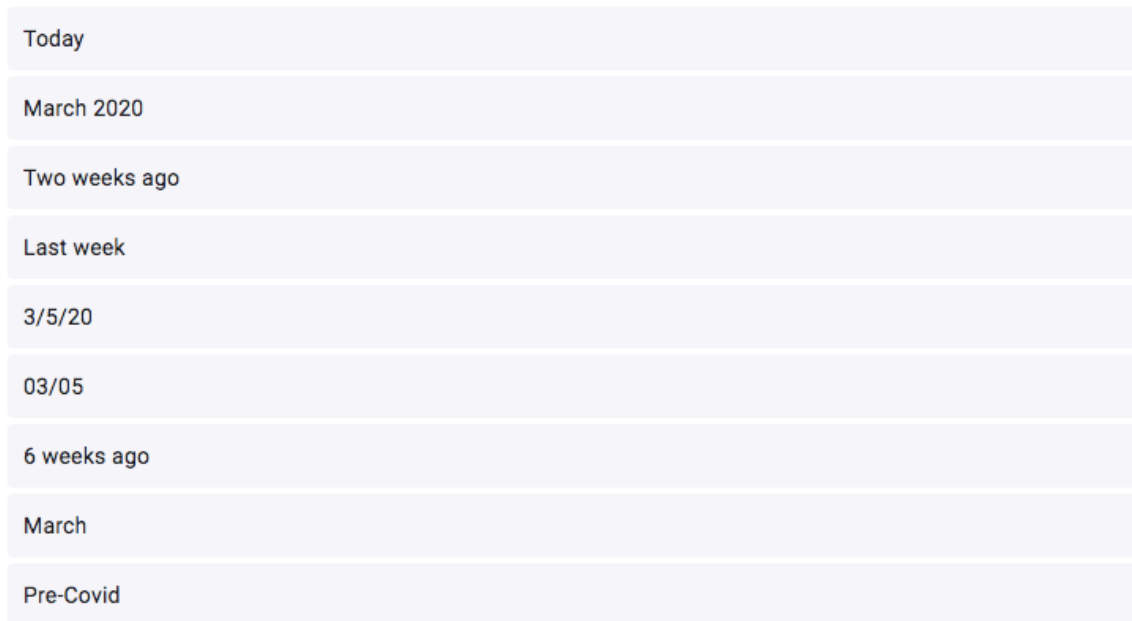
Why do you visit Cabbage Tree Bay?

60 responses



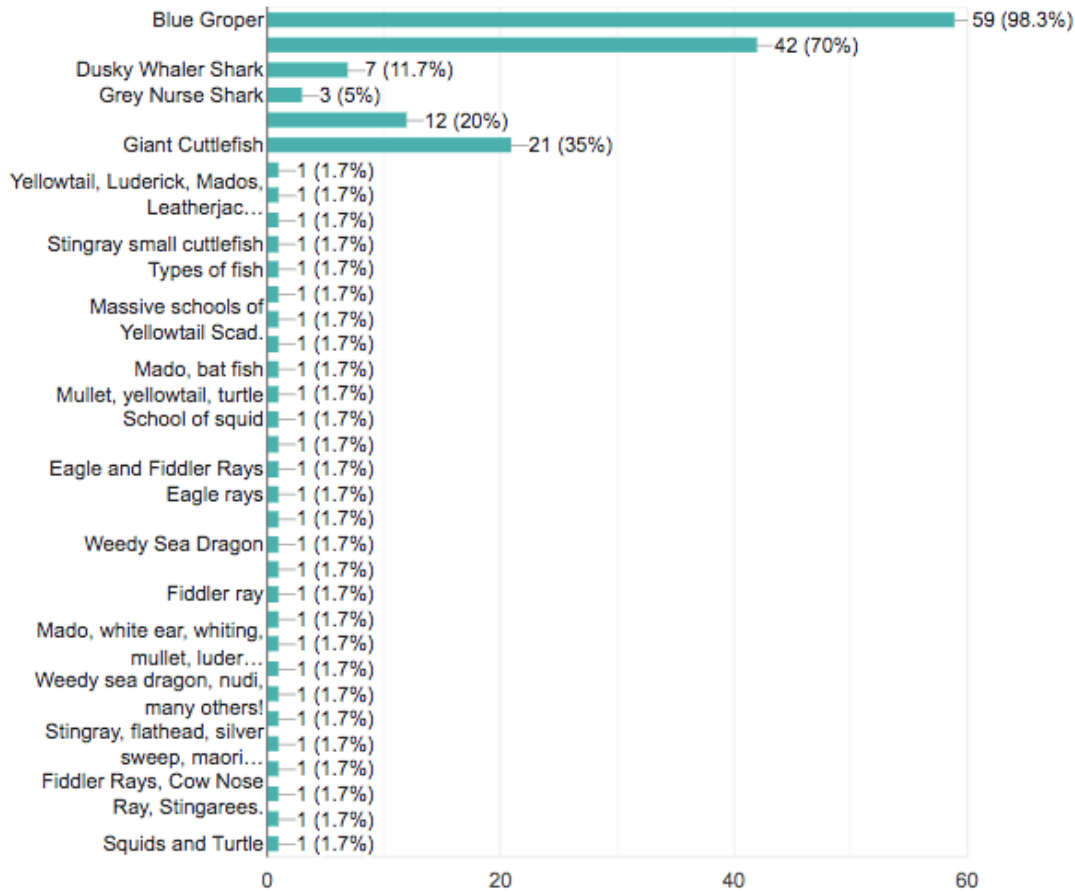
If you are a scuba diver, swimmer, freediver or snorkeler, when was your last visit to the reserve?

59 responses



If you are a scuba diver, swimmer, freediver or snorkeler which of these species did you see when you last visited the reserve?

60 responses



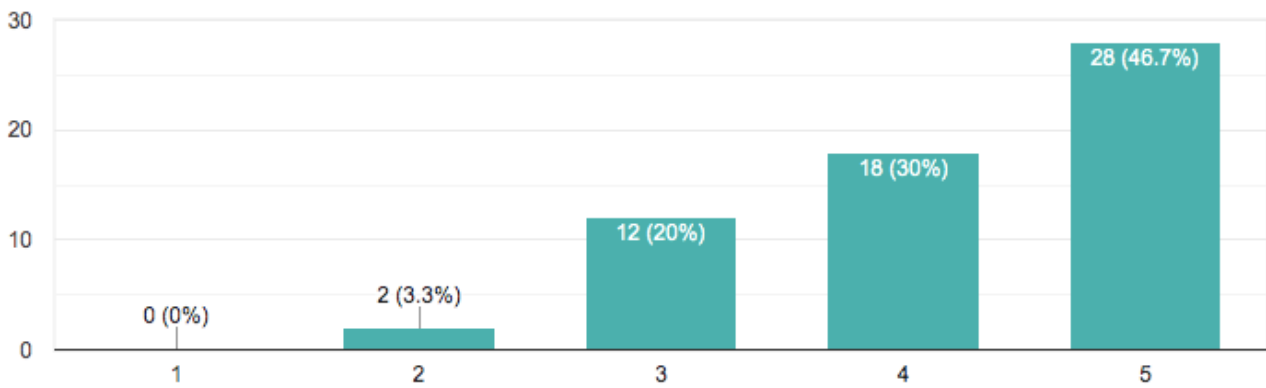
What is your favourite thing about the marine reserve?

60 responses

2 dive sites, good amenities easy access
Peace and quiet and full of sealife
Ease of diving. Very accessible. As a solo diver, it is shallow enough to dive with one tank and come up in an emergency without decompression sickness. No currents. Sand bottom. Ease of navigation.
Marine life
The ocean life
Clear water, lots of sea life
The fish! Aquatic environment is amazing
Calm, good marine life and very little waste

To what extent do you agree with the statement "Cabbage Tree Bay has superior marine biodiversity to other coastal marine sites in Sydney"

60 responses



Why do you believe this?

53 responses

Each site has differing biodiversity, I don't think it's superior to another it just happens that cabbage tree bay includes some of my favourite species

There just so much more than any other site!

I dont believe the marine biodiversity is superior to others in Sydney. I think Boat Harbour Aquatic Reserve is probably superior.

I've swam other places and seen posts. I swim there every day.

Because it is a protected marine reserve. Sites that allow fishing have a dearth of large fish, sharks or cephalopods

Just has a lot of consistency year round

Research has shown effectiveness of marine protected areas

Lots of fish and other creatures but no more variety than other locations

Why do you believe this?

54 responses

The reserve brings people to the area and people often need things or forget things. Local dive shops get scuba business local coffee shops cafes and restaurants get people who stay longer then intended or just need something

Well, it brings it traffic to the area. People are then likely to grab a bite nearby

It would support diving shops etc but people would go for beach and area anyway.

It attracts many people to the area who then buy food

Great attraction

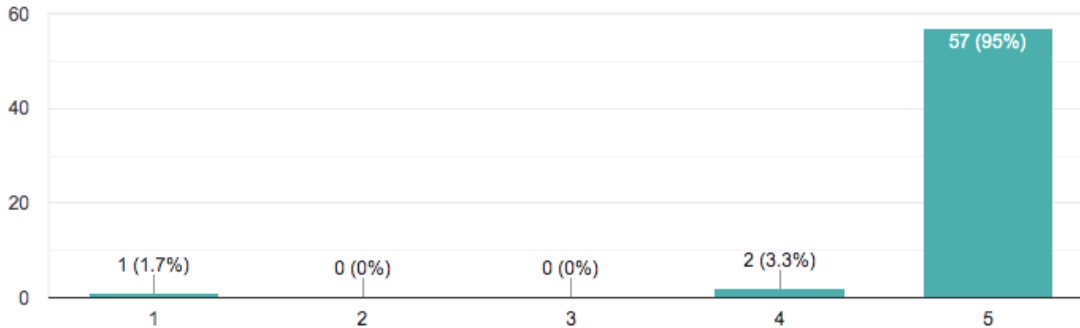
It brings people in to the area for a variety of reasons

Just count the number of divers in the water on a warm Saturday...

The beach is protected from swell (except really big swell) and it is relatively shallow to be able to see a lot of it from the surface for kids and families

To what extent do you agree with the statement "the marine reserve important to conserve the environment"

60 responses



Why do you believe this?

48 responses

Lots of people who visit do so because of the marine reserve and want to see the environment there continue to thrive. These people have an interest and respect for the environment and work to maintaining it.

Places like that are becoming rarer!

As it is a no take aquatic reserve marine life flourishes and numbers and species have increased.

It is clearly evident that shelly beach has far more diversity and amount of fish than any beach sites that allow fishing

Makes people love nature

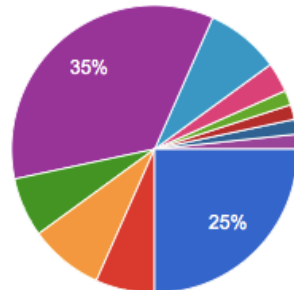
Marine reserves globally are an incredibly important part of the ecosystem to allow for juveniles to grow before moving on etc

Protection from fishing, anchors

It's an area where the amount of fish and sealife is abundant and being protected there is not discarded

What do you believe is the biggest threat to the reserve?

60 responses



- Plastic Pollution
- Other pollution (sewerage, ash, toxins)
- Overcrowding
- Illegal fishing
- Potential loosening of reserve restricti...
- Climate Change
- Nearby shark nets and drumlines
- Over fishing

▲ 1/2 ▼

Any other general comments?

13 responses

It is a unique and spectacular site that should continue to be protected. Banning boats would make it safer for both marine life and swimmers

It's very important because it is a great place for many kids to learn about the underwater world in a safe location

Thank you for your efforts!

Great initiative!

Extend marine sanctuaries across the country.

I would be curious to read your findings.

We need to protect this site vehemently

thank you for your concern

Survey 2: Clifton Gardens Survey distributed through Dive Centre Manly and Sydney Vis

Report Dive Group Facebook sites.

Clifton Gardens Survey

Thank you for completing my survey.

Purpose: I am in year 11 at International Grammar School and I intend to use this data as primary research for a geography assignment I am completing about Cabbage Tree Bay. I am using Clifton Gardens as a comparison site.

Duration: It should take no longer than 5-10 minutes.

Ethical considerations: The information collected will be shared with relevant International Grammar School staff. You may choose not to answer any questions of a personal nature.

*** Required**

To what extent do you agree with the statement "Clifton Gardens suffers from overfishing"? *

	1	2	3	4	5	
Strongly disagree.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree.

Why do you believe this?

Your answer

On a scale from 1 to 5, how much impact does discarded fishing gear have on the ecosystem at Clifton Gardens? *

	1	2	3	4	5	
No impact.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High impact.

Why do you believe this?

Your answer

To what extent do you agree with the statement "the human impacts on Clifton Gardens has created a habitat for certain species"? *

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

Why do you believe this?

Your answer

Why do you believe this?

Your answer

Apart from the resident Smooth Stingrays, do you ever encounter large fish species at Clifton Gardens? *

Yes

No

If you answered yes to the last question, which large fish species have you encountered?

Your answer

To what extent do you agree with the statement "Clifton Gardens suffers from a low population of large fish"? *

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

Why do you believe this?

Your answer

To what extent do you agree with the statement, "Clifton Gardens would benefit from the same protection given to Cabbage Tree Bay"? *

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

Why do you believe this?

Your answer

What do you believe is the biggest threat to Clifton Gardens? *

Plastic Pollution

Other pollution (runoffs)

Climate Change

Overfishing

Discarded fishing gear

Other: _____

Any other general comments?

Your answer _____

Submit

Clifton Gardens Survey Results.

7 responses

+ ⋮

Accepting responses

Summary Question Individual

Why do you believe this?

7 responses

Always so many Fisherman, Fishing lines and hooks cover the site everywhere and complete lack of decent to large sized and mature fish

There seems to still be a lot of fish down there

Always lots of fishermen, dead crabs and injured or dying smaller fish that have been released. Not a lot of bream or pleating fish

There is a lot of fishing yes, but whether this is detrimental to the environment I am not sure, considering the uniqueness of the sealife under the jetty

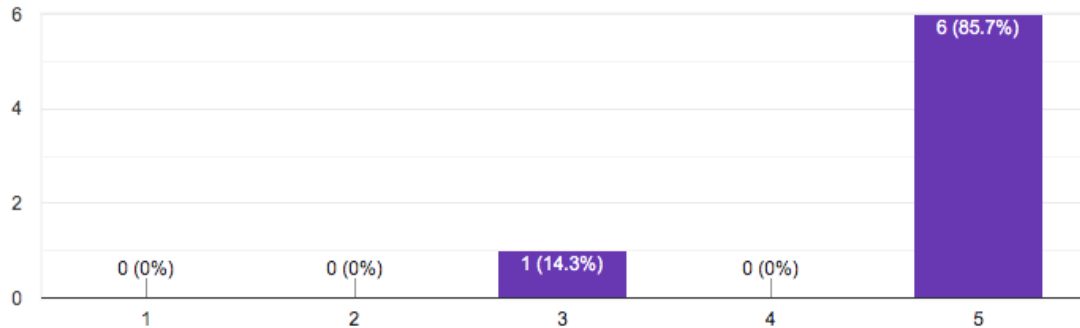
almost no big fish at the site

there are heaps of lures, line, etc all over the bottom. They get cleaned up and then just all over again the problem begins.

Lack of big fish

On a scale from 1 to 5, how much impact does discarded fishing gear have on the ecosystem at Clifton Gardens?

7 responses



Why do you believe this?

6 responses

Hooks and lines cover the floor and pylons and damages sessile animals E.g sponges, corals and tunicates but also tangles seahorses and other creatures as well as the aforementioned homes. There is a complete lack of mid and high trophic level predators at the site as they are over fished before than can mature and breed

From seeing the discarded gear underwater. Rubbish, fishing line, lures, etc

Plastic, fishing lines, lures, tins and other rubbish discarded in water. Moray eels with hooks in their mouths

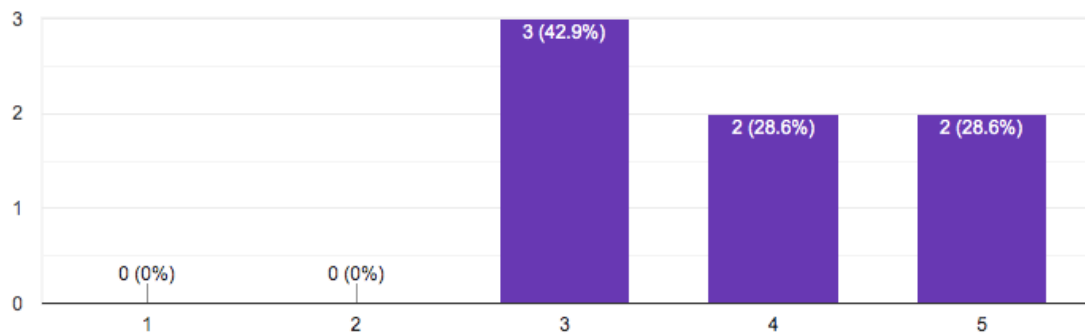
it surely look ugly, but I haven't seen much impact other than a few hooks in fish's mouth over the years, at the opposite I have seen many Blenny fish using discarded bottles or other items as protection

I regularly sea creatures entangled in fishing lines.

Constantly seeing marine life with fishing line around it. Last week an eastern frogfish tied up.

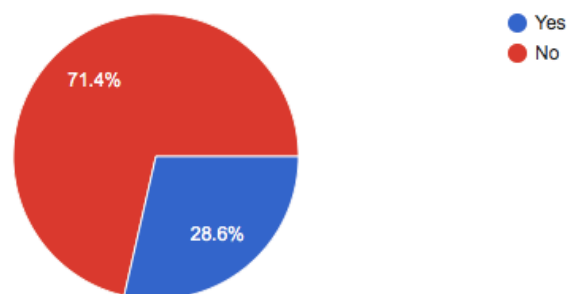
To what extent do you agree with the statement "the human impacts on Clifton Gardens has created a habitat for certain species"?

7 responses



Apart from the resident Smooth Stingrays, do you ever encounter large fish species at Clifton Gardens?

7 responses



If you answered yes to the last question, which large fish species have you encountered?

2 responses

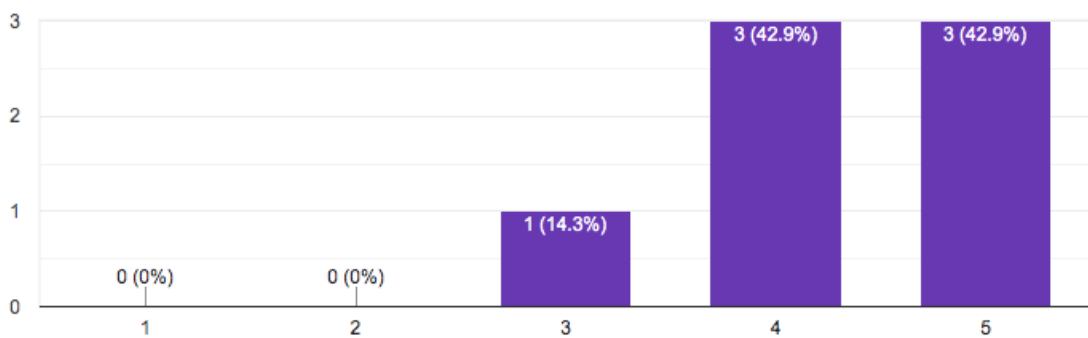
Leatherjackets ludwick

silver trevallys, ludericks, breams, porcupine fish

To what extent do you agree with the statement "Clifton Gardens suffers from a low population of large fish"?



7 responses



Why do you believe this?

4 responses

There are very few predatory fish that would be typically found throughout Sydney and those seen are very small and often caught before they mature and reproduce

Not many large fish around

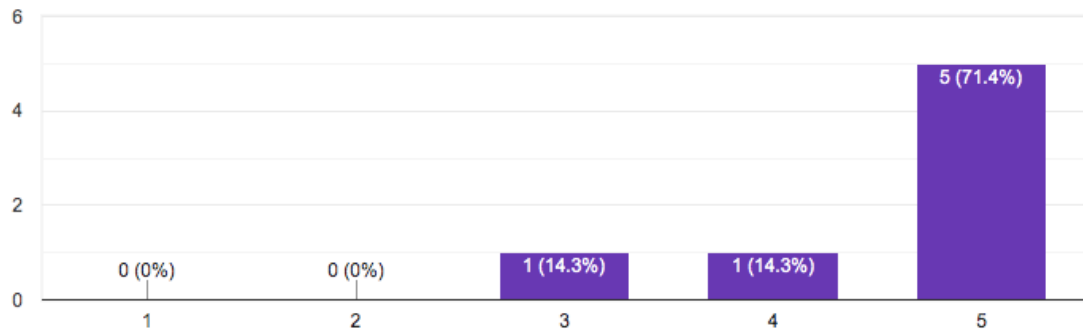
I dive there heaps and don't see larger species. But I do in similiar inner harbour sites.

Fishing

To what extent to you agree with the statement, "Clifton Gardens would benefit from the same protection given to Cabbage Tree Bay?"



7 responses



Why do you believe this?

6 responses

If the overfishing and habitat destruction from Fisherman and boats ceases there mid to high level fish would return as it would be safer and grow larger and have more offspring as well as increase site biodiversity and biomass

This would be awesome an marine park to protect the environment, encourage larger fish, reduce pollution in the water, reduce bycatch

it's already protected from spearfishing, and regarding fishing as said I am not sure it would help. Relations between fishermen and divers are usually decent and I have not experienced any argument, so for me I would not change what seems to work unless a credible source is able to demonstrate the opposite

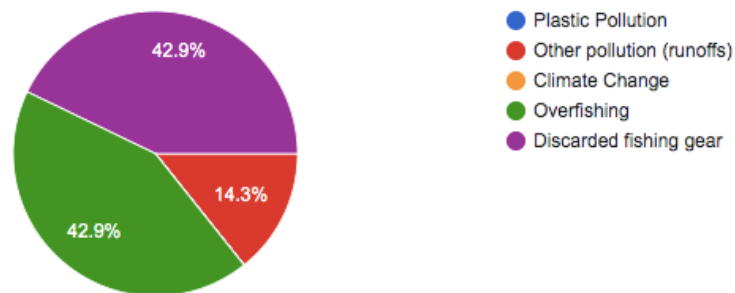
Fishing lines / gear are a major issue, but possibly overfishing as well. I'd like to ban fishing for a year or two to see the real impact.

I think it would be amazing for snorkellers, divers, kids and adults to protect this amazing site.

It would enable a more balanced ecosystem

What do you believe is the biggest threat to Clifton Gardens?

7 responses



Any other general comments?

3 responses

Most Fisherman have no concern for the welfare of the animals and health of the marine community there

It's suffers from all of the above mainly fishing related rather than climate change and runoff

great question and best of luck with your initiative!

Interviews:

Interview 1: Richard Nichols interview 3/5/20 and 17/5/20.

[Transcript of Interview between Richard Nichols of Dive Centre Manly and Euan Thomas, 3/5/20 at Dive Centre Manly.](#)

About Dive Centre Manly – This dive shop is one of the oldest in NSW. The original dive shop opened in 1962, and was one of only 3 dive shops in Sydney. The current owners, are Richard and Janet Nicholls who have been running the centre since 1993. They are headquartered in Manly, and run dives in and around Cabbage Tree Aquatic Reserve.

Euan Thomas (ET): Since Dive Centre Manly's creation, what have been the key changes you have observed, before and after the creation of the Cabbage Tree Aquatic Reserve?

Richard Nicholls (RN):First before it was a Marine Reserve there was very little marine life, there was an area that was heavily fished, and also we had a lot of pollution from North Head, because in those days, there was the North Head Sewerage Plant, pumped raw sewerage straight into the ocean, it used to sweep all round North Head and be at the front of Manly beach and also very high levels of sewerage in Cabbage Tree bay.

ET: What changes have you observed in the ecosystem since the reserve was created?

RN: The change has been very dramatic. Certainly with the amount of large fish there so the fish density, was extraordinary in Shelly Beach now, basically there is 20 times more larger fish, the fish are 20 times larger but the density is 20 times more than any other comparable place in Sydney, and also because it is serving as a breeding ground now there is huge biodiversity there because the edible fish, the flatheads, the breams, that aren't being fished out there is a much more balanced eco system.

ET: And do you think that creates, like, do you think that makes the fish stocks in other places higher because there is kind of like a flow on effect when those leave the reserve?

RN: There is a lot of sited evidence to indicate when you have a marine reserve that the fish don't just stay in the reserve they migrate outside that reserve and though there is fishing

pressure on those you're still going to see more fish and more larger fish for fisherman when the fish stray outside the reserve.

ET: Are there specific species in the reserve where their behaviour has changed or have large changes in their population?

RN: All the fish right across the board have large changes in their population particularly in the fish that were edible fish, flathead, bream, luderick etc. etc. All their populations have absolutely bloomed and because the ecosystem's balanced there is a real good cross section of fish now because there is not one type of predator that is the apex predator there any longer.

ET: So, would you say there is multiple apex predators like wobbegongs, like dusky whalers?

RN: Correct. So there is a balanced ecosystem so there is different types of predators for all of the fish there so the population is really balanced. Like other places for example like Chowder Bay would be a fantastic example where there is amazing macro life but that is because all of the predators have been taken. So even though it is a great site to go and see small stuff it is really a good indication of an ecosystem that is actually completely out of control.

ET: Because there is fishermen there?

RN: Correct. Because there is a lot of fishing pressure there because it is a very easily accessible site and safe so it is very popular with fisherman, so although some people tend to blame the fisherman, you can't blame them, because it is a very safe and easy site for them to go compared to the dangers of rock fishing.

ET: Have there been any species that have moved into the reserve, like that have been recorded since the reserve? Like they absent before then?

RN: It is hard to know. There was a fantastic survey done on the amount of species in the reserve of when it was 1st classified as a reserve. I think the biodiversity is better now. What's happened now is that there is more tropical fish, and that's just a by-product in Sydney as well, there is more tropical fish and they tend to live over winter now where as they used to die away but because there is good protection there, you tend to see them all year around.

ET: And stuff like the dusky whalers, they probably moved in because of the lessening of the fishing pressure.

RN: Correct. Because there is large populations of yellow tail scad there, which is their natural food, you see those and you see more sightings of grey nurse sharks than we have done since the mid 80s.

ET: Has the reserve's creation, like more people swimming there, negatively impacted any species?

RN: I don't think so, the area is used extensively by swimmers and snorkelers and that's really because it is a safe place to swim and also because there is so much to see when swimming. That is the biggest growth in user group has been the swimmers.

ET: What do you think are the biggest threats to the reserve?

RN: Well the threats to the reserve is undoubtedly fishing pressure, so it is illegal fishing in the reserve is really it's biggest threat, and also the other threat in a way is its size of the sight. Because it is only really very small, considering there is very little marine protection in Sydney. It would be a great benefit to the whole community if it was larger.

ET: It is very easy for people to fish at Blue Fish point which is right on the boundary.

RN: Correct. Because it is very small, it can be very unclear as to where the boundary is and where it is not.

ET: Thanks for answering these.

RN: No worries, thanks Euan.

Transcript of interview between Richard Nichols of Dive Centre Manly and Euan

Thomas, 17th May via phone

Euan Thomas (ET): I just have a some follow questions for my Cabbage Tree Bay assignment if that is ok?

ET: Based on what you have seen, has the reserve created tourism for the area?

RN: Yes.

ET: Roughly what % of divers are from outside NSW/or even internationally?

RN: Its more than just diving, Shelly Beach is also big for snorkelling. Diving wise, oh my God, what % of divers would be tourists? I'm trying to give you an accurate answer. For courses probably 50% of the courses, are run for tourists. I'd probably say half. Obviously at this point 100% of the divers are local. It does attract divers from interstate, so they think while they are here they will dive at Shelly Beach. Maybe about 5%; there are people there who dive there because it is a marine reserve who wouldn't normally dive there.

ET: Last thing – Has this had a positive impact on businesses around Manly and Shelly beach?

RN: Yeah, there are two flourishing cafes there that weren't there before , there is a very big club which swims in the bay, and does it mainly because it is a protected area and it is so fantastic, there is a pop up café in the surf club and there are a couple of stand-alone

snorkelling businesses that weren't there beforehand . And there is obviously a spin off if it is bringing people to Manly for the day. That's take away food or cafes and things, cups of coffees, increased revenue from the carpark.

ET: Thanks again for your help.

RN: Yep, no worries.

ET: Have a good one.

RN: Thanks Mate, Bye Euan.

Interview 2: Nays Baghai interview 17/5/20

[Transcript of an interview between Nays Baghai and Euan Thomas 17th of May via Facebook Messenger](#)

Euan Thomas (ET): Hi, as you know I am doing a school assignment on Cabbage Tree Bay, and I was wondering if you could answer some more questions, as it would be great to get the perspective of a filmmaker about Cabbage Tree Bay.

1) How important are marine reserves like Cabbage Tree Bay to filmmakers?

2) Apart from its protected aspect, what makes Cabbage Tree Bay special compared to other Sydney sites?

3) What species make Cabbage Tree Bay attractive to filmmakers?

4) What is the main subject matter of films created at Cabbage Tree Bay?

Thanks, Euan.

Nays Baghai (NB): Hi Euan. Here are my answers:

1. Very important. The abundance of marine life is crucial for underwater filmmaking. If a site is overfished, it quickly drops down in the ranking of good dive sites to film at.

2. CTB is a very accessible dive site. It's a short drive, you don't need a boat, the surface swim is short, there's a variety of landscapes and marine life, and it directly faces the Pacific Ocean.

3. The larger animals - wobbegong sharks, Port Jackson sharks, blue groupers, giant cuttlefish, eagle rays, and smooth stingrays.

4. My films are focused on either divers or marine life. The two are often combined together. Some of my previous films shot at CTB can be found here -

<https://vimeo.com/naysbaghai>.

ET: Thanks very much, this is a big help.

Table 3: Comparison of fish species between Cabbage Tree Bay Aquatic Reserve and Clifton Gardens and the changes in species numbers since the reserves creation (using data collated from observations (table 1,

				Cabbage	Cabbage
				Tree Bay	Tree
		COMMON		Status	STATUS
					Chowder
FAMILY	NAME	SPECIES NAME	2000	2020	Bay 2020
FISH					
	Blue Spot				
Acanthuridae	Unicornfish	Naso Unicornis	Absent	Present	Absent
	Sleek				
	Unicornfish	Naso hexacanthus	Absent	present	Absent
	Ringtail				
	Unicornfish	Naso annulatus	Absent	present	absent
	Striped	Ctenochaetus			
	bristletooth	striatus	Absent	present	absent
	Two Spot	Ctenochaetus			
	Bristletooth	binotatus	Absent	present	absent
	Convict	Acanthurus			
	Surgeon Fish	triestegus	Absent	present	absent
	Orange				
	blotch	Acanthurus			
	Surgeonfish	olivaceous	Absent	present	absent
	Brown	Acanthurus			
	surgeonfish	nigrofuscus	Absent	present	absent
	Pale				
	surgeonfish	Acanthurus mata	Absent	present	absent

	Lined				
	surgeonfish	Acanthurus lineatus	Absent	present	absent
	Eye stripe	Acanthurus			
	Surgeonfish	dussumieri	Absent	present	absent
	Brown Tang	Zebrasomas scopas	Absent	present	absent
	Sawtail	Prionurus			
	Surgeonfish	Microlepidotus	Present	present	present
Alploactinidae	Velvetfish	Cocotropus roscus	Present	present	absent
		Aplodactylus			
Aplodactylidae	Rock Cale	lophodon	Present	present	absent
	Four-Line				
Apogonidae	Cardinalfish	Apogon doederleini	Present	present	present
	Sydney				
	Cardinalfish	Apogon limenus	Present	present	present
	Capricorn				
	Cardinalfish	Apogon carpricornis	Absent	present	absent
	Ringtail				
	Cardinalfish	Apogon aureus	Absent	present	absent
	Southern				
	Orangeline				
	Cardinal	Apogon properuptus	Absent	present	absent
	Black-fined	Apogonichthyoides			
	Cardinalfish	nigripinnis	Absent	present	absent

Plain					
Cardinalfish	Apogon apagonides	Absent	present	absent	
Tiger					
Cardinalfish	Cheilodipterus macradon	Absent	present	absent	
Woods					
Siphonfish	Siphamia Cephalotes	Absent	present	absent	
Rifle					
Cardinalfish	Ostorhincus kiensis	Absent	present	absent	
White-line					
Cardinalfish	Ostorhincus cavitiensis	Absent	present	absent	
Striped					
Cardinalfish	Ostorhincus fasciatus	Absent	present	absent	
Yelloweye					
Cardinalfish	Ostorhincus monospilus	Absent	present	absent	
Spiny-eye					
Cardinalfish	Apogon fraenutus	Absent	present	absent	
Luminous					
Cardinalfish	Rhabdamia gracils	Absent	present	absent	
Pink-breasted					
Siphonfish	Siphamia rosiegaster	Absent	present	absent	
Halfband					
Cardinalfish	Apogon Semiornatus	Absent	present	absent	

	Australian				
Arripidae	Salmon	Arripis Trutta	Present	present	absent
	Sergeant	Aulopus			
Aulopidae	Baker	purpurissatus	Present	present	absent
	Bridled				
Balistidae	Triggerfish	Sufflamen fraenatus	Absent	present	absent
	Half Moon	Sufflamen			
	Triggerfish	chrysapterus	Absent	present	absent
	Wedge-Tail	Rhinecanthus			
	Triggerfish	rectangulus	Absent	present	absent
	Half Moon				
	Picasso	Rhinecanthus			
	Triggerfish	lunulata	Absent	present	absent
	Hawaiian	Rhinecanthus			
	Triggerfish	aculeatus	Absent	present	absent
	Blue	Pseudobalistes			
	Triggerfish	fuscus	Absent	present	absent
	Clown	Balistoides			
	Triggerfish	conspicillum	Absent	present	absent
	Eastern	Batrachomoeus			
Batrachoididae	frogfish	dubius	Present	present	present

	Brown sabretooth				
Blenniidae	blenny	Petroscirtes lupus	Present	present	present
	Piano	Plagiotremus			
	Fangblenny	tapeinosomo	Absent	present	absent
	Blue Striped	Plagiotremus			
	Fanblenny	rhinorhynchos	Absent	present	absent
	Bicolour	Plagiotremus			
	Fangblenny	laudandus	Absent	present	absent
	Brown sabretooth				
	blenny	Petroscirtes lupus	Present	present	absent
	Yellow-Lined Sabretooth				
	Blenny	Petroscirtes fallax	Absent	present	absent
	False				
	Cleanerfish	Aspidontus toeniatus	Absent	present	present
	Eyelash	Meiacanthus			
	Fangblenny	atrodorsalis	Absent	present	absent
Brachelurus	Blind Shark	Brachaelurus Waddi	Present	present	absent
	Painted				
Callionymidae	Stinkfish	Eocallionymus Papilo	Absent	present	absent

	Scooter				
	Dragonet	Synchiropus acellatus	Absent	present	absent
	Spotted	Repomucenus			
	Dragonet	Calcaratus	Absent	present	absent
Carangidae	Thicklip	Carangoides			
	Trevally	Orthogrammus	Absent	present	absent
	Blue Trevally	Carangoies ferdau	Absent	present	absent
	Yellowtail	Trachurus			
	Scad	novozelandiae	Present	present	present
		Pseudocaranx			
	Silver Trevally	geogianus	Present	present	present
	Highfin				
	Amberjack	Seriola rivaliana	Absent	present	absent
	Yellowtail				
	Kingfish	Seriola lalandi	Absent	present	absent
	Samsonfish	Seriola hippos	Absent	present	absent
	Big-eye				
	Trevally	Caranx sexfasciatus	Absent	present	absent
	Longnose	Carangoides			
	Trevally	Chrysophrys	Absent	present	absent
	Threadfin				
Chaetodontidae	Butterflyfish	Chaetodon auriga	Absent	present	absent

	Klein's				
	Butterflyfish	Chaetodon kleini	Absent	present	absent
	Vagabond	Chaetodon			
	Butterflyfish	vagabundus	Absent	present	absent
	Eastern	Chelmonops			
	Talma	truncates	Present	present	present
	Dot dash	Chaetodon			
	Butterflyfish	pelewensis	Absent	present	absent
	Dusky	Chaetodon			
	Butterflyfish	flavirostris	Present	present	present
	Pennant	Heniochus			
	Bunnerfish	chrysostomus	Absent	present	absent
	Merten's				
	Butterflyfish	Chaetodon mertensil	Absent	present	absent
	Forceps Fish	Forciger Flavssimus	Absent	present	absent
	Schooling	Heniochus			
	Bannerfish	diphreutes	Absent	present	absent
	Teardrop	Chaetodon			
	Butterflyfish	unimaculatus	Absent	present	absent
	Ciron				
	Butterflyfish	Chaetodon citrinellus	Absent	present	absent
	Black-backed	Chaetodon			
	Butterflyfish	melannotus	absent	present	absent

		Guenther's				
		Butterflyfish	Chaetodon gunther	absent	present	absent
		Masked	Heniachus			
		Bannerfish	monoceros	absent	present	absent
			Carcharinus			
Carcharhinidae		Dusky Whaler	Obscurus	Absent	present	absent
		Red				
Chaelodactylidae		Morwong	Cheilodactylus fuscus	present	present	present
		Blue	Nemadactylus			
		Morwong	douglasi	present	present	absent
		Crested				
		Morwong	Cheilodactylus fuscus	present	present	absent
		Blotched				
Cirrhitidae		Hawkfish	Cirrhitichthys aprinus	absent	present	absent
		Banded	Heteroclinus			
Clinidae		Weedfish	whiteleggii	present	present	absent
		Long-nosed				
		weedfish	Heteroclinus nasutus	present	present	absent
		Crested				
		weedfish	Cristiceps australis	present	present	absent
		Rosy				
		weedfish	Heteroclinus roseus	present	present	absent

	Yellow				
	Crested	Cristiceps			
	Weedfish	aurantiacus	present	present	absent
Clupeidae	Sandy Sprat	Hyperlophus vitta tus	present	present	present
	Estuary				
Dasyatididae	Stingray	Dasyatis Fuviorum	present	present	present
	Smooth	Bathytoshia			
	Stingray	Brivicaudata	present	present	present
	Black Stingray	Dasyatis Thetidus	present	present	present
	Long-finned				
Dinolestidae	Pike	Dinolestes lewini	present	present	absent
	Three-Bar	Dicotylichthys			
Diodontidae	Porcupinefish	punctulatus	present	present	absent
	Slender				
Echeneidae	Suckerfish	Echeneis naucrates	present	present	absent
	Australian				
Engraulididae	Anchovy	Engaulis Australis	present	present	absent
Enoplosidae	Old Wife	Enoplosus armatus	present	present	present
	Rough				
Fistulariidae	Flutemouth	Fistularia petimba	present	present	present
	Common				
Gerreidae	Silverbuddy	Gerres subfasciatus	present	present	absent

Gobiesocidae	Eastern Clingfish	Cochleoceps orientalis	present	present	present
		Asposmogoster			
	Pink Clingfish	costatus	present	present	present
Gobidae	Spotted fringefin Goby	Eviota guttata	present	present	absent
	Immaculate Glidergoby	Valenciennea immaculate	absent	present	absent
	Green-eye Dart Goby	Ptereleotris microlepis	absent	present	absent
	Arrow Dart Goby	Ptereleotris evides	absent	present	absent
	Lyretail Dart Gobies	Ptereleotris monoptera	absent	present	absent
	Redhead Stylophoro	Parogobiodon echinocephalus	absent	present	absent
	Spotted Fringefin Goby	Evioto guttato	absent	present	absent
	Sloth Goby	Istigobius hoesei	absent	present	absent
	Shoulder - Spot Goby	Gnotholepsis cauerensis	absent	present	absent

	Redhead				
	Pocillopora	Parogobiodon			
	Goby	modestus	absent	present	absent
	Red-barred	Amblyeleotris			
	Goby	wheeler	absent	present	absent
	Black-lined	Valenciennea			
	Sleeper Goby	helsdingenii	absent	present	absent
	Golden- Headed	Valenciennea			
	Sleeper Goby	strigoto	absent	present	absent
	Goldspotted	Piectorhinchus			
Haemulidae	Sweetlips	flavomaculatus	absent	present	absent
	Eastern Sea	Hyporhamphus			
Hemiramphidae	garfish	Australis	present	present	present
	Crested Horn	Heterodontus			
Heterodontidae	Shark	galeatus	present	present	absent
	Port Jackson	Heterodontus			
	Shark	portjacksoni	present	present	present
	Bigscale				
Holocentridae	Soldierfish	Holocentridae	absent	present	absent
		Hypnos			
Hypnidae	Numbray	monopterygium	present	present	present
Kyphosidae	Blackfish	Girella Tricuspidato	present	present	present

	Rock				
	Blackfish	Girella elevata	present	present	present
	Silver Sweep	Scorpius Lineolatus	present	present	present
	Brassy				
	Drummer	Kyphosus vaigienis	present	present	absent
	Silver	Kyphosus			
	Drummer	sydneyanus	present	present	absent
	Mado	Atypichthys Latus	present	present	present
		Microcanthus			
	Stripey	strigatus	present	present	present
	Silver Streak	Stethojulis			
Labridae	Wrasse	strigiventer	absent	present	absent
	Black backed	Anampses			
	Wrasse	neoguinaicus	absent	present	absent
	Gracilis				
	Wrasse	Suezichtys devisi	absent	present	absent
	Yellow Moon	Thaiassoma			
	Wrasse	lutescens	absent	present	absent
	Diamond	Anampses			
	Wrasse	caeruleopunctatus	absent	present	absent
	Blunt-Nose	Thaiassoma			
	Wrasse	amblycephalum	absent	present	absent

Elegant	Wrasse	<i>Anampses elegans</i>	absent	present	absent	
Pearly	Wrasse	<i>Halichoeres margaritaceus</i>	absent	present	absent	
Silver Streak	Wrasse	<i>Stethojulis strigiventer</i>	absent	present	absent	
Eastern Blue	Groper	<i>Achoerodus viridis</i>	present	present	absent	
Blue-Streak	Cleaner	Wrasse	<i>Labroides dimidiatus</i>	absent	present	absent
Moon Wrasse		<i>Thaiassoma lunare</i>	absent	present	absent	
Hartzfela's	Wrasse	<i>Halichoeres hartzfeldii</i>	absent	present	absent	
Snakeskin	Wrasse	<i>Eupetrichthys angustipes</i>	present	present	absent	
Scribbled	Wrasse	<i>Anampses geographicus</i>	absent	present	absent	
Black-Spotted	Wrasse	<i>Austrolabrus maculatus</i>	absent	present	absent	
Comb Wrasse		<i>Coris Picta</i>	present	present	absent	
Dusky Wrasse		<i>Hallechoeres marginatus</i>	absent	present	absent	

	Red Lined				
	Slender	Hologymnosus			
	Wrasse	doliatus	absent	present	absent
	Eastern				
	Leopard	Macrophyaryngodon			
	Wrasse	meleagris	absent	present	absent
	Nebulous				
	Wrasse	Halichores nebulosus	absent	present	absent
	Seaweed	Novaculichthys			
	Wrasse	macrolepidotus	present	present	absent
	Checkerboard	Halichoeres			
	Wrasse	hortulanus	absent	present	absent
	False-eyed	Halichoeres			
	Wrasse	biocellatus	absent	present	absent
	Pixie Wrasse	Coris pictoides	absent	present	absent
	Elongate	Pseudojuloides			
	Wrasse	elongatus	absent	present	absent
	Eastern Blue				
	Groper	Achoerodus viridis	present	present	absent
	Fine Spotted	Cirrihilabrus			
	Wrasse	punctatus	absent	present	absent
		Pseudocoris			
	Pink Wrasse	yamashiroi	absent	present	absent

		Ophthalmolopis			
	Maori Wrasse	lineolatus	present	present	present
	Crimson				
	Banded Wrasse	Notolobrus gymnogenis	present	present	present
	Bird-Nose				
	Wrasse	Gomphsus varius	absent	present	absent
	Senator				
	Wrasse	Pictilabrus laticluvius	present	present	absent
	Cut-Ribbon				
	Wrasse	Stethojulis interrupta	absent	present	absent
	Spangled				
Lethrinidae	Emperor	Lethrinus nebulosus	absent	present	absent
	Grassy				
	Emperor	Lethrinus laticaudis	absent	present	absent
	Monotaxis				
	Redfin Bream	heterodon	absent	present	absent
Limnichthyidae	Tommyfish	Limnichthys fasciatus	absent	present	absent
	Blackspot				
Lutjanidae	Snapper	Lutjanus fulvflamma	absent	present	absent
	Moses				
	Snapper	Lutjana russelli	absent	present	absent

	Bluestripe				
	Sea perch	Lutjanus kasmira	absent	present	absent
	Goldband				
	Fusilier	Caesio caerulea	absent	present	absent
	Humpback				
	Snapper	Lutjanus gibbus	absent	present	absent
	Mangrove	Lutjanus			
	jack	argentimaculatus	absent	present	absent
	False Fusiler	Paracaesio xanthurus	absent	present	absent
	Red Bass	Lutjanas bohar	absent	present	absent
	Goldspotted	Plectorhinchus			
	Sweetlips	flavomaculatus	absent	present	absent
	Lyretail Dart	Ptereleotris			
Microdesmidae	Goby	monoptera	present	present	absent
	Green-Eye	Ptereleotris			
	Goby	microlepis	present	present	absent
	Arrow Dart				
	Goby	Ptereletris evides	present	present	absent
	Yellow-finned	Meuschenia			
Monacanthidae	Leatherjacket	trachylepis	present	present	present
	Black Reef	Eubalichthys			
	Leatherjacket	bucephalus	present	present	absent

	Yelloweye				
	leatherjacket	Pervagor alternans	present	present	absent
	Six-Spine	Meuschenio			
	Leatherjacket	freycineti	present	present	present
	Yellow-				
	Striped	Meuschenia			
	Leatherjacket	flavolineata	present	present	absent
	Toothbrush	Acanthaluteres			
	Leatherjacket	vittiger	present	present	absent
	Mosaic	Eubalichthys			
	Leatherjacket	mosaicus	present	present	present
	Mimic	Paraluteres			
	leatherjacket	prionurus	present	present	absent
	Blackbar	Pervagor			
	Filefish	janthinosoma	present	present	absent
	Pygmy	Broachaluteres			
	Leatherjacket	jacksonianus	present	present	present
	Honeycomb				
	filefish	Cantherinus pardalis	present	present	absent
	Toothbrush	Acanthaluteres			
	Leatherjacket	vittiger	present	present	absent
	Rough	Scobinichthys			
	Leatherjacket	granulatus	present	present	present

	Barred				
	Leatherjacket	<i>Cantherinus dumerilii</i>	present	present	absent
	Fan-belly	<i>Monacanthus</i>			
	Leatherjacket	<i>chinensis</i>	present	present	present
	Largetooth				
Moridae	Beardie	<i>Lotella rhacina</i>	present	present	absent
Mugillidae	Sea Mullet	<i>Mugil cephalus</i>	present	present	present
	Blue-lined	<i>Upeneichthys</i>			
Mullidae	Goatfish	<i>lineatus</i>	present	present	present
	Diamondscale				
	Goatfish	<i>Parupeneus ciliatus</i>	present	present	present
	Yellow-lined	<i>Mulloidichthys</i>			
	Goatfish	<i>flavolineatus</i>	absent	present	absent
	Many-Bar	<i>Parupeneus</i>			
	Goatfish	<i>multifasciatus</i>	absent	present	absent
	Bartail				
	Goatfish	<i>Upeneus tragula</i>	absent	present	absent
	Blue-lined				
	Goatfish	<i>Upeneus lineatus</i>	present	present	absent
	Black Spot				
	Goatfish	<i>Parupeneus spilurus</i>	absent	present	absent
	Yellow Saddle	<i>Parupeneus</i>			
	Goatfish	<i>cyclostomus</i>	absent	present	absent

	Small Pot	Parupeneus			
	Goatfish	heptacanthus	absent	present	absent
	Australian				
	Goatfish	Upeneus australiae	absent	present	present
	Yellow				
	saddled	Parapeneus			
	goatfish	cyclostomus	absent	present	absent
	Bicolour	Parapeneus			
	Goatfish	barerinoides	present	present	absent
	Side spot	Parapeneus			
	Goatfish	pleurostigma	absent	present	absent
		Gymnothorax			
Muraenidae	Green Moray	prasinus	present	present	present
	Stout Moray	Gymnothorax			
	Eel	eurostus	present	present	present
	Sieve-				
	patterned	Gymnothorax			
	Moray	cribroris	present	present	present
	White-eyed				
	Moray	Sideria thyrsoida	present	present	present
	New Zealand	Myllobatis			
Myliobatididae	Eagle Ray	tenuicaudatus	present	present	absent

	Spotted Eagle				
	Ray	Aetobatus Narinari	absent	present	absent
Nemipteridae	Lattice	Scolopsis			
	Spinecheek	monogramma	absent	present	absent
	Blue Whiptail	Pentapodus	absent	present	absent
Odontaspidae	Grey Nurse				
	Shark	Carcharius Taurus	absent	present	absent
Orectolobidae	Ornate				
	Wobbegong	Orectolobus ornatus	present	present	absent
	Banded				
	Wobbegong	Orectolobus Halei	present	present	absent
	Spotted	Orectolobus			
	Wobbegong	maculatus	present	present	absent
Ostraciidae	Black Boxfish	Orstracion meleagris	absent	present	absent
	Eastern				
	Smooth boxfish	Anoplocapros inermis	absent	present	present
	Yellow				
	Boxfish	Ostracion cubicus	absent	present	absent
Pempherididae	Blacktip				
	Bullseye	Pempheris offinis	present	present	present
	Common	Pempheris			
	Bullseye	multiradata	present	present	present

	Smallscale bullseye	Pempheris compressa	present	present	present
Pentacerotidae	Giant Boarfish	Paristiopterus labiosus	present	present	absent
	Sharprioise Grubfish	Parapercis australis	absent	present	absent
Pinguipedidae	Pink Banded Grubfish	Parapercis nebulosa	absent	present	absent
	Spotted Grubfish	Parapercis ramsayi	absent	present	absent
Platycephalidae	White- Streaked Grubfish	Parapercis stricticeps	absent	present	absent
	Dusky flathead	Platycephalus fuscus	present	present	present
Platycephalidae	Tassel- snouted Flathead	Thysanophrys cirronasus	present	present	absent
	Long-Spine Flathead	Platycephalus grandispinis	present	present	absent
Platycephalidae	Marbled Flathead	Platycephalus marmoratus	present	present	absent

	Bluespotted	Playcephalus			
	Flathead	coeruleopunctatus	present	present	absent
Plesiopidae	Eastern				
	Hulafish	Trachinops toeniatus	present	present	present
	Eastern Blue				
	Devil	Paraplesiops bleekeri	present	present	absent
Plotosidae	Striped				
	Catfish	Plotosus ineatus	present	present	absent
	Estuary	Cnidoglanis			
	Catfish	macrocephalus	present	present	absent
Pomocanthidae	Bicolour				
	Angel Fish	Centropyge bicolour	present	present	absent
	Keyhole				
	Angel Fish	Centropyge tibicen	present	present	absent
Pomocentridae	Weber's				
	Chronis	Chronis weberi	absent	present	absent
	White ear	Parma microlepis	present	present	present
	Bengal				
	Sergeant	Abudefduf			
	Major	bengalensis	absent	present	absent
	Gulf Damsel	Pristotis Obtusirostis	absent	present	absent
	Yellow-back				
	Puller	Chromisnitida	absent	present	absent

	Ambon	Parmacentrus			
	Damselfish	amboinensis	absent	present	absent
	Girdled				
	Scalyfin	Parma unifasciata	present	present	present
		Parmacentrus			
	Fire Damsel	bankanensis	absent	present	absent
	Blue				
	Scribbled	Parmacentrus			
	Damsel	nagasakiensis	absent	present	absent
	Common				
	Sergeant				
	Major	Abudeduf vaigiensis	absent	present	absent
	Scissortail				
	Sergeant	Abudeduf			
	Major	sexfasciatus	absent	present	absent
	White-ringed	Plectroglyphidodon			
	Damsel fish	leucozonus	absent	present	absent
	Yellowtail	Neopomacentrus			
	Demoiselle	ozysron	absent	present	absent
	One spot				
	Puller	Chromis hypsileps	present	present	present
	Immaculate	Mecaenichthys			
	Damsel	immaculateus	absent	present	absent

Whitley's					
Sergeant					
Major	Abudeduf whitleyi	absent	present	absent	
Banded					
parma	Parma polylepsis	present	present	absent	
	Plectroglyphidodon				
Dicks Damsel	dickii	absent	present	absent	
Yellow-					
Finned	Chrysiptera				
Damsel	flavipinnis	absent	present	absent	
Big Scale					
Scalyfin	Parma oligolepis	present	present	present	
Bicolour					
Chromis	Chromis margaritifer	absent	present	absent	
Three-Spot	Dascyllus				
Dascyllus	trimaculatus	present	present	absent	
Australian	Permacentrus				
Damsel fish	australis	present	present	absent	
Half and Half					
Chromis	Chromis iomelus	absent	present	absent	
	Pamacentrus				
Neon Damsel	coelestris	absent	present	absent	

	Vanderbilt				
	Puller	Chronis vanderbilti	absent	present	absent
	Headband				
	Humbug	Dascylus resticulatus	absent	present	absent
	Yellow-Tipped				
	Gregory	Stegastes apicalis	absent	present	absent
	Coral Sea				
	Gregory	Stegastes gasgoynei	absent	present	absent
Pomatomidae	Tailor	Pomatomus saltatrix	present	present	absent
	Blotched	Heteropriacanthus			
Priacanthidae	Bigeye	carolinus	absent	present	absent
		Rachycentron			
Rhachycentron	Cobia	Canadum	absent	present	absent
	Eastern	Trygonorhina			
Rhinobatidae	Fiddler Ray	fasciata	present	present	present
	Shovelnose	Aptchyoatrerna			
	Ray	rostrata	present	present	present
	Australian				
Rhinopteridae	Cownose Ray	Rhinoptera Neglecta	absent	present	absent
	Blue-spotted	Leptoscarus			
Scaridae	Parrotfish	vaigiensis	absent	present	absent

	Redlip	Scarus			
	Parrotfish	rubroviolaceus	absent	present	absent
	Blue-barred				
	Parrotfish	Scarus ghobbon	absent	present	absent
	Reef				
	Parrotfish	Scarus rivulatus	absent	present	absent
	Leaping				
Scombridae	Bonito	Cymbiosarda elegans	present	present	absent
	Australian				
	Bonito	Sarda Australis	absent	present	absent
		Centropogon			
Scorpaenidae	Fortescue	Australis	present	present	present
	Zebra Lionfish	Dendrochirus zebra	absent	present	absent
	Southern Red				
	Scorpionfish	Scorpaena papilloso	present	present	absent
	Eastern Red	Scorpaena			
	Scorpionfish	jacksoniensis	present	present	absent
	Dwarf	Dendrochirus			
	Lionfish	brachypterus	absent	present	absent
	Common				
	Lionfish	Peterois volitans	absent	present	absent
	Toadstool	Trachypoma			
Serranidae	Grouper	macracanthus	absent	present	absent

	Banded Sea Perch	Hypoplectrodes nroruber	present	present	absent
	Half Banded Sea Perch	Hypoplectrodes Maccullochi	present	present	absent
	Eastern Wirrah	Acanthistius Ocellatus	present	present	absent
	Black Cod	Epinephelus Daemelii	absent	present	absent
Sillaginidae	Sand Whiting	Sillago ciliate	present	present	present
Soleidae	Black Sole	Brachirus nigra	present	present	present
Sparidae	Snapper	Chrysophrys aurata	present	present	absent
	Yellowfin Bream	Acanthaoparus Australis	present	present	present
	Tarwhine	Rhabdosargus Sorba	present	present	absent
	Yellowtail Barracuda	Sphyraena abtusata	present	present	absent
	Eastern Angelshark	Squatino albipunctata	present	present	absent
	Australian Angelshark	Squatino australis	present	present	absent
	Sydney Pygmy Pipehorse	Idiotropiscis lumnitzeri	present	present	present

	Bentstick	Trachyrhamphus			
	Pipefish	bicoarctatus	present	present	present
	Widebody				
	Pipefish	Stigmatopora nigra	present	present	present
	Upside down				
	Pipefish	Heraldia nocturna	present	present	present
	Javelin				
	Pipefish	Lissocampus runa	present	present	present
	Weedy	Phyllopteryx			
	Seadragon	toeniolatus	present	present	absent
	Large-scale	Saurida			
Synnodontidae	Saury	Undosquamis	present	present	present
	Sand	Synodus			
	Lizardfish	dermatogenys	present	present	present
	Tail-Blotch				
	Lizardfish	Synodus jaculum	present	present	present
	Bennet's	Canthigaster			
Tetradontidae	pufferfish	bennetti	absent	present	absent
	Stars and				
	Stripes				
	Toadfish	Arothron hispidis	absent	present	absent
	Starry				
	Pufferfish	Arothron stellatus	absent	present	absent

	Scalytail	Torqigener			
	Toadfish	squamicauda	absent	present	absent
	Weeping	Torqigener			
	Toadfish	pleurogramma	absent	present	absent
	Smooth				
	Toadfish	Tetractenos glober	present	present	absent
		Canthigaster			
	Clown Toby	callisterna	present	present	absent
	Starry	Arothron			
	Toadfish	firmamentum	present	present	absent
	Black-saddled	Canthigaster			
	Toby	valentini	present	present	absent
Trachichthyidae	Roughie	Trachichthys australis	present	present	absent
	Ringscale	Enneapterygius			
Tripterygiidae	Threefin	atrogulare	absent	present	absent
	Clark's				
	Threefin	Trinorfolkia clarkei	absent	present	absent
	Kapalensis				
Urolophidae	Stingaree	Urolophus kapalensis	present	present	present
	Commonn	Trygonoptera			
	Stingaree	testacea	present	present	present
Zancliae	Moorish Idol	Zanclus cornutus	absent	present	absent

Secondary Research:

Summary A:

Cabbage Tree Bay Management Plan Key Insights by E. Thomas taken from Cabbage Tree Bay Management plan, published in October 2000.

Cabbage Tree Management Plan Key Insights -

CABBAGE TREE SITE MAIN OBJECTIVES:

- enhance the conservation of marine biodiversity
- reduce risks to identified habitats of the bioregion
- promote marine ecotourism in the bioregion
- enhance the intrinsic benefits derived by the community from the marine estate
- reduce conflicts between users of the marine estate
- enhance opportunities for scientific research, education and learning
- provide baseline monitoring areas (scientific reference sites)
- promote stewardship of the marine estate.

Threats and Proposed Benefits of Establishing Reserve

Threat/Benefit	Environmental	Environmental	Environmental	Social Cultural, Economic	Social Cultural, Economic	Social Cultural, Economic
Threat	Climate Change	Commerical Fishing	Recreational fishing	Reduction in Species	Habitat Disturbance	Lack of awareness
Benefit	Rocky Shores	Shallow Reefs	Deep Reefs	Scientific Reference Sites	Viability of businesses	Individual enjoyment
Benefit	Fish Assemblages	Species protection	Biodiversity	Participation (wellbeing)	Participation (socialising)	Enjoyment (biodiversity and beauty)

Cabbage Tree Bay permissible activities

	Boating	Anchoring	Line Fishing	Spear Fishing	Lobster fishing	Abalone Fishing	Scuba diving/snorkelling	Hard gathering	Collecting marine vegetation	Commercial Fishing
Pre Reserve	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Post Reserve	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗

Figure 2: Faecal Coliforms and Enterococci levels from Shelly Beach 2008-2009, from the Harbourwatch State of the Beach report.

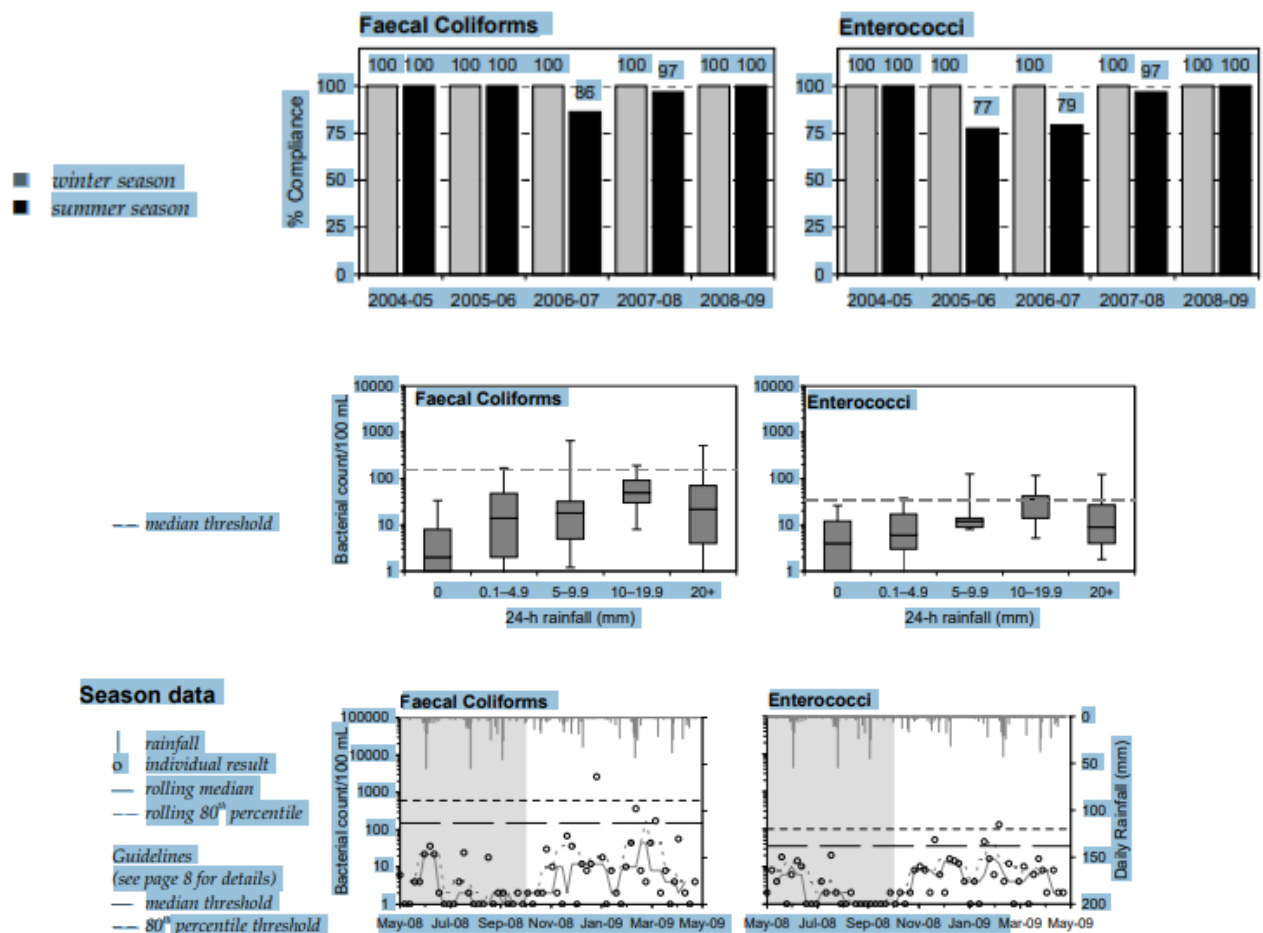


Figure 3: Urban list's top Sydney fishing spots from 2018.

Cast A Line At 11 Of The Best Fishing Spots In Sydney

By Mathew Trenear
25th Apr 2018



Cooks River

BRIGHTON LE SANDS

If you're fresh on the fishing bandwagon, this spot should be your [first port of call](#). The water here is generally pretty calm and you can go for gold with beach fishing (just make sure you've got a long rod). If you head on over to the mouth of the river, there's also a rock wall you can set yourself up on.

Type: Bank fishing

Catch: Flathead, Trevally, Salmon and Snapper

Best Time: Early evening

Clovelly Beach

CLOVELLY

The great and fishy expanse from [Gordon's Bay to Clovelly](#) offers up an abundance of spots to get your angler on (read: keep a rod in your car at all times). Our picks? Walk past the carpark towards Gordon's and set up on the cliff face or head to the Clovelly side (low tide is the best time) and kick up on the headland opposite the pool. If all else fails, you can always hit [Out Of The Blue](#) for one of the best fishburgers of all time. And note, spearfishing is banned here, as is fishing for Blue Groper.

Type: Rock fishing (by law you need to wear a lifejacket)

Catch: Bream, Parrot Fish, Red Rock Cod and Trevally

Best Time: Early morning

Manly Dam

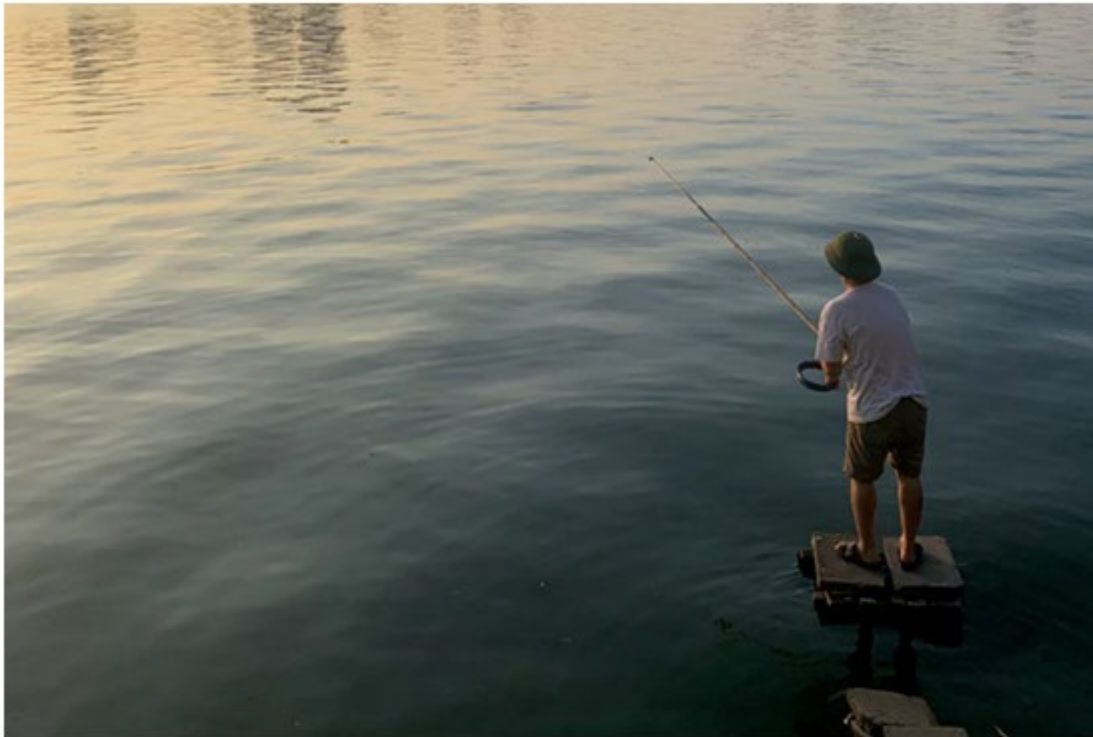
MANLY VALE

This beauty is a [heritage-listed dam](#) with a reservoir stretching into Allambie Heights. If you're a novice fisher, the wetland area is definitely a swell place to start. If you're wanting to make a full day of it, bring up a kayak, sweat it up on one of the bushwalks or load up the picnic basket for a solid feast.

Type: Freshwater fishing

Catch: Australian Bass, Silver Perch, Carp and Redfin

Best Time: Sunset (due to no tide)



Gunnamatta Bay

PORT HACKING

Head down to the shire for this fishing hotspot. [Gunnamatta Bay](#) is known for fishing off and around the nets surrounding its baths, which provide tons of food for the little fishies (convenient, we know). Hot tip: cast off the western side of the baths for the best chance of getting a bite.

Type: Jetty fishing

Catch: Flathead, Whiting, Bream

Best time: Morning

Beulah Street Wharf

SYDNEY HARBOUR

Sit across from the Opera House and cast your line into Sydney Harbour. While [this spot](#) can be more difficult to catch a bite due to fast currents, it's well worth it for the views. Yellowtail larger than your average can be found here, and again, you're best going after the last ferry for the best chances of snagging a big one.

Type: Wharf fishing

Catch: Squid, Yellowtail and Trevally

Best time: Night

Gladesville Wharf

PARRAMATTA RIVER

[This](#) popular spot known for its high population of the hard to catch Jewfish, is the perfect place to head down for a night time fishing session. Go after 9pm, when the last ferry has passed through, for the best chances of catching a line.

Type: Bank fishing

Catch: Jewfish, Flathead, Yellowtail

Best time: Night

Clarks Point Reserve

PARRAMATTA AND LANE COVE RIVERS

Sitting right at the meeting point of the Parramatta and Lane Cove Rivers is [Clarks Point Reserve](#), where you will find the best of both worlds. For the run-out tide, cast off the eastern side of the peninsula, and for the run-in tide set yourself up over on the southern facing side. The reserve has great BBQ facilities, so why not bring the fam along for a picnic?

Type: Bank fishing

Catch: Leatherjackets, Bream, Snapper

Best time: Evening

Blues Point Reserve

SYDNEY HARBOUR

Another absolutely stunning place to cast a line in Sydney, [Blues Point Reserve](#) has unbeatable views of the Harbour Bridge and the Opera House. You'll need a decent cast to get out past the snags along the shore but it's worth it for the chance to catch Kingfish, Jewfish and even Salmon.

Type: Bank fishing

Catch: Trevally, Kingfish, Jewfish

Best time: Afternoon

Tom Ugly's Bridge

GEORGES RIVER

Your best bet over at [Tom Ugly's Bridge](#) is to set up over on the northern side and park right up next to where you're going to cast from. Bait with a few bloodworms and head here during the run-out tides for your best chance of catching a few Bream.

Type: Bank fishing

Catch: Bream, Tailor

Best time: Anytime, though very busy on weekends

Clifton Gardens

PORT JACKSON

One of the most picturesque spots in Sydney to fish has to be [Clifton Gardens](#). The huge public pool attracts hordes of beachgoers, so our advice is to head out on the jetty and past the pool in the early morning, then cast off into the deep waters. Another option is to set up along the parklands, esky by your side (obviously).

Type: Bank and jetty fishing

Catch: Trevally, Bream, Yellowtail, Kingfish

Best time: Early morning

Brighton Le Sands Beach

COOKS RIVER

The calm waves at [this beach](#) making it relatively quiet, so it's the perfect place for a spot of fishing. Bring your swimmers for a dip when it gets a bit too warm, then sit back and cast away. You're almost guaranteed a bite every time at this hotspot.

Type: Beach fishing

Catch: Bream, Tarwhine and Snapper

Best time: Early evening

Figure 4 Relative Magnitude of Interactions on Social, Environmental, and Economic Value taken from *Implementing a Triple Bottom Line Approach to Monitor the Impacts of Tourism in Manly, University of Western Sydney*

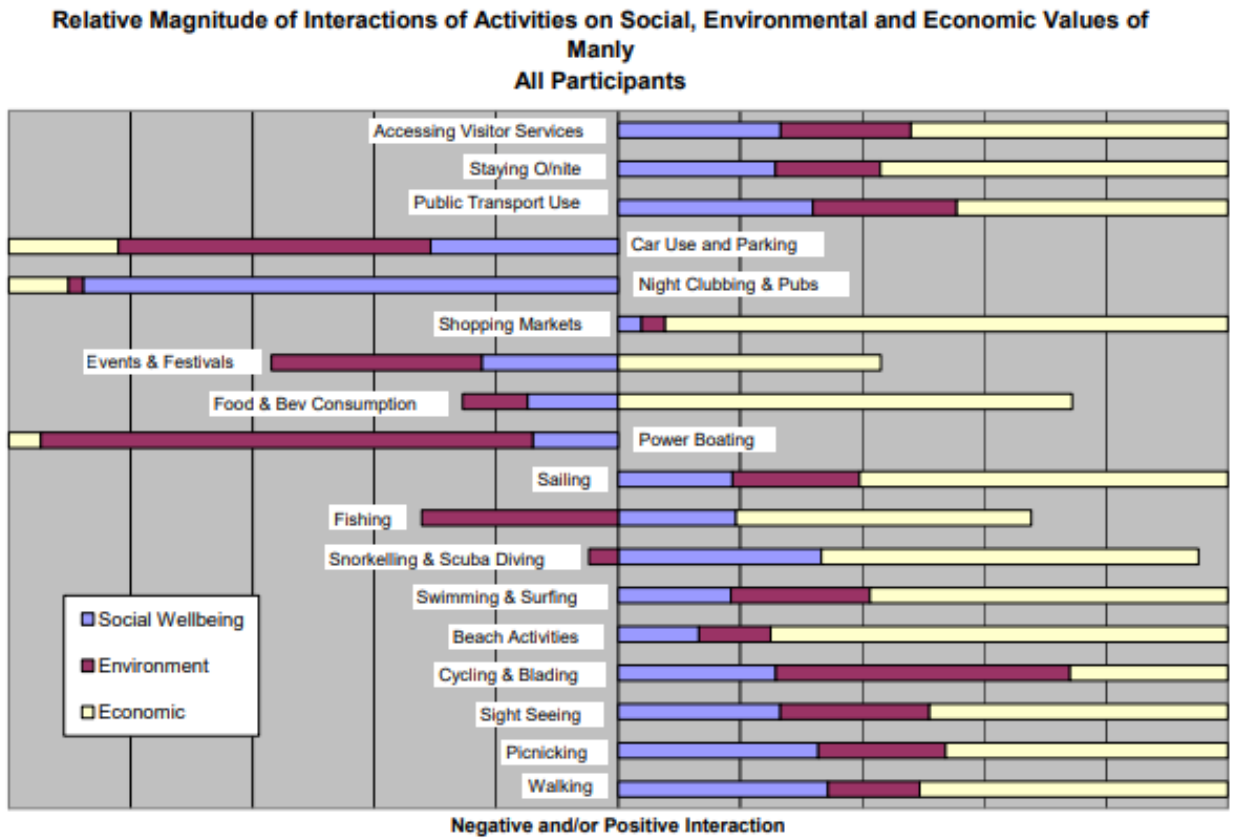


Figure 5: Perceived Net Value of Tourism activities in Manly, taken from *Implementing a Triple Bottom Line Approach to Monitor the Impacts of Tourism in Manly, University of Western Sydney*

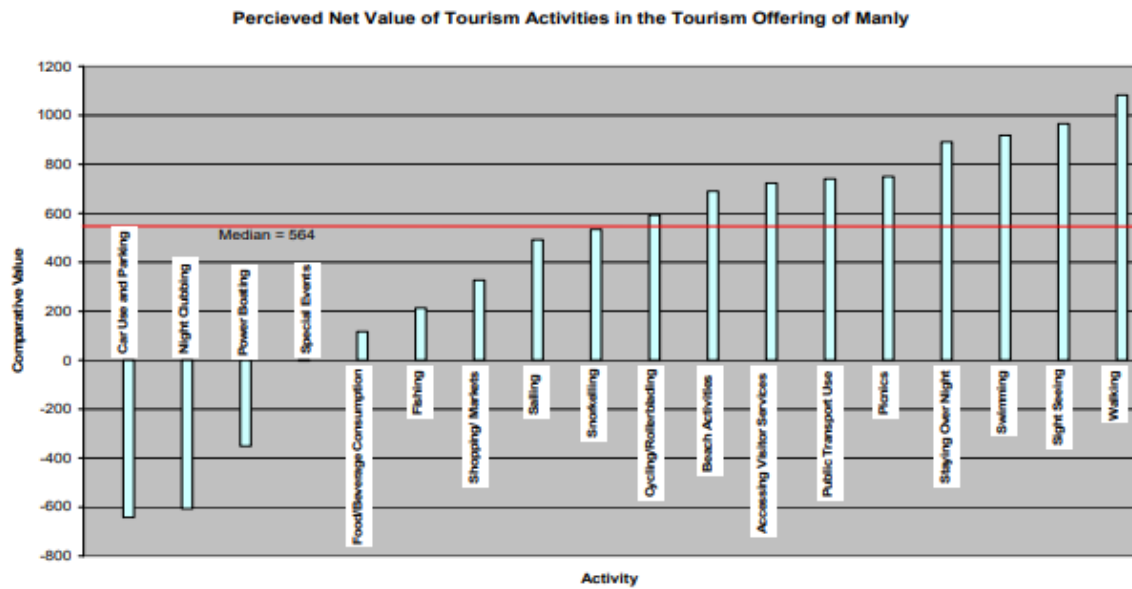


Figure 6: Tourism Effect of Social Wellbeing Values of Manly, taken from *Implementing a Triple Bottom Line Approach to Monitor the Impacts of Tourism in Manly, University of Western Sydney*

Perceived Interaction on a Scale of +/- 100 on Social Values of Manly of Top 4 Scoring +ve and -ve Activities

	Community					Council					All				
	Health	Access	Heritage	Amenity	Overall	Health	Access	Heritage	Amenity	Overall	Health	Access	Heritage	Amenity	Overall
walking	33	17	48	49	39	30	28	26	37	32	27	16	41	42	33
picnics		8	28	45	30						4		33		
sight - seeing	31		52	52	35		11	37	35	21	25		40	40	26
cycling/blading							22	22							
beach activities				37			-64					-39			
swimming & surfing	31		26					22					25		
snorkel/scuba						41	19				30				
fishing							22								
sailing	30														
power boating	-11					-24		-22	-9	-15	-16		-2		-8
food/bev consumpt.	-18	-33			-4	-39		-19			-27				-8
events & festivals	-20	-50			-7	-31	-81				-32				-14
shopping/markets															
nightclubbing/pubs	-62	-46	-9	-17	-33	-65	-58	-7	-9	-33	-70		-9	-14	-37
car use & parking		-49	-13	-16	-19		-72	-19	-14	-23					
public transport use	34	39			29					27					24
staying Overite		19				28		22	38	26	26	12		32	25
accessing visitor services						30		48		25			23		

Table 3: Total Visitors to Manly, sourced from Destination NSW, utilising data from International Visitors Survey and National Visitors Survey, Tourism Research Australia

Total Visitors to Manly

	YE March 2016	YE March 2017	YE March 2018	YE March 2019	4 Year Average
International and Domestic overnight and day trip visitors ('000)	2,216.2	2,269.7	2,572.0	2,611.9	2,417.4

International Visitors to Manly

	YE March 2016	YE March 2017	YE March 2018	YE March 2019	4 Year Average
(a) International <u>overnight</u> visitors to Manly i.e. spent at least one night in Manly ('000)	44.3	49.1	60.2	53.2	51.7
(b) International <u>overnight</u> visitors to NSW who visited Manly as a day trip, but stayed overnight elsewhere in NSW ('000)	936.8	995.5	1,008.2	956.5	974.2
Total international visitors ('000)	981.1	1,044.6	1,068.4	1,009.7	1,025.9

Domestic Visitors to Manly

	YE March 2016	YE March 2017	YE March 2018	YE March 2019	4 Year Average
(c) Domestic <u>overnight</u> visitors to Manly i.e. spent at least one night in Manly ('000)	123.6	205.4	129.2	146.2	151.1
(d) Domestic <u>overnight</u> visitors to NSW who visited Manly as a day trip, but stayed overnight elsewhere in NSW ('000)	627.6	657.5	789.5	810.5	721.3
(e) Domestic <u>day trip</u> visitors to Manly ('000)	483.9	362.2	584.9	645.5	519.1
Total domestic visitors ('000)	1,235.1	1,225.1	1,503.6	1,602.2	1,391.5

Table 4: Excerpt from Northern Beaches Annual Financial report 2019.

Northern Beaches Council

Notes to the Financial Statements

for the year ended 30 June 2019

Note 3 Income from continuing operations (continued)

	Year Ended 30 June 2019 \$'000	Year Ended 30 June 2018 \$'000
(b) User charges and fees		
User charges (pursuant to s.502)		
Commercial Waste Management Services (non-domestic)	128	493
Total user charges	126	493
Fees		
Advertising Fees	858	837
Animal Registration	142	164
Aquatic Centres*	7,158	6,804
Caravan Park	5,728	5,877
Cemeteries	1,051	724
Child Care	12,198	11,832
Coastal Environmental Centre	230	220
Community Centres	2,127	2,048
Currawong State Park	358	368
Film Permits	118	128
Glen Street Theatre	1,511	1,245
Golf Courses*	1,808	1,739
Kimbriki Waste & Recycling Centre*	22,238	22,375
Leaseback Fees - Council Vehicle	780	788
Libraries	171	188
Parking Areas	13,300	11,802
Sportsfields and Reserves*	1,608	1,672
Planning and Building Regulation	5,328	6,142
Regulatory/ Statutory Fees	831	664
Restoration Charges	1,674	1,558
Road Inspections	450	409
Section 10.7 Certificates (EPA Act)	688	744
Section 603 Certificates (LG Act)	350	380
Other*	983	994
Total fees	81,658	79,292
Total user charges and fees	81,784	79,785

Accounting policy for user charges and fees

User charges and fees are recognised as revenue when the service has been provided.

* Items have been re-classified in accordance with the Local Government Code of Accounting Practice.