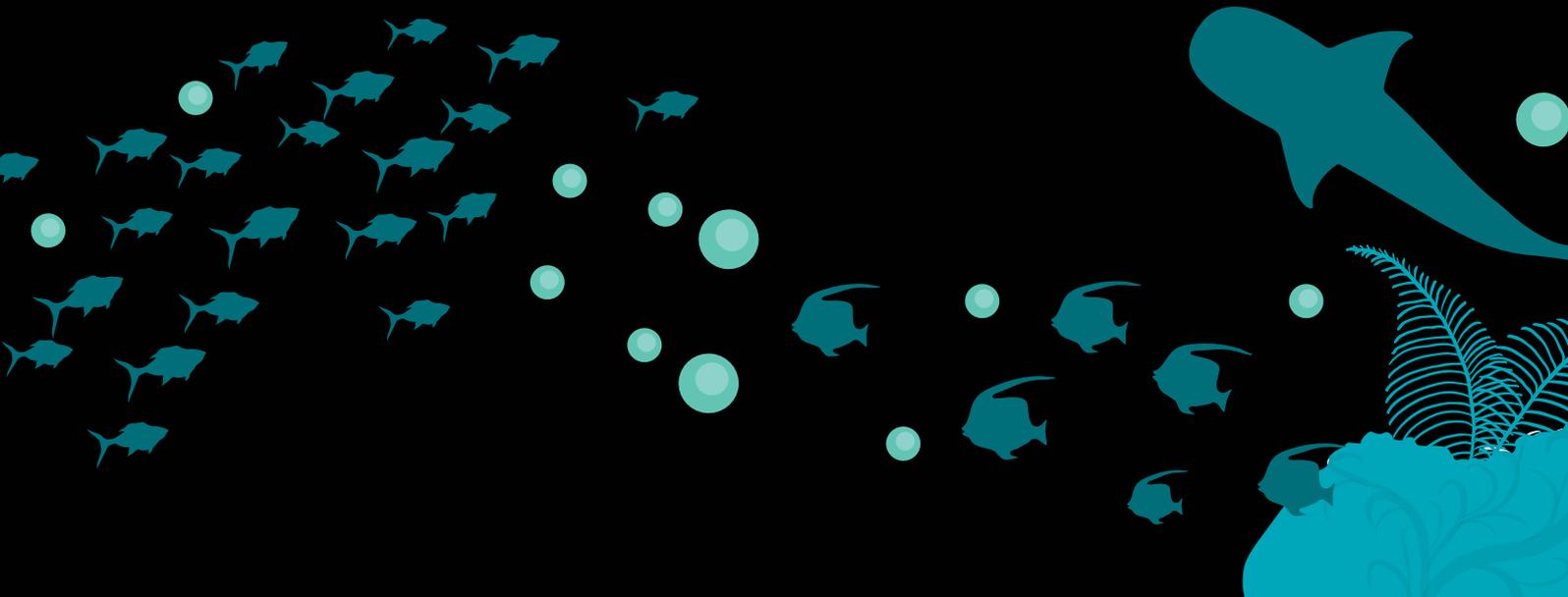




Economic contribution
of Ningaloo: one of
Australia's best kept secrets

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Foreword

The COVID-19 global pandemic and resulting economic fallout demonstrates the potentially significant consequences of overlooking environmental risk events. Events such as a warming world and a changing climate, while more gradual, will be as disruptive, and potentially more so, than what we have all experienced through COVID-19.

While Governments and business rightly focus on managing today's public health crisis and the resulting economic implications, we cannot lose sight of the bigger picture viz. challenges to our environment and the role we have as custodians and managers of the wonderful natural assets that exist in the world around us.

The Ningaloo region, located on the remote western coast of Australia, is a universally astonishing place. The scientific significance of Ningaloo Reef is remarkable – placed on an ecotone between tropical and temperate waters, the Ningaloo Reef hosts an unusual diversity of marine species.

The dramatic land and seascapes of the region tell unparalleled stories across time, latitude and species – about the movement of continents, changing climates and the evolution of life over 150 million years.

There is no doubt that Ningaloo has a very special place in the hearts of Western Australians. I have a deep affection for this region, having been a regular visitor since the mid-1970s. The beauty of the pristine waters and remarkable marine life mesmerised me, as did the adjacent ancient landscape that evoked deep spiritual connections with this land.

Beyond its unparalleled beauty and richness of biodiversity, this report illustrates the economic contribution and activity that Ningaloo delivers to Western Australia.

The unique interaction of our economy, communities and the environment is at the forefront of our thinking when it comes to planning for both resilient economies and ecosystems. We cannot have one without the other. The Ningaloo Reef is a globally unique asset that must be protected so that it can continue to be enjoyed and support the significant contribution the Ningaloo region makes to the Western Australian economy.

As the world seeks to recover from the impacts of COVID-19 and establish a recovery pathway that ensures resilience for our economies, communities and the environment – there has never been a more critical time to understand, and value, precisely what Ningaloo contributes.

Professor Peter Klinken AC

Chief Scientist of Western Australia

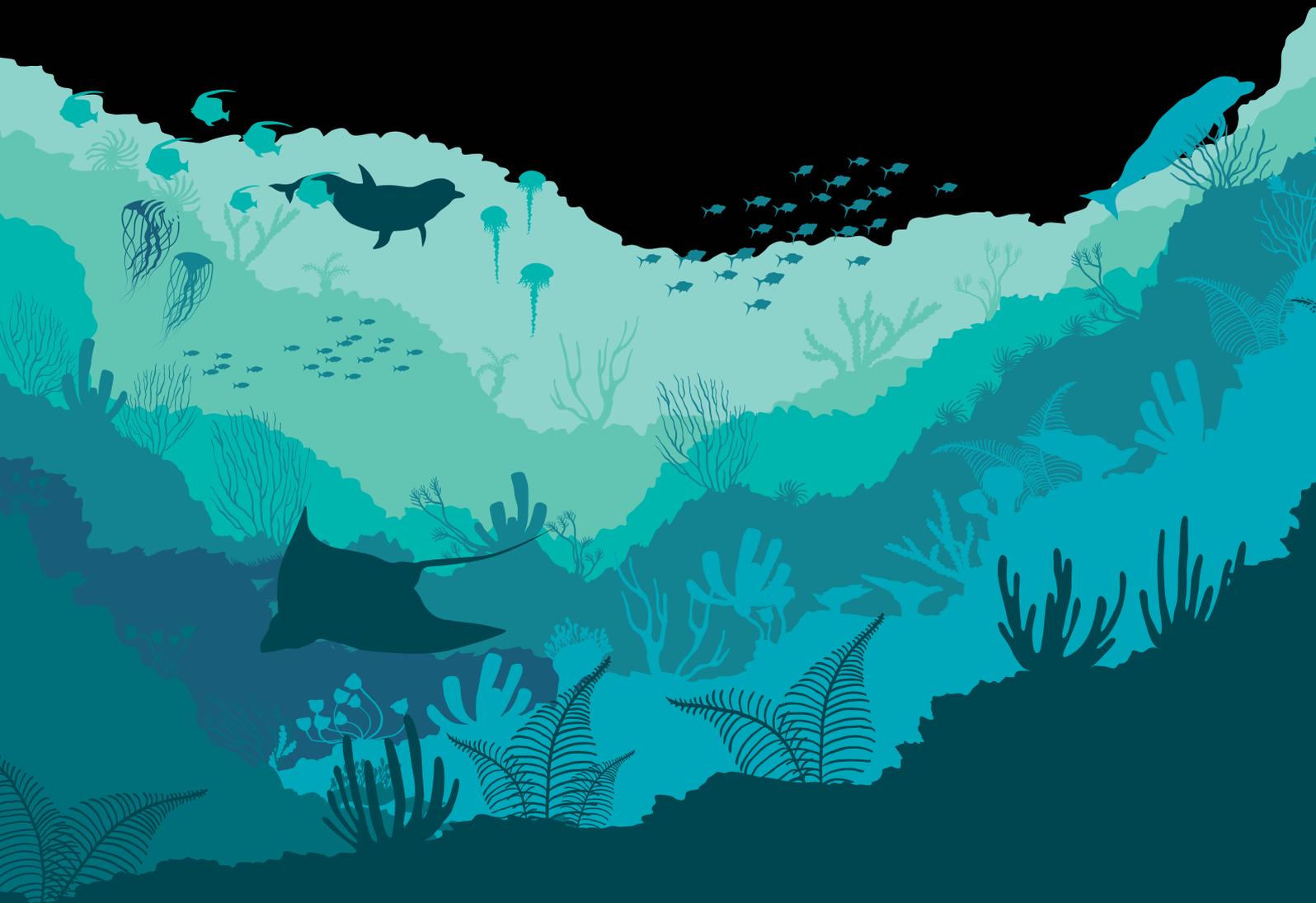
Acknowledgements

Deloitte Access Economics acknowledges and thanks the West Australian Department of Biodiversity, Conservation and Attractions (Ningaloo) for commissioning this report as part of the Resilient Reefs Initiative.

Launched in 2018, the Resilient Reefs Initiative is partnering with communities across five pilot World Heritage Reef sites to respond to climate change and local threats. Resilient Reefs funds long term resilience planning, capacity building and implementation in the five pilot sites. This includes funding and training for a new leadership role—a Chief Resilience Officer—in the local reef management authority. Enabled by the BHP Foundation, the program is a collaboration between the Great Barrier Reef Foundation, UNESCO World Heritage Marine Programme, The Nature Conservancy's Reef Resilience Network, Columbia University's Center for Resilient Cities and Landscapes, Resilient Cities Catalyst and AECOM. These global partners each bring unique expertise and support to the pilot sites, as well as help to share the lessons and learnings from the initiatives with reef communities around the world.

We would like to acknowledge and pay our deepest respects to the Traditional Owners of the Ningaloo Reef country – the Baiyungu, Thalanyji and Yinikurtura people – as First Nations Peoples holding the hopes, dreams, traditions and cultures of the Reef. In particular, we thank Hazel Walgar for her significant contribution and assistance in articulating the Aboriginal value of the Ningaloo Reef, as a Traditional Owner who lives on country at Cardabia Station and is involved in the joint management of Ningaloo Marine Park (NMP) and adjacent lands.

Executive summary



The Ningaloo region is one of Western Australia's best kept secrets, contributing **\$110 million** in value added to the State economy in 2018-19.

A natural wonder of the world

When the skies above Perth and the South West turn grey during winter, it's a call for many Western Australian families to pack up their four-wheel drives and travel thirteen hours north in search for a warmer climate. Their destination: The Ningaloo region.

The Ningaloo region ('Ningaloo') encompasses Ningaloo Reef ('the Reef') and the surrounding coastal region. While the Ningaloo Coast World Heritage Area covers much of the area of assessment, this study also includes the Exmouth Gulf, communities of Exmouth and Coral Bay, and adjacent proposed southern coastal reserves and pastoral leases. Home to one of the world's largest near-shore reefs, the Reef can be reached by just a short swim from the coast in many places.

Ningaloo's uniqueness, biodiversity and incredible natural beauty put it on UNESCO's World Heritage list in 2011 and is on many people's 'bucket list' to visit to swim with the largest fish in the ocean, the majestic whale shark.

While the Reef's natural wonder is currently well-preserved, the Reef, like all reef systems, faces uncertainty over future impacts from a changing climate and the constant need to balance preservation with broader economic prosperity.

Careful management and planning for resilience in the World Heritage Area are critical to ensuring the Reef's natural wonder is both preserved today and for future generations. In addition to careful monitoring of the reef conditions, a deeper understanding of the economic contribution of this unique natural landscape can help inform policy and management decisions.

Economic contribution of nature

This report estimates the economic contribution of the Ningaloo region. To do so, it quantifies the contribution of Ningaloo to the Western Australian (WA) economy in 2018-19, based on four key channels of economic activity related to the Reef.

Ningaloo's economic contribution to WA is attributed to four key types of economic activity:

- **Tourism expenditure** by international, interstate and WA visitors to the Ningaloo region
- **Commercial fishing** in the Exmouth Gulf
- **Recreation** activity involving the Reef by residents of the Ningaloo region
- **Management and research** relating to the Reef.

The economic contribution of Ningaloo can be understood through its **value added** to WA's gross state product (GSP) and the level of full-time equivalent (FTE) **employment** supported by these activities. Value added and employment are alternative, not additive, measures of economic contribution.

In 2018-19, Ningaloo contributed an estimated **\$110 million in value added to the WA economy**. More than 90% of this value added is attributed to the hundreds of thousands of domestic and international tourists who visit Ningaloo each year, with this tourism activity largely contingent on the Reef's unique existence.

Ningaloo is estimated to have supported **more than 1,000 full time jobs** in WA in 2018-19, with employment concentrated in tourism-related industries catering to visitation to the region.

The contribution of economic activities related to the Reef is summarised in Table i.

Table i: **Estimated contribution Ningaloo to the WA economy, 2018-19**

Activity	Economic expenditure (\$ millions)	Value added (\$ millions)	Value added (FTE employment)
Tourism	\$173.8	\$99.5	954
Commercial fishing	\$12.2	\$8.3	41
Recreation	\$0.7	\$0.5	4
Management and research ¹	\$7.2	\$1.3	55
Total	\$193.9	\$109.6	1,053

Source: Deloitte.

The \$110 million in value added to the WA economy in 2018-19 was driven by an estimated \$194 million in economic expenditure on tourism, commercial fishing, recreation, management and research activities.² Total expenditure is the input to the estimation of Ningaloo's economic contribution, while the output is measured by value added.

Importantly, value added is not a representation of the total economic value of Ningaloo as an asset, nor does it represent the wider social, cultural or community value of Ningaloo or any related activities. This study discusses these wider measures of value qualitatively.

Social, cultural and Traditional Owner value

In addition to supporting local recreational and economic activities, Ningaloo lends itself to a laid-back lifestyle where visitors and locals can enjoy the outdoors, by the beach, away from the hustle and bustle of urban life. A lifestyle inherent to the Australian cultural identity.

The economic contribution of local recreation and economic activities is only one measure of value of the Ningaloo region. Ningaloo also has intrinsic non-use value to those who have not, or may not ever, visit; for generations to come (bequest value); and in knowing that other people have access to the benefits of the Reef and the surrounding region (altruistic value). People value its existence, simply because the natural asset – worthy of World Heritage status – exists (existence value). These values are used to qualitatively describe the social and cultural contribution of Ningaloo in Chapter 4.1.

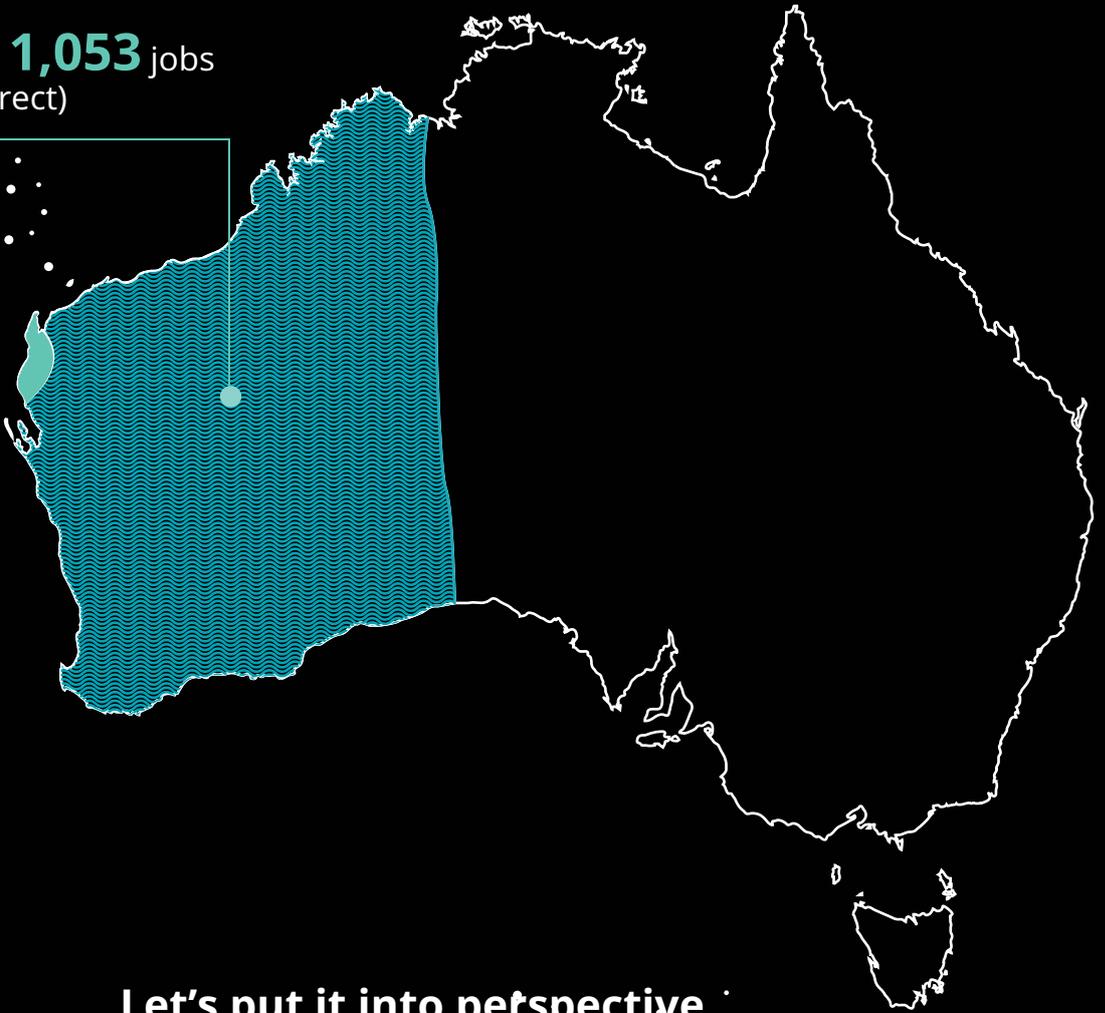
Ningaloo has significant value for the local Aboriginal people, the *Baiyungu*, *Thalanyji* and *Yinikurtura* people. Prior to European Settlement, the Traditional Owners lived in a coastal – resource driven economy, relying on Ningaloo to service fundamental needs including food, shelter and material resources.³ The Ningaloo region provides the foundation for cultural heritage dating back at least 32,000 years, including ceremonial Thalu sites. The value of Aboriginal connection to country is important to the Traditional owners' spirituality and religion, with local fauna representative of family totems. The contribution of Ningaloo Reef to the Aboriginal economy, cultural heritage and spirituality is discussed in Chapter 4.2.

Lastly, the Reef provides important ecosystem services to the region. Though the values of these services are not quantified in monetary terms as part of this study, the role of ecosystem services not addressed by economic, social and aboriginal contribution are described qualitatively in Chapter 4.3.

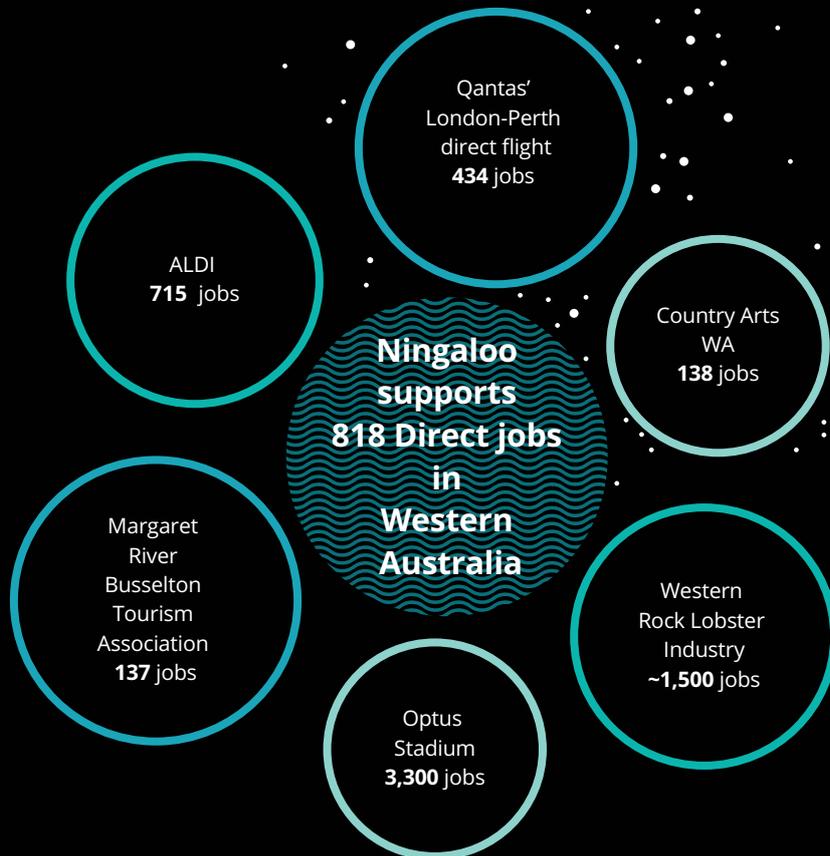
The annual GSP contribution of Ningaloo presented in this study is one way to quantify the economic 'value' of Ningaloo – specifically, the gross value added to the State economy in 2018-19 from reef-related expenditure. The value of ecosystems – coral reefs – also remains in the use and non-use value of their ecosystem services, qualitatively described in the Chapter 4 of this report. A previous study by Deloitte Access Economics found when these values were quantified, the Total Economic Value of the Great Barrier Reef was almost ten times the value of its economic contribution for FY2015-16.⁴ Even then, some attributes of ecosystems – such as the 32,000 years of Traditional Owner knowledge at Ningaloo – will not be reflected in its quantitative value.

This study demonstrates that the Reef is not only one of Australia's best kept secrets, but also an essential driver of local economic activity for Ningaloo.

\$110M and **1,053** jobs
(direct and indirect)

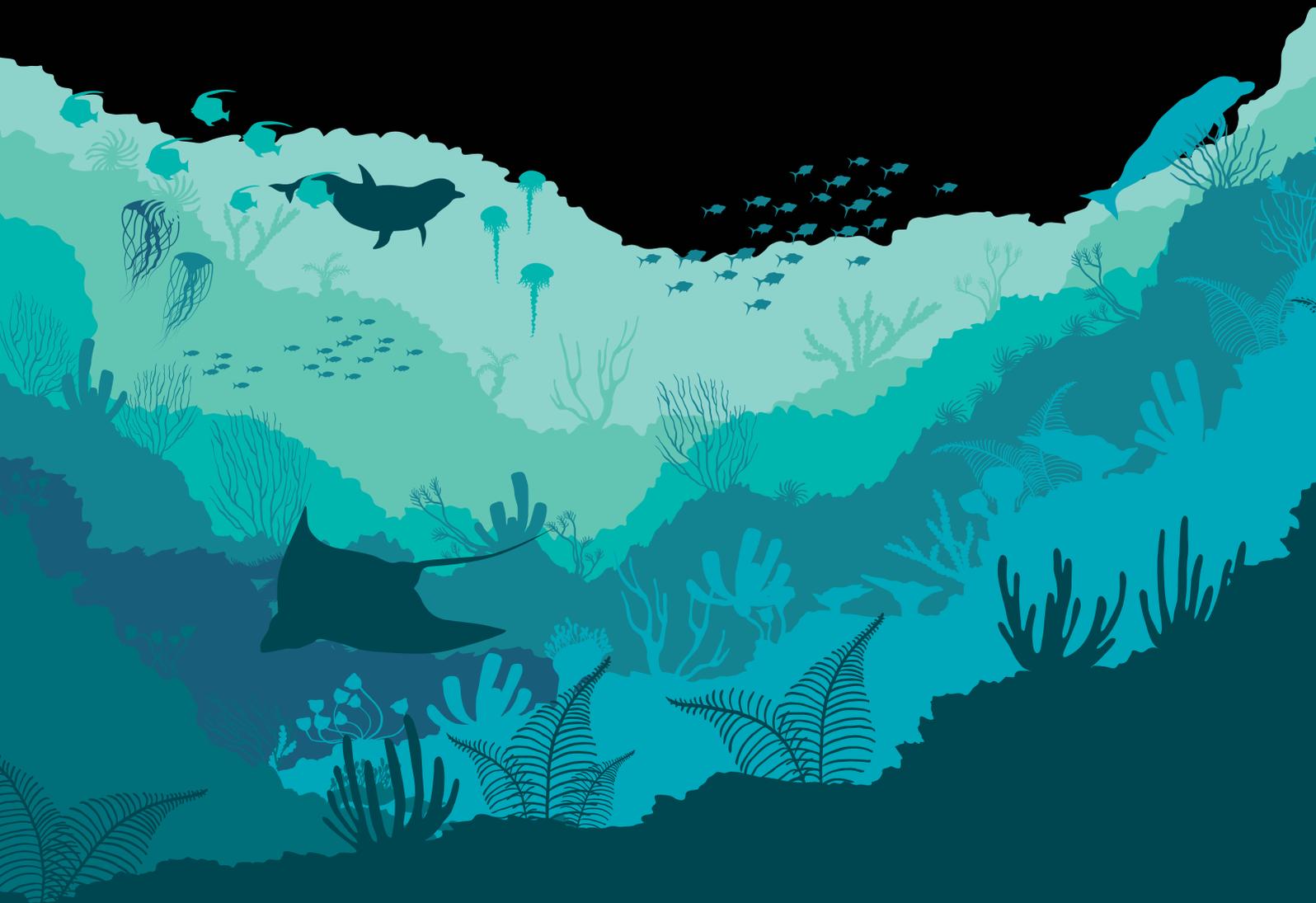


Let's put it into perspective...



Note: The figures represent direct FTEs from Ningaloo as compared to direct employees of businesses or industries in WA

1 Introduction



1.1 Overview

When the temperature in the South West drops and the skies begin to turn grey – Western Australians know it's time. Time to pack up the kids, their snorkels and their swimsuits. Time to load up their four-wheel-drives with camping gear. Time to drive thirteen hours north in search of warmer weather to the Ningaloo region ('Ningaloo').

Fringing Ningaloo in Western Australia's Gascoyne region, at 260 kilometres long, is the Reef – the largest near-shore reef in the world.⁵

So close that if you step off the beach and into the ocean at Coral Bay – as the name suggests – you find yourself immediately immersed in a marine park with pristine coral gardens, turtles, and hundreds of species of fish. Just metres from shore.

But it isn't just the Reef's accessibility to shore that makes it unique. Ningaloo also hosts a broad diversity of whale sharks, manta rays, dugongs, dolphins and more than 1,000 other marine species. Female humpback whales are also known to use the Reef to protect their calves from predators, specifically killer whales (*Orcinus orca*).⁶ With low levels of development, a long history of effective management, and legislative and regulatory protections at the national and state level, the Reef is remarkably well preserved compared to other reef systems.⁷

A 'jewel of the ocean', Ningaloo Reef is one of Australia's best kept secrets.

However, like all reef systems, Ningaloo Reef faces unprecedented challenges in the future. Rising sea surface temperatures as a result of climate change are projected to cause mass bleaching of the Reef at a rate of twice-per-decade by 2041, and annually by 2049⁸. With numbers of visitors increasing each year, there is also increasing pressure on the Reef in terms of physical damage to high use sites, increased boat activity and greater pressure on fish stocks. There is a realisation that more needs to be done to strengthen the Reef and the local community. The Department of Biodiversity, Conservation and Attractions (DBCA) has recently launched the Resilient Reefs Initiative with support from Great Barrier Reef Foundation to connect reef managers and users with global expertise to develop leading-practice management strategies for resilience.



Source: Google Earth, (1999)

The United Nations Educational, Scientific and Cultural Organisation ('UNESCO') has called for concentrated action to strengthen the resilience of coral reefs to changing climate conditions. The Resilient Reefs Initiative is partnering with communities across five World Heritage Reef sites to respond to climate change and local threats. This four-year, \$US9 million program is a collaboration between the Great Barrier Reef Foundation, UNESCO World Heritage Marine Programme, The Nature Conservancy's Reef Resilience Network, Columbia University's Center for Resilient Cities and Landscapes, Resilient Cities Catalyst and AECOM and enabled by the BHP Foundation. The initiative aims to:

- Engage with broad stakeholders
- Assess the state of resilience
- Develop a Resilience Strategy and design Resilience Actions
- Implement Resilience Actions.

At a local level, the Department of Biodiversity, Conservation and Attractions ('DBCA') is responsible for the everyday management of Ningaloo coastal reserves. DBCA has engaged Deloitte to undertake a contribution study to better understand the contribution of the Ningaloo region to the Western Australian economy as part of ongoing management plans and sustainability of the area and to support the Resilience Strategy and design of Resilience Actions.

A clear understanding of the economic contribution of Ningaloo and industries associated with the Reef will inform future planning for management and assist industry, government, the scientific community and the wider public to fully appreciate the contribution of Ningaloo to the economy and society.

1.2 Solving for the economic invisibility of nature

Biodiversity is a measure of the variety of biological life; it exists in many layers. Ecosystems, species and genes are layered across many geographies, local, state and global. They are our stock of *natural capital*, providing a flow of benefits to support societal and economic prosperity.⁹ What is often taken for granted – or invisible – is how dependent our society is on the health of environmental systems.

Because natural capital does not have a transactional cost, meaning society does not pay for its use, the System of National Accounts ('SNS') does not capture its value to supply chains.¹⁰ For example, in a coral reef ecosystem the SNS recognises the value of fish and crustacea supplied by fisheries in the surrounding region, the income to households in exchange of produce and the fishermen's employment as benefits to the economic health of the State. Yet the destruction of reefs causing significant habitat and biodiversity loss has very little visibility in our national account systems.

Changes in our natural capital stock are important to understand because they affect the flow of goods and services that rely on nature. The lack of measurement and reporting feeds into a lack of informed public discussion on what to do, where and by whom.

1.3 Why value Ningaloo Reef?

Coral reefs are widely considered as the most biodiverse ecosystem on the planet. Globally, coral reefs make up less than one percent of the ocean floor, yet they contain 25 percent of marine life.¹¹ They are the primary source of food production for more than 500 million people worldwide – or an eighth of the population.¹² Ultimately, they face the problem of economic invisibility.

Understanding value is critical to inform trade-offs in decision-making regarding economic, social and ecosystem management. The time, effort and money allocated to conservation compared with other causes is determined by its relative value to society. When the true value of ecosystems are included, traditional trade-offs may be revealed as unacceptable and broader decision making can be supported. The cost of acting to sustain biodiversity and ecosystem services can be significantly lower than the cost of inaction.¹³

Understanding the value of our natural assets has never been more important. The economic fallout resulting from the COVID-19 global pandemic demonstrates the potentially significant consequences of overlooking environmental risk events. Events such as a warming world and a changing climate, while more gradual, will be as disruptive, and potentially more so, than what we have all experienced through COVID-19.

This report examines the role of the Ningaloo in contributing to the State economy, quantitatively and qualitatively. It draws on methodological learnings from previous Deloitte Access Economics reports to quantify Ningaloo Reef's value added to the economy and the contribution to employment.

In addition to providing a contribution analysis, the significance of Ningaloo Reef from a social and cultural perspective is considered. The connection of Aboriginal people to the Ningaloo Reef spans 32,000 years and its natural features are deeply embedded in Indigenous culture, spirituality and wisdom. While this value is not quantified, its significance and qualitative value is demonstrated.

"We cannot manage what we do not measure".¹⁴

2 Background



2.1 The Ningaloo region

The scope of this study is the Ningaloo Reef and Coast, which includes the 300km of fringing reef that extends down the western side of North West Cape to Red Bluff, as well as the terrestrial areas and communities that are associated with Reef. This includes:

Marine Areas:

- **Ningaloo Marine Park (State Waters)** – DBCA Parks and Wildlife Service in joint management with Traditional Owners is primarily responsible for the management of the Ningaloo Marine Park (State Waters) which spans the length of the reef from Bundegi to Red Bluff. This area includes the Muiron Islands Marine Management Area, as well as a coastal strip of land that extends to 40m above the high tide mark in pastoral leases that front the Marine Park.
- **Ningaloo Marine Park (Commonwealth Waters)** – Parks Australia is primarily responsible for management for managing the Commonwealth Waters, which covers 2,435 square kilometres of the outer area of Ningaloo. The reserve ranges from a water depth of 300 to 500 metres and comprises deep under-sea canyons, diverse sponge gardens and rich fish communities.

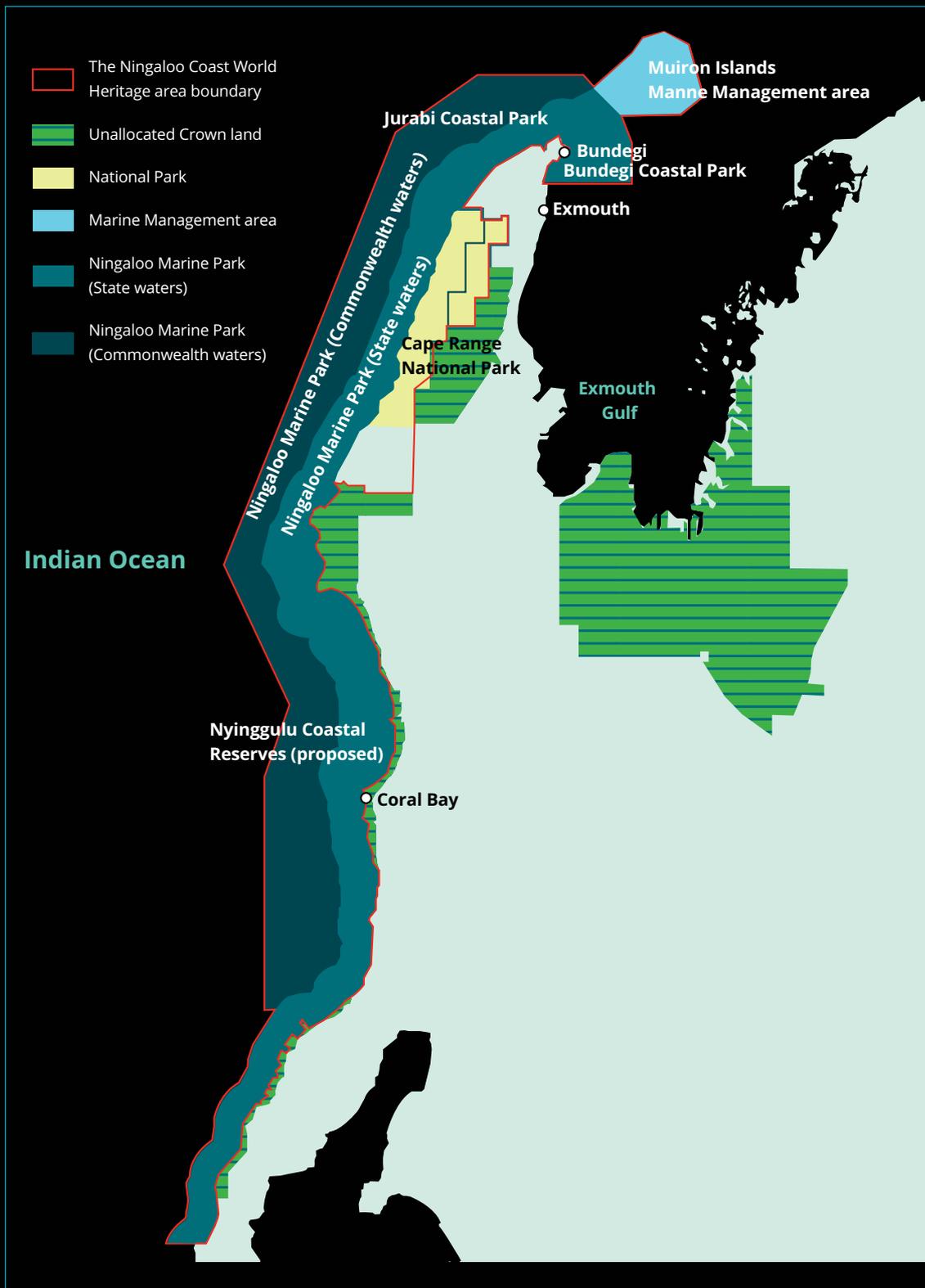
Terrestrial Areas:

- **Cape Range National Park** – extending from Tantabiddi to the south of Yardie Creek and adjacent to the northern end of the Ningaloo Marine Park (State waters), the Cape Range National Park is managed by DBCA Parks and Wildlife Service.
- **Jurabi and Bundegi Coastal Parks** – At the northern end of North West Cape, north of Cape Range National Park, the Jurabi and Bundegi Coastal Parks are jointly managed by DBCA and Shire of Exmouth. Harold E. Holt Naval Communication Station, managed by Defence, sits adjacent to these Coastal Parks.

- **Pastoral leases and proposed southern coastal reserves** – the area to the south of Cape Range National Park has had a long history of management via pastoral leases, which also support extensive coastal camping tourist nodes. Ningaloo, Cardabia, Warroora, Gnaraloo and Quobba Stations are adjacent to the NMP and are managed by leaseholders or under joint management by DBCA and Traditional Owners.
- The communities of **Exmouth and Coral Bay**
- **Exmouth Gulf** – The Gulf is a large, shallow embayment to the eastern side of North West Cape. The Gulf was originally considered for inclusion as part of the World Heritage nomination but did not have the same levels of legislative protection and clear tenure for management as the areas of the Ningaloo Coast covered by marine and national park status. However, there is clear connectivity of this area to Ningaloo Reef, both ecologically with many iconic marine animals and fish moving between the Reef and the Gulf and socially (the Gulf supports an commercial prawn fishery which is important to the local economy as well as having significant recreational and tourism value), and a portion Exmouth Gulf is included in the Ningaloo Marine Park and the Ningaloo Coast World Heritage Area.
- Various areas of unallocated **Crown Land and Commonwealth Defence Land** that are immediately adjacent to the tenures listed above.

The World Heritage listing for the Ningaloo Coast encompasses the Ningaloo Marine Park (State and Commonwealth Waters), Cape Range National Park, Jurabi and Bundegi Coastal Parks, and areas of unallocated Crown Land and Defence Land. In that sense, the World Heritage Area covers much of the area of assessment, though this study also includes the Exmouth Gulf, communities of Exmouth and Coral Bay, and adjacent proposed southern coastal reserves and pastoral leases (Figure 2.1).

Figure 2.1: The Ningaloo region local geography and tenure boundaries



Source: The Department of Biodiversity, Conservation and Attractions

The remainder of this section describes the ecology and biodiversity of the region which contribute to Ningaloo's status as a World Heritage Area and discusses the economic nuances of the surrounding region.

Ningaloo Ree

Up to
500 whale sharks
per year

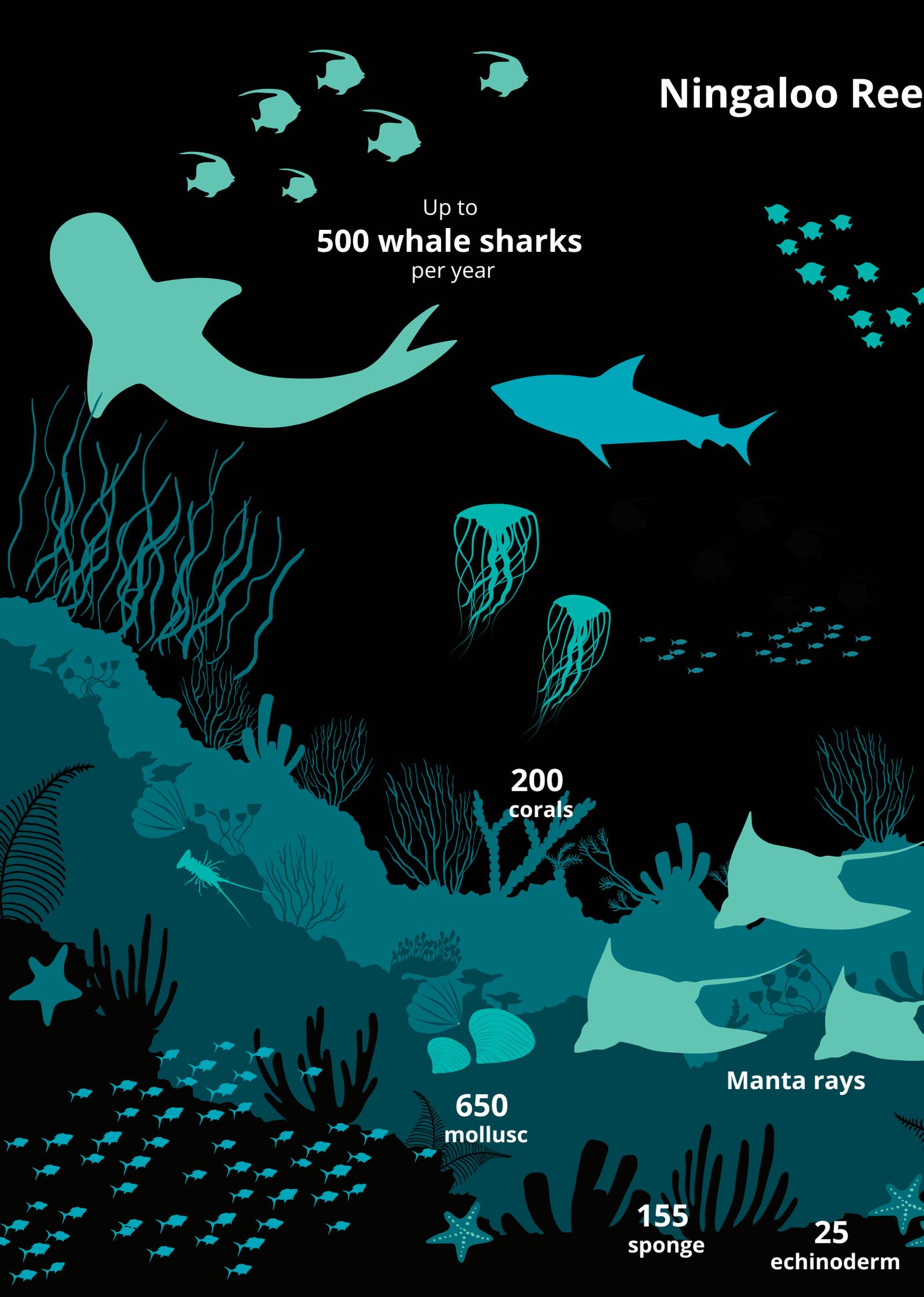
200
corals

650
mollusc

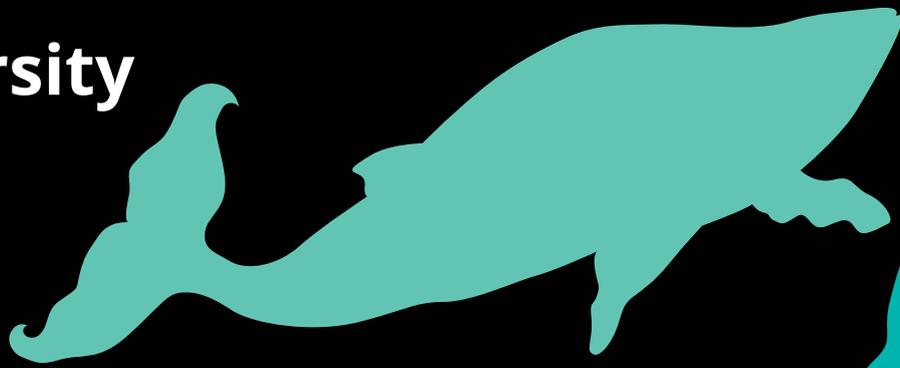
155
sponge

25
echinoderm

Manta rays



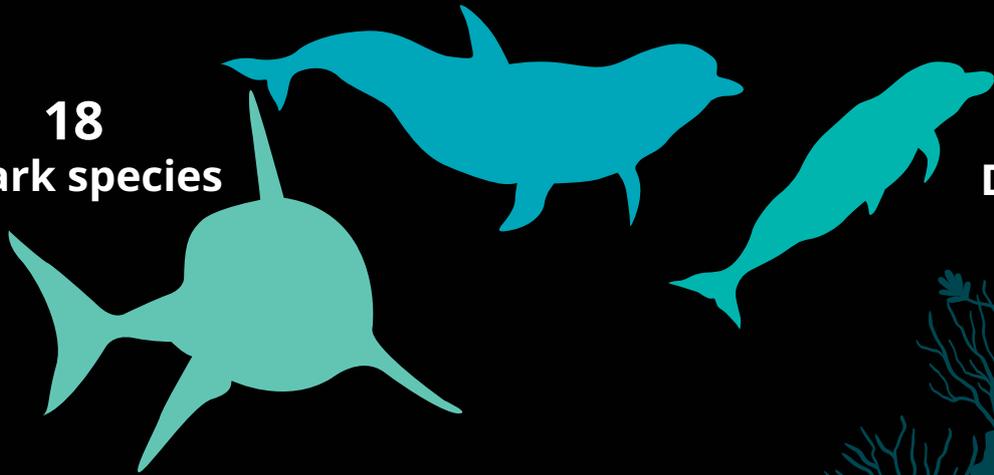
f Biodiversity



Humpback whales

Dolphins

18
shark species



Dugong

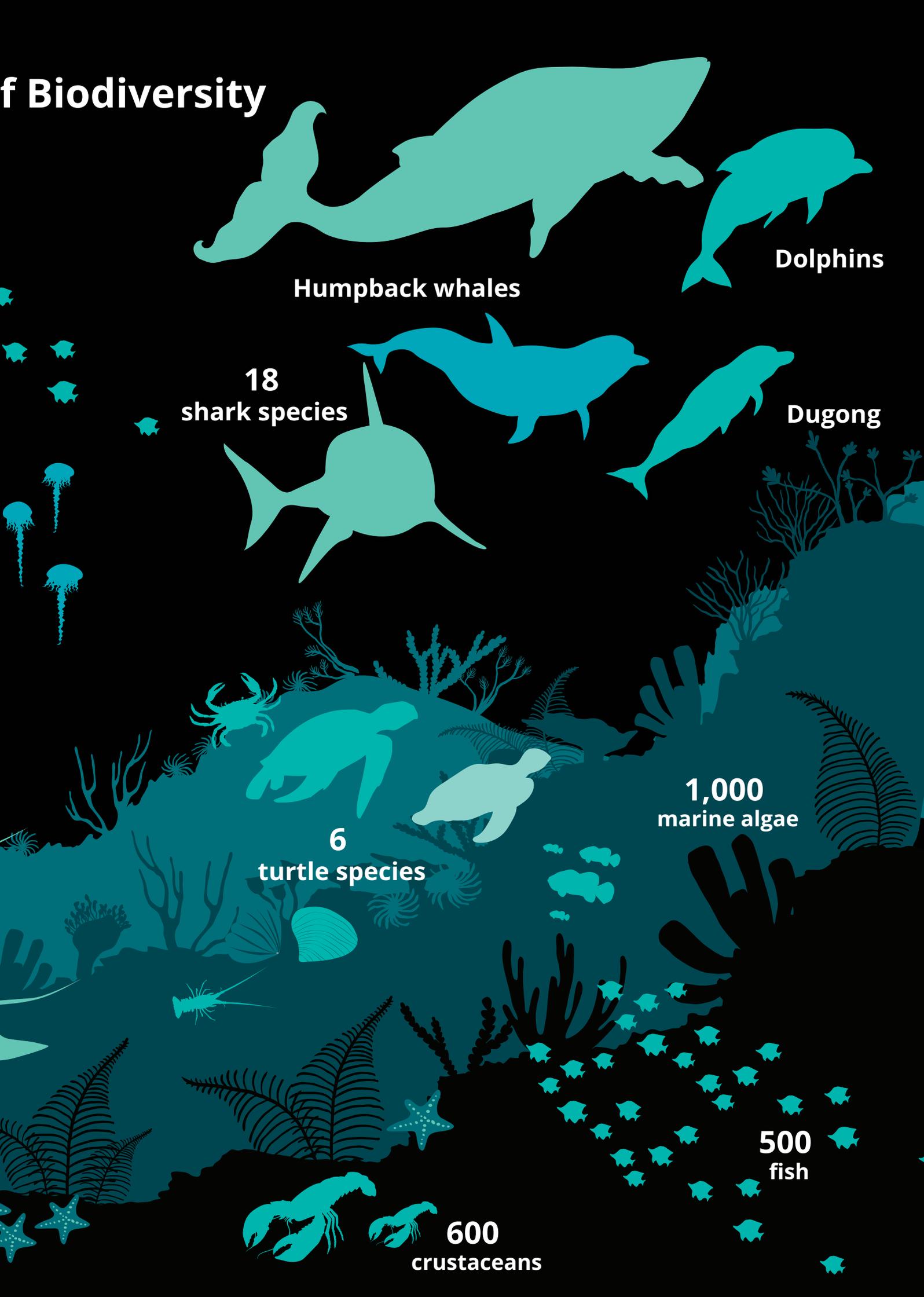
6
turtle species



1,000
marine algae

500
fish

600
crustaceans



Ningaloo: A World Heritage Area

The Ningaloo Coast World Heritage Area ('NCWHA') was inscribed on the World Heritage list on 24 June 2011 under two of the natural World Heritage Outstanding Universal Value criteria:

- containing areas of incredible natural beauty
- containing the most important and significant natural habitats for in situ conservation of biological diversity.

The NCWHA is located on Western Australia's central remote coast along the East Indian Ocean, approximately 1,180 kilometres north of Perth. The interconnected ocean and arid coast form aesthetically striking landscapes and seascapes.

Further, Cape Range National Park is a biogeographic transition zone between the tropic, temperate and desert regions, resulting in an exceptionally high diversity of plants, birds and reptiles, a high proportion of which are found nowhere else in the world. This exceptional transition zone is the result of the mixing between the cold north-flowing West Australian Current and the warm Indian Ocean Counter Current or Leewuin Current.

One of the longest and most pristine fringing reefs in the world, Ningaloo Reef also has an unusually narrow continental shelf. The deep oceanic waters, the reef and coastline communities are in close proximity resulting in a huge array of internationally significant and healthy marine life coexisting in one area.

The NCWHA is also known a migratory route for eight species of whales. Specifically, the Exmouth Gulf is an important nursery for humpback whales – with 688 calves recorded from August to November in 2018.¹⁵ Mothers and calves use the sheltered waters of the Gulf to rest and feed in preparation for their return migration from the breeding and calving grounds along the Western Australian coast into the Kimberley and back to feeding grounds in Antarctica.

The key outstanding universal value linked to the terrestrial portion of the NCWHA that contributed to the World Heritage listing is the extensive karst system. Below the arid terrain lies a substantial network of caves, conduits, groundwater streams, pools and aquifers that support a diversity of subterranean aquatic species. More than 80 subterranean taxa have been recorded, 75 of which are completely underground and confined to subterranean habitats.¹⁶

General economic activity in the region

Situated within the Gascoyne Level 3 Statistical Area (SA3), the Ningaloo region is an important source of economic activity for the central west coast. The Shire of Exmouth, defined by the Local Government Area (LGA), lies adjacent to the reef, where most of reef-related activity is situated. Some reef-related activity also occurs at Coral Bay, a small town in the Shire of Carnarvon with a population of 190 people. The infographic on the following page highlights some of the key features of the Ningaloo economy. The Shire of Exmouth LGA is more considered to be more representative of the Ningaloo region population, compared to the Shire of Carnarvon. For this reason, the analysis of general economic activity only refers to the Shire of Exmouth LGA.

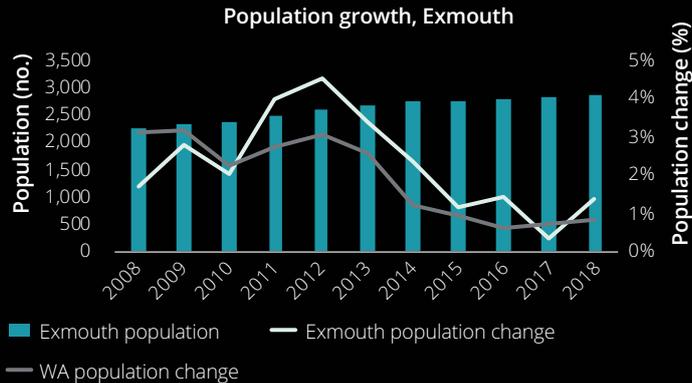
The Ningaloo Economy

Ningaloo is an important source of economic activity for the central west coast. In 2018, the Exmouth contributed \$720.9 million to the Gascoyne region.

Population

In the five years to 2012, Exmouth's population grew by **18%**, greater than surrounding regions in Western Australia (**15%**) and Gascoyne (**5%**). Since, Exmouth's population growth has mostly remained above population growth in WA.

Source: ABS Labour Force



In the five years to 2016, Exmouth's population aged:

10%

Population growth Aged 15-64

30%

Population growth Aged 65+

Source: Department of Education, Skills and Employment

Employment

Recent travel restrictions implemented during the COVID-19 pandemic significantly affected Exmouth and Coral Bay with many tourism operators, cafe's and restaurants closing down and laying off staff. A similar situation may occur if the Reef was significantly damaged.

Jobs supported by tourism

Region	Percentage
WA	5.0%
Gascoyne	14.8%
Exmouth	35.5%

Jobs supported by professional, Scientific and Technical services by year

Year	2006	2011	2016
No. of jobs	21	76	114

Top 5 industries of employment, Exmouth 2016

Accommodation and Food Services	12%
Retail Trade	11%
Construction	10%
Public Administration and Safety	10%
Professional, Scientific and Technical Services	8%

Source: ABS Census, 2006, 2011 and 2016

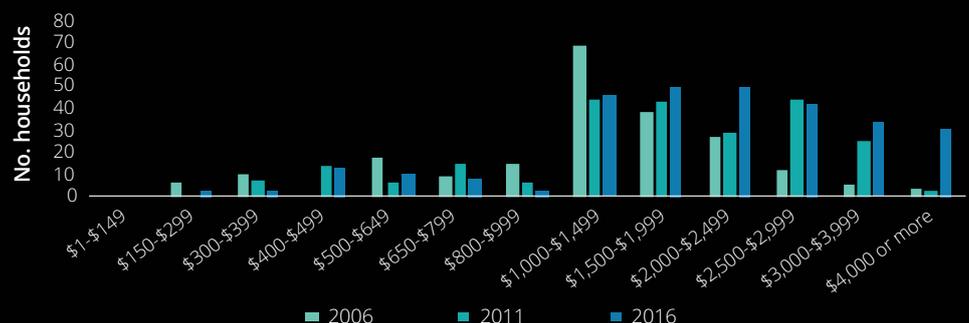
The number of employed persons in the Professional, Scientific and Technical industry will continue to grow with investment of \$AU100 million announced towards research initiatives from the Mindaroo Foundation, including a new marine research centre.

Income

In the ten years to 2016, the number of households who earned \$1,500 or more per week doubled to 270.

More than 50 additional households earned \$3,000 or more per week from 2011 to 2016.

Weekly household income, Exmouth



Source: ABS Census, 2006, 2011 and 2016

The importance of biodiversity to the regional economy

“Exmouth Community Vision: To be a prosperous and sustainable community living in harmony with our natural environment.”¹⁷ – Exmouth 2030 Strategic Community Plan 2019.

Introduced in Chapter 2.1, the biodiversity of Ningaloo Reef is unique to the Australian coast, and incredibly well preserved. As outlined in Chapter 2.2, the economic make-up of the surrounding region heavily depends on tourism and recreational industries as a direct consequence of the regions natural advantage: being situated adjacent to the Reef.

This section highlights why biodiversity is so important to the regional economy.

Solving for the market failure

Globally, the damage to ecosystem services and biodiversity of coral reefs is accelerating. According to a report by Natural Capital Coalition (formally TEEB for Business Coalition), coral reef losses accelerated significantly once atmospheric concentrations of CO₂ reached around 320 ppm due to temperature-induced coral bleaching, compounded by excessive CO₂ dissolution in sea water. This in turn hampers reef regeneration.

The accelerating damage to the environment is the largest market failure known to mankind.¹⁸ Markets fail when the price of a good, our natural assets, fails to reflect the value to society. Where the market price of a good is zero (non-excludable) and anyone can use it (non-rival), the asset becomes a common resource – owned by no one and exploited by everyone. Because no one owns the asset, there is little incentive to preserve the natural asset for future use, rather, to exploit it as much possible before someone else does. Our degraded ecosystems are a classic, frighteningly large case of the economic problem: the tragedy of the commons.

So far Ningaloo has been spared the coral mortality seen in some coral reefs, such as the Great Barrier Reef, as a result of coral bleaching. However, projections from the Intergovernmental Panel on Climate Change (IPCC) estimate that without intervention, Ningaloo Reef could experience two severe bleaching episodes per decade from as early as 2041, and annually from 2049.¹⁹ This places greater emphasis on the need to address market failures through reef resilience and sustainable management practices going forward for all coral reefs across the world.



Understanding the value of our natural capital

Most people understand the value of goods and services by their exchange value derived by the market: the trade-off made for a good or service by some monetary term. It is more difficult to understand the public benefits of our natural capital because the services they provide – our ecosystem services – cannot be exchanged.

To understand the value of our natural capital, it is important to understand how our natural capital contributes to human well-being. Broadly speaking, human well-being is the result of the interaction between:

- Built capital – the infrastructure
- Human capital – the people
- Social capital – the society
- Natural capital – the environment.

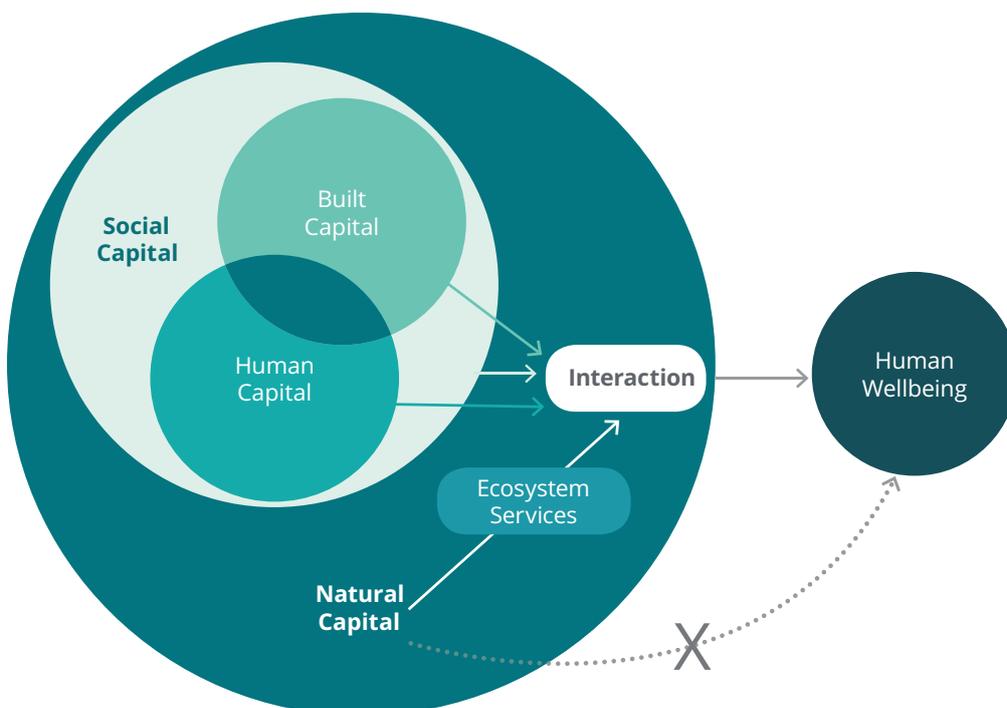
Our built and human capital make up the economy. They are embedded in society (our social capital) which is embedded in the rest of nature (our natural capital). It is important to understand that natural capital does not contribute to human well-being directly.

Rather, the benefit of our natural capital is derived from our ecosystem services – the continual material and energy outputs of our natural environment (Figure 2.2). For example, this could be realised in the form of storm and erosion protection and nurseries for our commercial fisheries.

It is also important to realise that ecosystems provide benefits to human well-being in the presence of people, their communities and their built environment. Natural capital may provide benefits through the interaction of ecosystem services with the other three forms of capital (Figure 2.2).²⁰

The value of our natural capital is derived from the non-market value of our natural assets and ecosystem services. We do not pay for the exchange of ecosystem services such as storm protection, erosion protection and nurseries for our commercial fisheries; however these services hold significant value in how we use these them (use value) and how we appreciate their existence, even if we never physically use them (non-use value).

Figure 2.2: **Natural capital and human capital**



Source: Costanza et al. (2014)

So, where lies the value of Ningaloo Reef?

As an incredibly biodiverse natural asset, it is simply impossible to understand the value of Ningaloo Reef in terms of its market value: it cannot be bought or sold. It does provide an array of ecosystem services to the Ningaloo region, services we use – and rely on – for tourism, commercial recreational and research purposes, which generate economic activity. The interconnectivity between ecosystem services provided by Ningaloo Reef and economic activity – specifically whale shark tourism – is highlighted in the study below.

The whale shark tourism industry

Every March, the pristine waters of the Ningaloo Coast transform into colourful clouds during coral spawning season. The abundant food source and seasonal nutrient upwelling caused by this event attracts up to 500 whale sharks to the Ningaloo coast over a season. For this reason, the largest documented aggregation in the world is recorded at Ningaloo.

A flourishing whale shark tourism industry has grown out of this spectacular natural event. The Ningaloo whale shark industry was the first of its kind worldwide, established in 1989. Since then, 12 whale shark companies remain active in the region.

During a whale shark tour, spotter planes locate sharks swimming at the surface off the reef front and direct tour vessels 30 metres ahead of the shark. Small groups of snorkelers disembark ahead of the shark's direction of travel to interact with the whale shark at a minimum of a three-metre distance.

This unique experience has become a critical economic activity for the Ningaloo region.

In 2013-14, Ningaloo whale shark tourism contributed \$AU11.5 million to the region in direct expenditure (whale shark tour expenditure). The same study estimated an additional \$AU12.5 million was spent on related travel, accommodation and other activities in the region by divers who would not have visited the region if the opportunity to dive with whale sharks did not exist.

Of all shark tourism industries identified in the study, the Ningaloo whale shark tourism industry contributed the most in terms of total (direct and indirect) expenditure to the Australian economy in 2013-14, almost double the contribution of the second largest shark industry.

Source: Huveneers et al. (2017)



The economic contribution of Ningaloo Reef is quantified according to the value added to the economy and the employment added to the region, according to the National Accounting Framework in Chapter 3 (Figure 2.3).

Not only does the Reef provide the means for economic activity; it has intrinsic non-use value in the form of:

- **Bequest value** – those who have not or may not ever visit it or directly use it now, but value the ability for it to be used for generations to come
- **Altruistic value** – knowing other people have access to the benefits of the Reef
- **Existence value** – simply because the natural asset – worthy of a World Heritage title – exists.

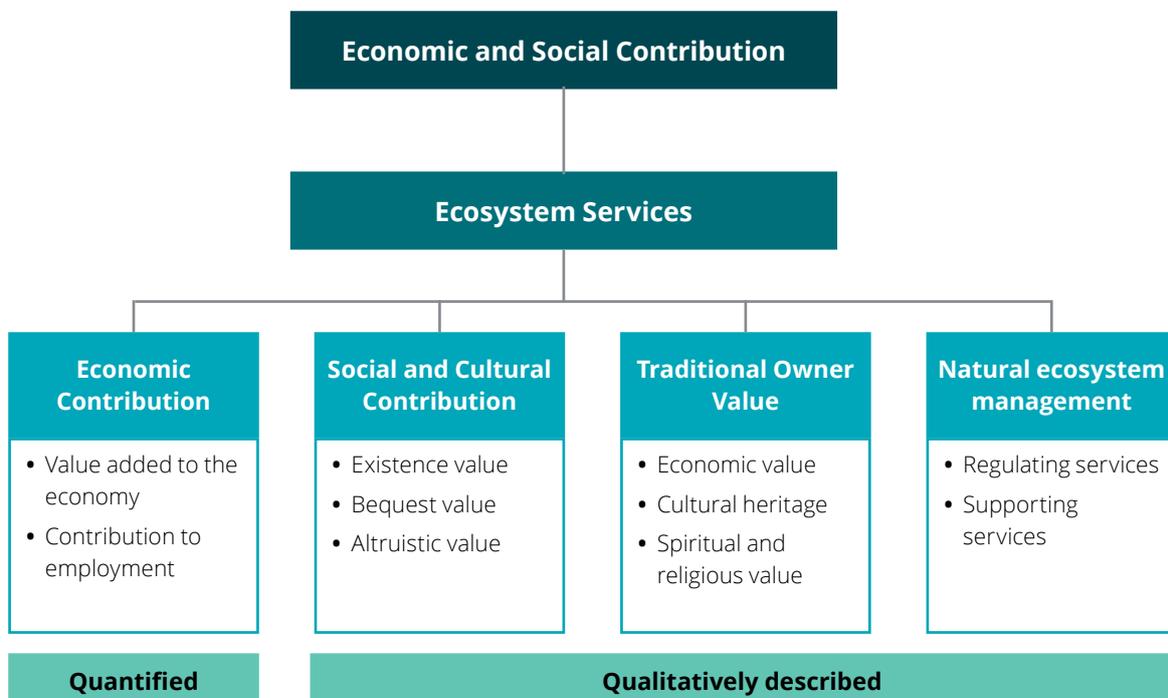
These values are used to qualitatively describe the social and cultural contribution of the reef in Chapter 4.1 (Figure 2.3).

The Ningaloo region has significant value for the local Aboriginal people: the Baiyungu, Thalanyji and Yinikurtura people. The value of Aboriginal connection to country is important to the Baiyungu, Thalanyji and Yinikurtura Aboriginal spirituality and religion, with local fauna representative of family totems. The contribution of Ningaloo to the Aboriginal economy, cultural heritage and spirituality is discussed in Chapter 4.2 (Figure 2.3).

Lastly, the Reef provides important ecosystem services to the region. While the ABS released an Experimental Ecosystem Account for the Great Barrier Reef Region in 2015 that accounts for the stock of ecosystem services and condition in both monetary and physical terms, no such account exists for Ningaloo Reef. Instead, the role of ecosystem services not addressed by the economic, social contribution or Traditional Owner value is described qualitatively.

The economic and social contribution of Ningaloo is outlined according to Figure 2.3 and provides the framework for the remainder of this report.

Figure 2.3: Economic and social contribution framework



The big picture

Western Australia has always had a comparative advantage by way of natural resources. Traditionally, the economic value of our natural capital has been realised in the extraction of natural capital, rather than its preservation. Understandably so, as profitability from the exchange of iron ore, coal and minerals has driven significant investment into the region over the last decade, generating \$103.1 billion in 2018-19 alone to the Western Australian economy and contributing to 36 percent of Gross State Product ('GSP').²¹

However, the State Government recognises the need to diversify our economy:

"While natural resources and primary industries have underpinned our success, one thing is clear: the world is changing and if we take this success for granted, we will fall behind."²²

The end of the resource investment boom saw unemployment rise to new highs, population growth slow, and gross domestic product shrink. The economy has since struggled to recover.

The event was a wake-up call for Western Australian policy makers, private business owners and local citizens realising that we cannot solely rely on the next resource boom to fuel future economic prosperity. Moreover, a shift in global demand towards cleaner and more sustainable resource use has begun that will inevitably reduce demand for resources such as coal and fossil fuels in the long term.²³

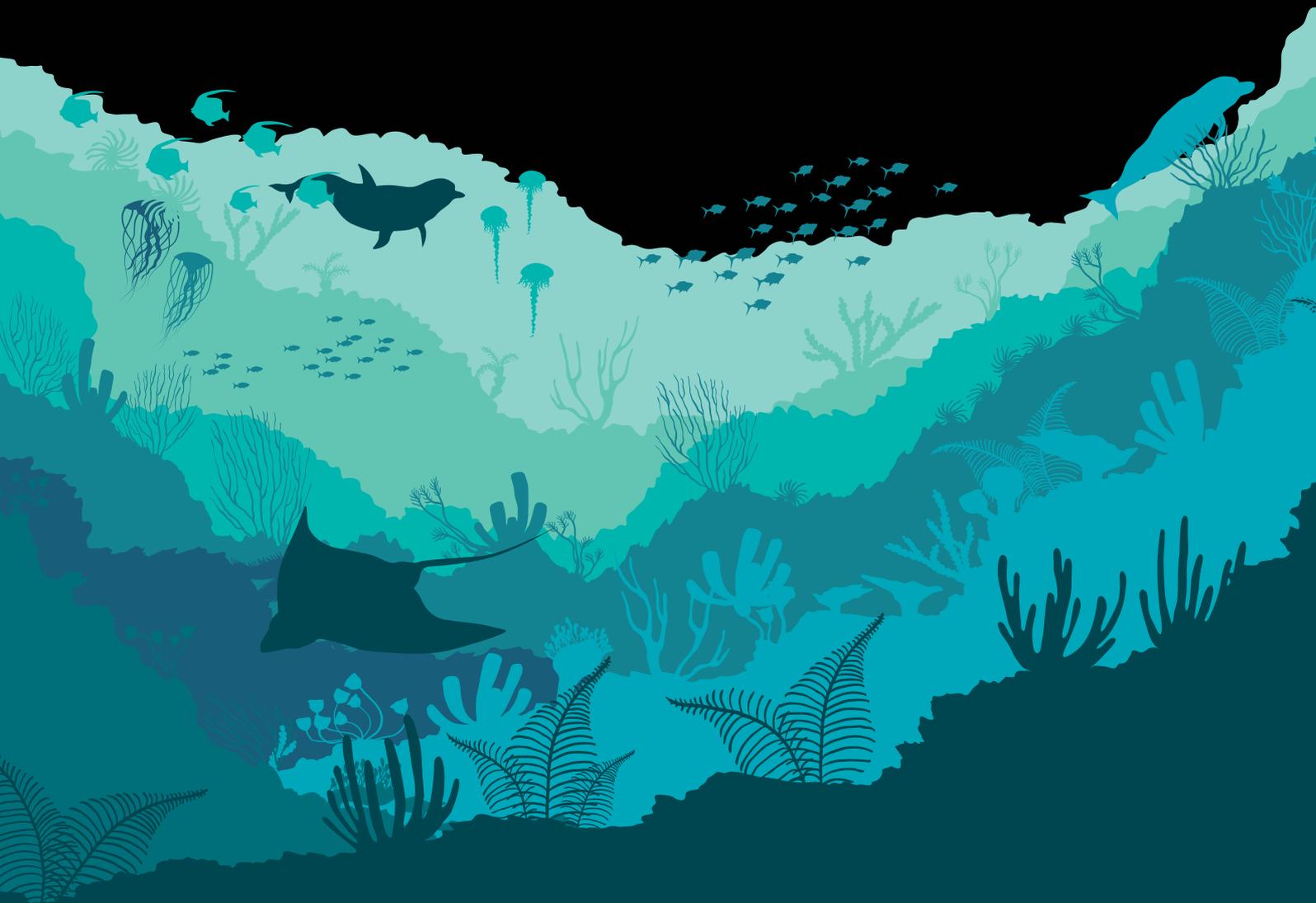
It is easy to understand the private benefits of resources extraction, for resources are commoditised and branded with a value determined by the market. Unlocking the potential of Western Australia's economy and its natural advantage will require the public to understand the concept of 'value' by more than just exchange value. This will ultimately shape the trade-offs between persevering natural assets like Ningaloo Reef for generations to come and extracting our resources for short-term private gain.

Economic incentives and disincentives are powerful and shouldn't be underestimated. They remain central to our inability to preserve our environment through policy levers such as subsidies, taxation, trading rules and reporting requirements.

Preserving Ningaloo Reef presents an opportunity for Western Australia to realise the potential of its natural resources beyond mining.

To do this, we must start by understanding the value of what we are preserving.

3 Economic Contribution



Ningaloo contributed \$110 million in value added to the Western Australian economy in 2018-19, supporting more than 1,000 full time jobs.

3.1 Measuring the economic contribution

Ningaloo contributes to the Western Australian economy through several channels. The contribution of the Reef is mainly attributable to economic activity that occurs through:

- Tourism
- Commercial fishing
- Recreational activity
- Scientific research and reef management.

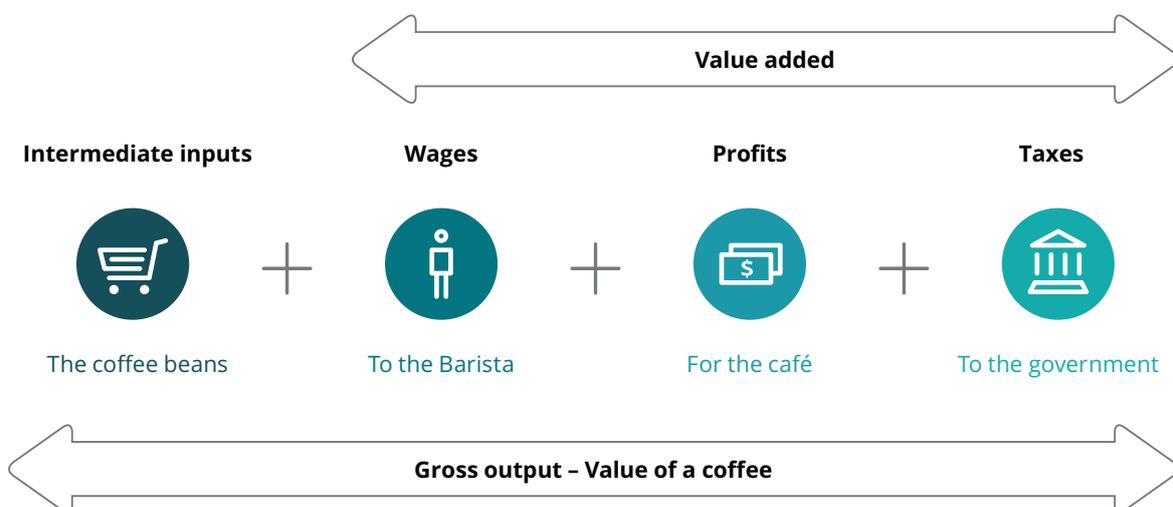
In this case, economic contribution can be understood as the **value added** to the economy by economic activity associated with Ningaloo; and the **employment** supported by that activity. Value added is the incremental additional value generated by an activity or industry, equal to the sum of payments to labour (salaries and wages), capital (gross operating surplus or profit) and net production taxes minus subsidies.²⁴ Value added is not intended as a measure of the wider social, cultural or community benefit of an activity.

Figure 3.1 shows the simple example of measuring value added in the case of producing a cup of coffee. The **direct value added** is the sum of wages paid to the barista and profits to the coffee shop, minus any net taxes and subsidies on production. Producing the cup of coffee also requires purchasing intermediate inputs from other suppliers, such as coffee beans and milk. The **indirect value added** comes from these intermediate inputs.

The same principle applies to employment. Producing a cup of coffee requires **direct employment** of the barista, but the purchasing of intermediate inputs also supports **indirect employment** in other businesses and sectors.

This framework is applied to all economic activity associated with Ningaloo to estimate its total contribution to the WA economy. Further information on the economic contribution framework is provided in Appendix A and the approach to estimating each type of contribution is outlined in Appendix B.

Figure 3.1: Measuring value added – producing a cup of coffee



Source: Deloitte

3.2 Tourism

Ningaloo is one of Western Australia's major tourism offerings. It is one of the leading destinations promoted by the regional tourism organisation responsible for Australia's Coral Coast, boasting unique opportunities such as swimming with whale sharks, humpback whales and manta rays at Exmouth and Coral Bay. Tourists are also drawn to snorkelling and diving among the Reef's coral gardens, and some of Australia's best beaches along the Ningaloo coast.

In 2018-19, the Ningaloo region²⁵ hosted an estimated 218,000 overnight visitors.²⁶ International visitors represented 25% (54,000 visitors) while domestic overnight visitors accounted for 75% (164,000 visitors). Collectively, overnight visitors spent an estimated 1.3 million nights in the region, with international visitors staying in the region for an average of 4.1 nights and domestic visitors an average of 6.7 nights. The region also hosted an estimated 61,000 domestic daytrip visitors in 2018-19 (Table 3.1).²⁷

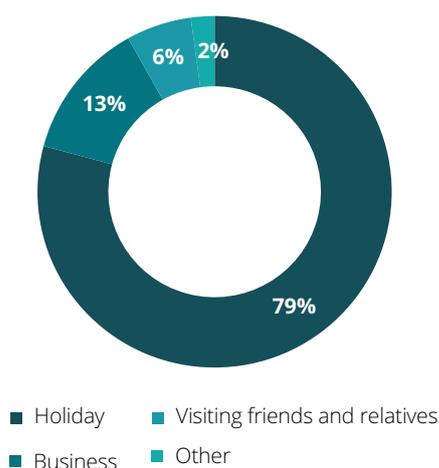
Table 3.1: **Estimated number of visitors to the Ningaloo region, 2018-19**

Type of visitor	Visitors ('000s)	Visitor nights and days ('000s)	Average nights/days per visitor
International	54	221	4.1
Domestic overnight	164	1,093	6.7
Total overnight	218	1,314	6.0
Domestic daytrip	61	61	-
Total	279	1,375	4.9

Source: Tourism Research Australia; Deloitte.

Holidaymakers were the largest visitor group to the Ningaloo region, accounting for more than 79% of the total number of visitor nights and days spent in the region in 2018-19 (Figure 3.2). Business travellers represented a further 13% of total visitor nights and days, while those travelling to visit friends and family represented 6% of the total. Those travelling for other purposes – including employment and education – made up 2% of visitor nights and days in the region.

Figure 3.2: **Total visitor days and nights in the Ningaloo region by purpose of visit, 2018-19**



Source: Tourism Research Australia; Deloitte.

Purpose of visit is an important determinant of visitor expenditure. For example, the average spend per visitor day/night was \$137 for holidaymakers, 50% higher than the average \$89 per night spent by those visiting friends and family. Average spend per day/night by visitor purpose is summarised in Table 3.2.

Table 3.2: Average expenditure per visitor day/night by purpose of visit, 2018-19

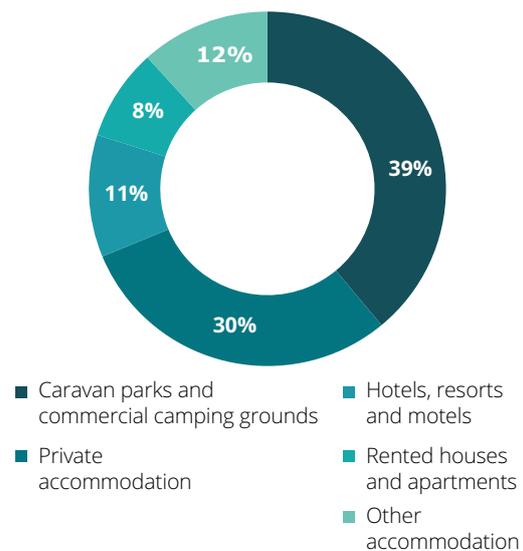
Purpose of visit	International	Domestic overnight	Domestic daytrip	All visitors
Holiday	\$123	\$142	\$93	\$137
Business	\$97	\$79	-	\$81
Visiting friends/relatives	\$51	\$106	\$96	\$89
Total	\$112	\$131	\$100	\$126

Source: Tourism Research Australia; Deloitte.

Caravan parks and commercial camping grounds were the most popular accommodation option among overnight visitors to the Ningaloo region, accounting for 39% of total visitor nights in 2018-19. Nights spent in private accommodation represented 30%, while 11% of visitor nights were spent in hotels, resorts and motels and 8% in rented houses and apartments. The remaining 12% of visitor nights were spent in hostels and other forms of accommodation (Figure 3.3).

Like purpose of visit, choice of accommodation is an important determinant of average visitor expenditure. For example, visitors staying in hotels, resorts and motels tended to have a higher average spend per night (\$203) than those staying in caravan parks and commercial camping grounds (\$132). Average spend per night by type of accommodation is summarised in Table 3.3.

Figure 3.3: Total visitor nights in the Ningaloo region by type of accommodation, 2018-19



Source: Tourism Research Australia; Deloitte.

Table 3.3: Average expenditure per visitor night by type of accommodation, 2018-19

Caravan parks and commercial camping grounds	International	Domestic overnight	All overnight
Caravan parks and commercial camping grounds	\$133	\$111	\$114
Private accommodation	\$69	\$106	\$99
Hotels, resorts and motels	\$240	\$261	\$257
Rented houses and apartments	\$53	\$212	\$161
Other accommodation	\$125	\$96	\$101
Total	\$112	\$131	\$128

Source: Tourism Research Australia; Deloitte.

Total expenditure by visitors to the Ningaloo region amounted to \$174 million in 2018-19, of which \$143 million (82%) is attributable to domestic overnight visitors. International visitors spent a total of \$25 million (14%), with the remaining \$6 million (4%) spent by domestic daytrip visitors.

The economic contribution of tourism expenditure is estimated using the Tourism Satellite Accounting (TSA) framework. The TSA approach is conceptually consistent with the input-output approach used to estimate economic contribution from other activities, but is specifically tailored to estimating the contribution from expenditure by tourists. More information on the TSA approach is provided in Appendix B.

Tourist activity in the Ningaloo region contributed an estimated \$99.5 million to the WA economy in 2018-19 (Table 3.4), of which \$57.5 million was direct value added from activities in the Ningaloo region and \$42.0 million generated indirectly elsewhere in the economy.

A total of 954 full-time equivalent (FTE) jobs were supported by tourist activity in the Ningaloo region, of which 735 FTE represent direct employment and 219 FTE supported indirectly through the purchase of intermediate inputs.

Table 3.4: **Economic contribution of tourist activity in the Ningaloo region, 2018-19**

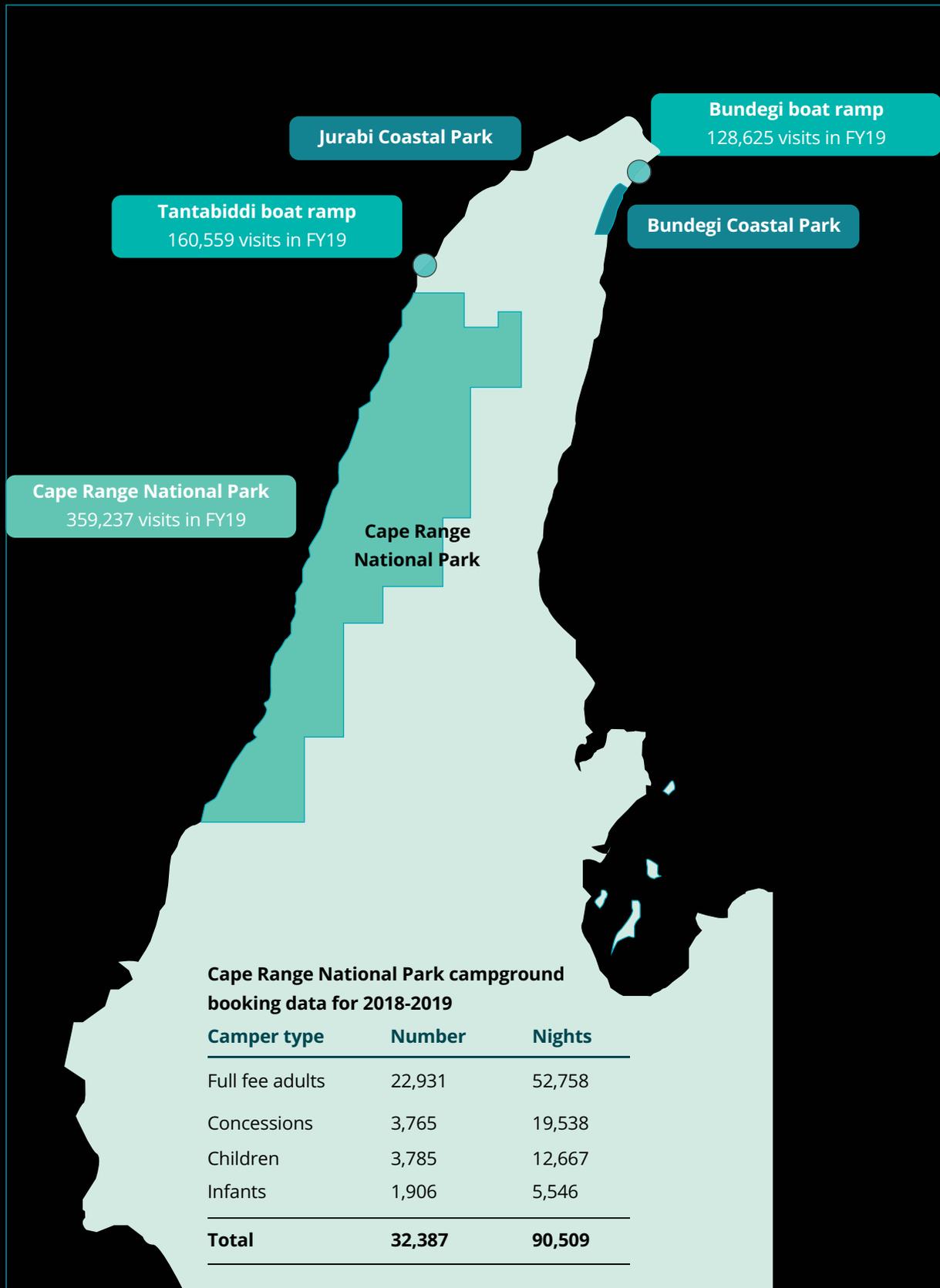
	International	Domestic overnight	Domestic daytrip	All visitors
Tourist expenditure (\$ million)				
Total	\$24.6	\$143.0	\$6.1	\$173.8
Value added (\$ million)				
Direct	\$9.1	\$46.6	\$1.8	\$57.5
Indirect	\$6.4	\$34.3	\$1.3	\$42.0
Total	\$15.5	\$80.9	\$3.0	\$99.5
Value added (FTE employment)				
Direct	111	601	23	735
Indirect	34	179	7	219
Total	144	780	29	954

Source: Deloitte.

Ningaloo is one of Western Australia's most noteworthy attractions among interstate and international tourists. Many tourists would likely visit WA with Ningaloo as their primary destination, and also spend money elsewhere – for example, in Perth or the South West region – on the same trip. While it is not possible to quantify the value added from this expenditure, it is important to note that Ningaloo is a driver for tourism elsewhere in the State.

This is true of Ningaloo's value as a marketing tool for the tourism industry. Ningaloo imagery and attractions are widely used by Tourism WA in marketing and promotional activities to attract interstate and international tourists to WA. The value of this marketing activity is likely to be substantial, however it is not possible to quantify within the value added described in Table 3.4.

Ningaloo visitors



Note: The data used in this image captures visitors to the abovementioned locations and is not representative of visitors to the entire Ningaloo region

Source: DBCA

3.3 Commercial fishing

The rich biodiversity of the Ningaloo coast supports one of Western Australia's largest prawn fisheries in the Exmouth Gulf. The fishery is estimated to have directly employed 18 skippers and crew in 2017, with further employment supported in Exmouth and Fremantle.

The Exmouth Gulf prawn fishery produced approximately 880 tonnes of prawns in 2018-19, with an estimated gross value of production (GVP) of \$12.2 million. This represents significant growth on the 713 tonnes (\$9.8 million GVP) reported for 2017-18. Table 3.5 summarises the catch and estimated GVP across the four species of prawn caught by the fishery.

Commercial prawn fishing in the Ningaloo region is estimated to have contributed \$8.3 million to the Western Australian economy in 2018-19, supporting 40.7 FTE jobs across the State (Table 3.6).

Table 3.5: Exmouth Gulf prawn fishery, estimated catch and gross value, 2018-19

Species	Catch (tonnes)	Gross value (\$ million)
Brown tiger	392	\$6.6
Blue endeavour	313	\$2.9
Western king	174	\$2.6
Other	<1	<\$0.1
Total	880	\$12.2

Source: Department of Primary Industries and Regional Development; Deloitte.

Table 3.6: Economic contribution of Exmouth Gulf prawn fishery, 2018-19

	Value added (\$ million)	Value added (FTE employment)
Direct	\$6.1	28.4
Indirect	\$2.2	12.3
Total	\$8.3	40.7

Source: Deloitte.

3.4 Recreational activities

Recreational activities by local residents in the Ningaloo region – such as boating, fishing and sailing – are not captured by the tourism contribution in Chapter 3.2. However, the expenditure associated with these activities still adds value to the Western Australian economy attributable to the Ningaloo Reef.

There are an estimated 1,166 households in the Ningaloo region for the purpose of estimating residents’ recreational expenditure,²⁸ representing a total population of approximately 2,800 people.

Recreational expenditure has not been quantified for people living outside of the Shire of Exmouth, due to the risk of double-counting with the intrastate tourism expenditure captured in Chapter 3.2.

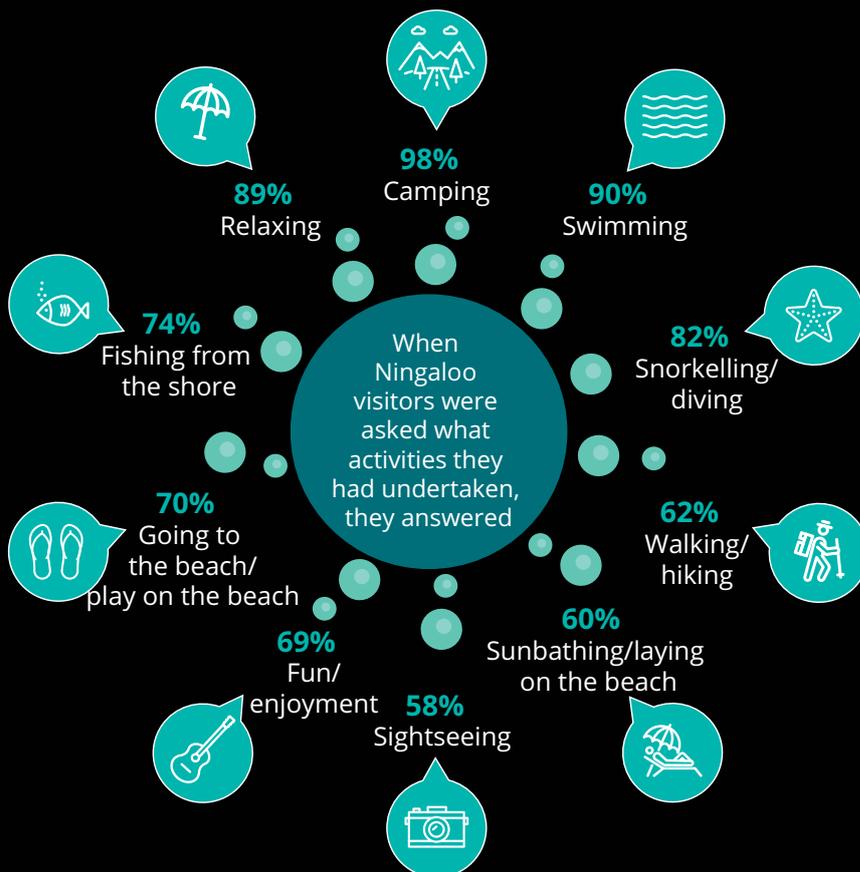
Recreational expenditure includes the purchase of equipment (such as boats, fishing gear and camping supplies) as well as personal expenses on recreational activities such as boating, fishing and sailing, such as fuel and other transport costs.

Local residents are estimated to have spent a total of \$702,000 on recreational fishing, recreation equipment, boating and sailing activities in 2018-19, of which more than half (\$431,000) was spent on the purchase, registration and maintenance of equipment. This expenditure is estimated to have added \$497,000 to the Western Australian economy, supporting 3.7 FTE jobs (Table 3.7).

Table 3.7: Economic contribution of recreational activity in the Ningaloo region, 2018-19

	Value added (\$ thousand)	Value added (FTE employment)
Recreational fishing	\$98	0.5
Recreation equipment	\$302	2.4
Boating and sailing	\$97	0.9
Total	\$497	3.7

Source: Deloitte.



Note: The survey data used in this image was designed to capture views of those who visited proposed coastal reserves only. It was not designed to capture a representative sample of the Ningaloo region.

Source: DBCA Visitor Survey Report, 2017

3.5 Management and research

The Department of Biodiversity, Conservation and Attractions (DBCA) is responsible for management of the Ningaloo Marine Park (State Waters) and Cape Range National Park. Under joint- and co-management arrangements with the Commonwealth Government, Shire of Exmouth and Traditional Owners, DBCA also undertakes management activities in the Ningaloo Marine Park (Commonwealth Waters) and coastal reserves along the Ningaloo coast.

Total expenditure by DBCA in undertaking its conservation, regulatory and maintenance activities for the Reef was estimated at \$7.0 million in 2018-19, of which \$3.9 million represented salaries and wages paid to DBCA staff and \$3.1 million in purchases of intermediate inputs.

In addition, a range of research and not-for-profit organisations are estimated to have spent \$1.4 million on scientific and conservation activities in the region in 2018-19, including more than \$700,000 in salaries and wages. These organisations and initiatives include:

- Australian Institute of Marine Science (AIMS)
- Resilient Reefs Initiative²⁹
- Ningaloo Outlook program.³⁰

Reef management and research activities are estimated to have contributed a total of \$1.3 million in value added to the WA economy in 2018-19, supporting more than 55 full-time jobs across the State (Table 3.8).

Table 3.8: **Economic contribution of reef management and research activity, 2018-19**

	Value added (\$ million)	Value added (FTE employment)
Direct	\$0.6	51.7
Indirect	\$0.7	3.7
Total	\$1.3	55.4

Source: Deloitte.

Note that the results for the management and research activity undertaken in the region are based on the contributions of the primary reef management agency (DBCA) and various institutions that conduct research on the reef. There is additional activity that occurs beyond what is measured and accounted for in this study by other management agencies – including the Shire of Exmouth, Shire of Carnarvon, Department of Primary Industries and Regional Development, Department of Transport and others. Therefore, the expenditure and value added described above are inherent underestimates of total management costs and economic contribution. The results are limited on the basis of availability of data and information required for the specific purposes of this study. If the full scope of regional management and research activities were to be included, the estimated economic contribution would be greater.

Further, value added is a representation of contribution to the WA economy as measured by gross state product (GSP). It is not intended to capture the wider social, cultural or community contribution of management activities – for example, DBCA's importance as a local employer, or the impact of its engagement with local schools and community organisations.

3.6 Economic contribution

Overall, Ningaloo is estimated to have contributed \$109.6 million in value added to the Western Australian economy in 2018-19 and supported a total of 1,053.3 FTE jobs across the State.

Approximately 91% (\$99.5 million) of the value added resulted from tourism expenditure in the Ningaloo region. Economic activity associated with tourism also supported 953.5 FTE jobs in WA. The Ningaloo region therefore accounted for approximately 11% of the value added by the Australia's Coral Coast tourism region.

Table 3.9 shows that \$64.6 million in value added is directly attributable to economic activity associated with Ningaloo, while a further \$45.1 million occurs indirectly throughout the State economy. This corresponds to 817.5 direct FTE jobs and 236.8 indirect FTE jobs, respectively.

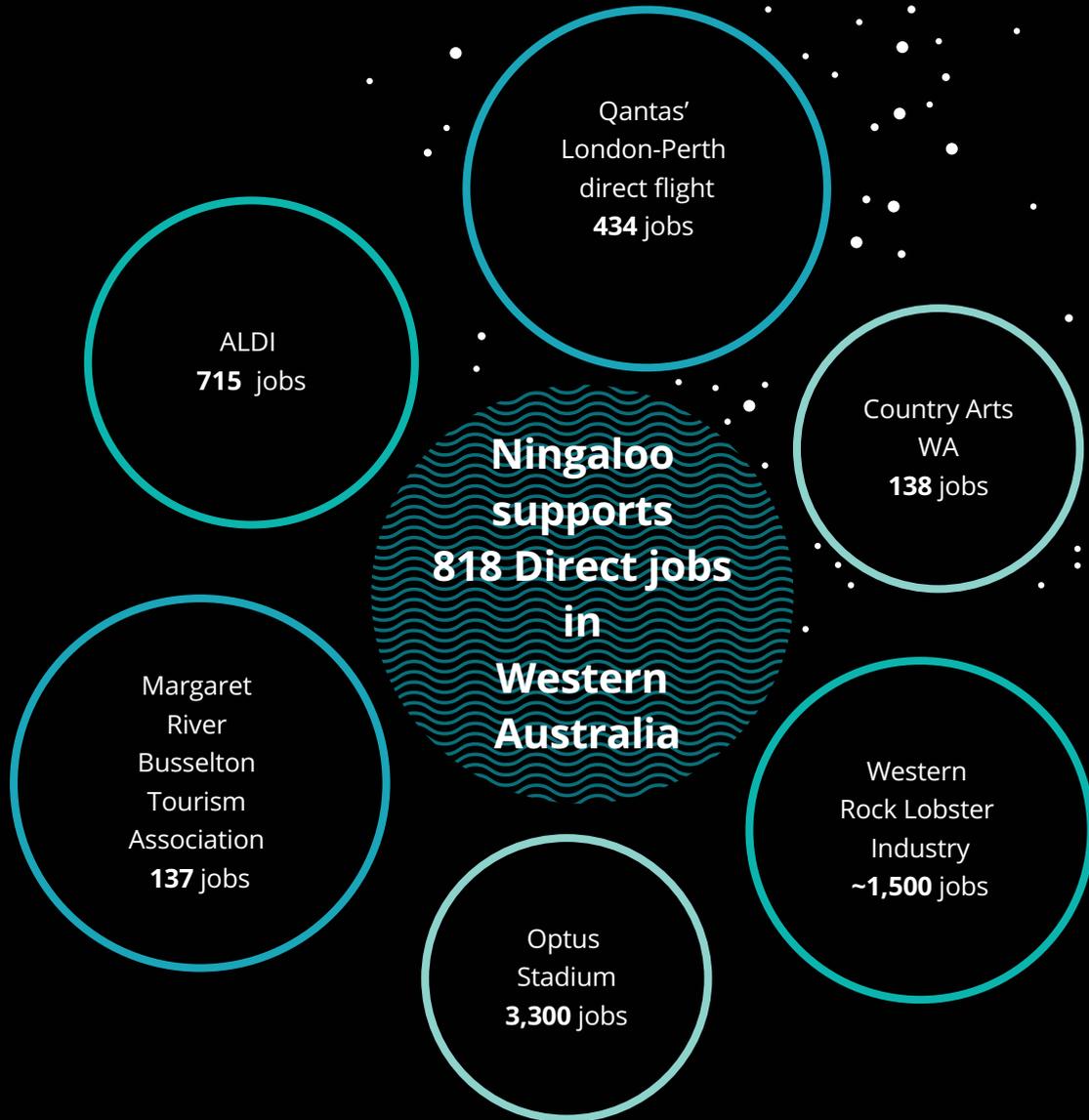
Table 3.9: Total economic contribution of Ningaloo, 2018-19

Activity	Direct	Indirect	Total
Value added (\$ million)			
Tourism	\$57.5	\$42.0	\$99.5
Commercial fishing	\$6.1	\$2.2	\$8.3
Recreation	\$0.4	\$0.1	\$0.5
Management and research	\$0.6	\$0.7	\$1.3
Total	\$64.6	\$45.1	\$109.6
Value added (FTE employment)*			
Tourism	734.5	219.0	953.5
Commercial fishing	28.4	12.3	40.7
Recreation	3.7	0.9	3.7
Management and research	51.7	3.7	55.4
Total	817.5	235.8	1,053.3

Source: Deloitte.

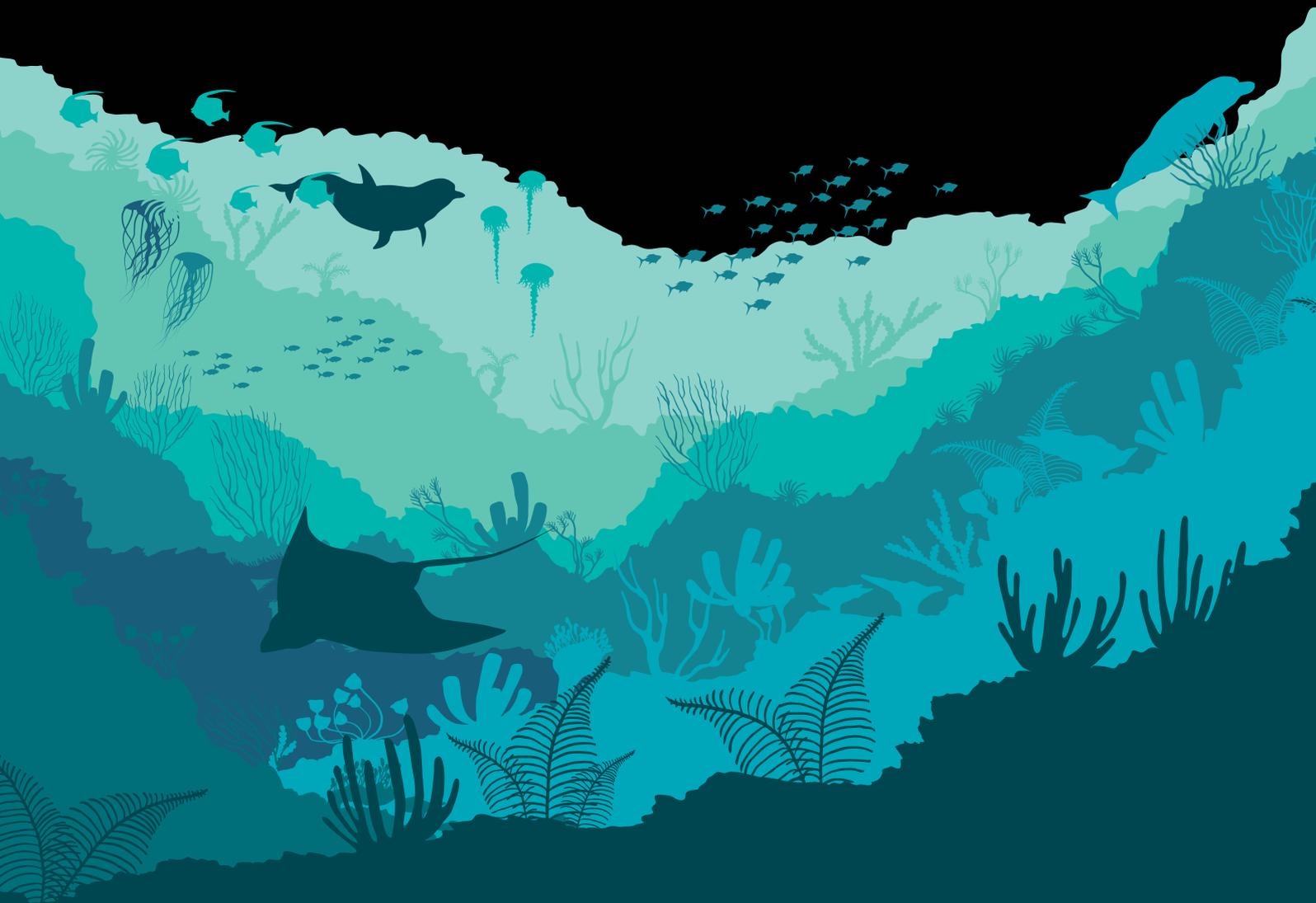
*Value added can be expressed either as a contribution to output (in millions of dollars) or through the level of full-time equivalent (FTE) employment supported by that contribution. These are alternative, not additive, ways of expressing value added.

Let's put it into perspective



Note: The figures represent direct FTEs from Ningaloo as compared to direct employees of businesses or industries in WA

4 Social, Cultural and Indigenous contribution



4.1 Social and cultural contribution

This chapter qualitatively describes the social and cultural value of Ningaloo Reef to Western Australians. For a range of reasons, the annual GSP contribution of the Ningaloo Reef presented in the previous chapter does not entirely reflect the Ningaloo Reef's total contribution to the welfare of society.

Consider the price paid for a holiday to visit Ningaloo Reef. A visitor may have paid \$2,000 to fly to Exmouth, to relax on the beach and to go scuba diving or swimming with whale sharks. If the value and prices were higher, say \$2,500, they might still be willing to pay more to make sure they can enjoy Exmouth. That \$500 price difference the holidaymaker is willing to pay is a benefit to them because while they only paid \$2,000, it was worth \$2,500 to the visitor.

When consumers' value is above the market price, an economic contribution study will underestimate the value because it is never paid. Or in this case, when the price of a holiday to Exmouth is less than what a tourist might be willing to pay, the value of the Ningaloo Reef's offering is undervalued. This underestimated value is referred to as consumer surplus and comes from the Ningaloo Reef's direct use through tourism and recreation. While it is out of scope of this report to quantify the consumer surplus, it is mentioned here to highlight that the \$110 million economic contribution captured in Chapter 3 underestimates the value of Ningaloo Reef.

The case study below highlights why Ningaloo is important to visitors who camp in the region. These attributes underpin reasons why the price of a camping holiday may underestimate the value of Ningaloo to some visitors.

Why Ningaloo is important to its visitors

An online survey was undertaken between October 2016 and May 2017 to understand the value of the Ningaloo coast to visitors of a new conservation and recreational reserve in the Ningaloo region. A total of 1045 people who visited Gnaraloo, Warroora, Cardabia and Ningaloo stations were asked:

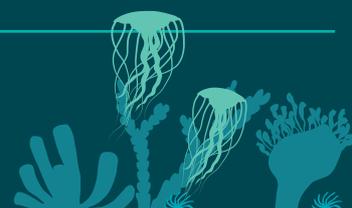
*'What aspect(s)/part(s) of your experience along the Ningaloo coast do you value the most (is important to you)?'*²⁹

Respondents were presented with a list of aspects and asked to rate how important each aspect was to their experience of Ningaloo from 'not at all important' to 'extremely important'. The eight most important aspects and the corresponding proportion of respondents who answered 'extremely important' are listed below.

Reason	Respondents who answered 'extremely important'
To enjoy nature and the outdoors	75.9%
Being close to the beach	70.8%
Having a break from everyday urban/town life	65.4%
Camp sites are spread out; not too close to neighbours	64.1%
To rest and relax	63.6%
Lack of development – simplicity of the campground	63.3%
Peace and quiet	60.4%
Access to the reef	59.8%

Notes: The study was used to understand the value of new conservation and recreational, therefore is not representative of the entire Ningaloo region described in Chapter 2.

Source: DBCA Visitor Survey Report, 2017



The remainder of this chapter qualitatively discusses non-use sources of value that make up consumer surplus:

- Altruist value – knowing other people have access to the benefits of the reef
- Existence value – simply knowing the Reef exists as a part of nature, and
- Bequest value – leaving the benefits of the reef to future generations.

4.1.1 Altruistic value

Altruist value is the value of knowing other people have access to the Ningaloo Reef. One way to capture this is to estimate the value using contingent valuation, by asking consumers how much they would be ‘willing to pay’ to protect the reef. The table below presents four studies that have used this approach to determine the non-use value of coral reefs by asking respondents what they were willing to pay to conserve the reef.³²

Table 4.1: Willingness to pay for the protection of coral reefs

Reef location	Average WTP per capita \$AUD,2019	Payment occurrence	Source
Great Barrier Reef	\$1.40	Per week	Deloitte Access Economics (2017)
Taiwan	\$3.60	Per week	Murphy, Campbell and Drew (2018)
Guam	\$15.43	One-time payment	Grafeld, Shanna, et al. (2016)
Philippines	\$16.59	One-time payment	Subade and Francisco (2014)

4.1.2 Existence value

Intrinsically, Western Australians appreciate nature and the wonders of the natural environment. Western Australians have that feeling, that instinctive understanding of what nature means and the power of it.

Even if we don’t use it, we appreciate the significance of Ningaloo’s World Heritage title, and the important role it plays in the biodiversity of the region. We appreciate the unique natural landscape: where the sunburnt country meets azure blue seas, even if we have never seen it with our own eyes. We appreciate importance of the area to iconic migratory animals like whale sharks, humpback whales and turtles, even if we have never experienced swimming with such magnificent creatures ourselves.

This value may be captured in terms of Ningaloo’s existence value: the value that individuals place on the beauty of a natural landscape or the existence of a species.

4.1.3 Bequest value

Bequest values are reflected in the desire to preserve a given natural asset for future generations. This is particularly important for the many Western Australians who grew up with memories of Ningaloo and are passionate about giving their children the same opportunities to experience swimming in the pristine ocean amongst the fish and enjoy the beauty of the natural landscape.

A study by Laurans et al. (2013) which evaluated the literature on the total economic value of coastal service provisions (including non-use values, such as bequest value) demonstrated the bequest value of coastal ecosystems can contribute as much as 31 percent of total economic and social value, measured by international dollar per capita.³³

Bequest values further reflect the cultural services custodians pass on to younger generations through knowledge and skills in areas that reflect their cultural identity such as cultural practices, totems, observances, customs and lore. For this reason, it is also important for the traditional custodians of the Ningaloo region, described in the next section.

4.2 Traditional Owner value

The natural features of the Ningaloo Reef are embedded in Aboriginal culture, spirituality and wisdom, with evidence of their connections to country dating back at least 32,000 years.³⁴

The North West Cape and Ningaloo Coast is home to the traditional lands and waters of the *Baiyungu*, *Thalanyji* and *Yinikurtura*. Currently, there are 25 Aboriginal heritage sites registered within the Ningaloo region, including shell middens, artefact scatters, skeletal material/burial sites, camps, meeting places, hunting places and water sources. However, anecdotal evidence would indicate that the real number is in the thousands.

The southern coastal reserves along the Ningaloo Coast are jointly managed by Traditional Owners and the DBCA.³⁵ The Joint Management Body ensures that the Traditional Owners have an opportunity to make decisions about environmental management and land use.

Aboriginal peoples' connection to country is a primary example of the non-market value of Ningaloo Reef and the surrounding ecosystem. Its use value can be qualitatively described by the interaction of Ningaloo ecosystem services with human, built and cultural services specific to Aboriginal culture. The Aboriginal non-market value of Ningaloo is classified according to:

- Traditional Owner economic value (Aboriginal human and built capital)
- Traditional Owner cultural heritage
- Traditional Owner spiritual and religious value.

4.2.1 Traditional Owner economic value

As predominantly coastal dwellings peoples, the *Baiyungu*, *Thalanyji* and *Yinikurtura* rely on Ningaloo ecosystem services to maintain a coastal-resource driven economy. Ningaloo ecosystem system services interact with the Aboriginal people and their built capital to service human fundamental needs:

- **Food and medical sources** – For Aboriginal people, Ningaloo Reef and the surrounding mudflats, mangroves and sand dunes provide a critical breeding ground for marine and terrestrial wildlife. Coastal-dependent food sources include turtles, turtle eggs, fish and shellfish (such as *Terebralia*, Melo and rock oyster). Local flora may also be used as bush medicine – such as *gulbayamarnu* for internal illness.³⁶

- **Material resources** – *Baiyungu*, *Thalanyji* and *Yinikurtura* also manufactured a wide range of tools made from the local silicified limestone and other environmental resources to service the hunter-gatherer lifestyle. For example, baler shells were used to carry water and worked into other food preparation tools. Woodwork in the form of boomerangs and spears were also used for hunting and warfare.³⁷
- **Shelter** – Prior to European settlement, Traditional Owners camped primarily in open-air sites in the dunes adjacent to the tidal mudflats and mangroves next to accessible food resources. The environment also provided rock overhangs and rock shelters in the gorges and along the coast used as a refuge during inclement weather.³⁸

4.2.2 Traditional Owner cultural heritage

The Aboriginal hunter-gatherer economy is embedded in society: an ordered community with cultural and spiritual values. At the heart of Aboriginal culture is the traditional law that guides the area's Traditional Owners in all aspects of their life.

The physical environment, plants and animals have been inseparable from traditional law, culture, language and knowledge since creation-time. The inseparability of society from the natural environment in traditional law is integral to the maintenance and protection of country.

Under traditional law, the *Baiyungu*, *Thalanyji* and *Yinikurtura* people have a binding responsibility to care for country and keep culture strong.³⁹

Specifically, the *Baiyungu* people traditionally obeyed a system of rights and obligations, transmitted through birth and marriage. Ceremonies are an important part of Aboriginal culture and mark the significance of such events. For example, Corroborees, a form of ritual carried out by Indigenous people, provides valuable opportunities for people to meet, share stories, perform ceremonies and transmit important cultural knowledge.⁴⁰

Other rituals performed at ceremonial sites, known as *Thalu* sites, ensure the continuation or proliferation of species of animals, plants and natural phenomena. The ceremonies to achieve this are aimed at 'taming' the natural environment and then driving or directing the spiritual forces inherent in the landscape. These sites are described in the case study below, which highlights the use value of ceremonial sites provided by the surrounding environment.

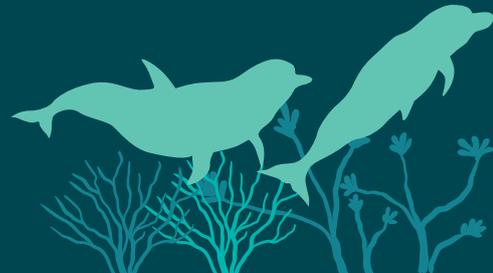
Thalu

Thalu sites are places used for ceremonies and rituals surrounding a totemic species, including ceremonies for the increase in numbers of a particular totem.

The *thalu* rituals are part of an intricate belief system that is concerned with defining and establishing or sustaining man's relationship with his environment and epitomised the link between totemic descent systems and country.

Thalu ceremonies typically can only be performed by a member of a particular totemic association, often seen as the descendent or reincarnation of that totem (Berndt and Berndt 1999). Each member of a kin group was seen as having a totemic association and subsequent *thalu* site, all of which belonged to the head of each family, descending from father to son. If, for example, a *Banaka* man (of the *Baiyungu* class system) had the totem and *thalu* of an eagle hawk, and wished for them to multiply, that *Banaka* man and any number of other *Banaka* men would journey to the appropriate *thalu* site for the eagle hawk to conduct an 'increase' ceremony.

Berndt and Berndt (1999)



4.2.3 Traditional Owner spiritual and religious value

For many Aboriginal people, country is the source of spirit, culture and language and the place where spirits return to when they die. The physical environment plays an important role in Aboriginal spirituality and is defined by its non-use value, its spiritual significance.

Many Aboriginal people refer to the creative period as 'The Dreaming'. As the mythological ancestors travelled they carved out run, sleaving clearly marked landscape features across the country. One of the most well-known spiritual ancestors of Australia, the Rainbow Serpent, is believed to control the rain cycles and governs the vitality of water sources through totemic increase rituals. The name given to the rainbow serpent by the Baiyungu is Wanamangura.⁴¹

Fauna also can be of cultural significance if it is a sacred totem, related to 'The Dreaming', has ceremonial significance or is used for food (bush tucker). Fauna of cultural significance includes the *gajalbu* (emu), *bundgardi* (kangaroo), *bardurra* (bush turkey), majun (marine turtles) and *bilygurumarda* (osprey, the language name literally means fisherman) all of which exist in the fragile but well-preserved ecosystem of Ningaloo.

Gujawari: Our regular Ningaloo visitors

The following story is told by Hazel Walgar, a Baiyungu woman from the Ganyara language group, a traditional owner who lives on country at Cardabia Station and is involved in the joint management of Ningaloo Marine Park (NMP) and adjacent lands. Hazel has shared the following story about the Gujawari, our regular visitors to the Nyinggulu Coast, in order to highlight the cultural connection and understanding that traditional owners have for the land and sea.

“Gujawari, the Baiyungu word for whale. Our regular visitors to the Ningaloo Coast, he’s not from here, he’s from somewhere else. It’s springtime and the Gujawari makes his journey to Ningaloo, Buluwha cold/cooler time. For traditional owners, it’s the right time of the year when most of our traditional food is available as the land and the ocean are flourishing. The winter rains come delivering rich nutrients into the ocean, this helps create food sources. Fish are fat, our shellfish are rich and plump, large quantities of food is available for the Gujawari. The temperature of the water changes and mums have their babies. Around September the Gujawari heads south making their journey home by now on country its coming into summer Thubayurri – Hot time. Studying these creatures still continues in the scientific world but we traditional owners know exactly what is happening here on the Ningaloo Coast, these stories have been passed down by our Baiyungu elders.” – Hazel Walgar, 2019

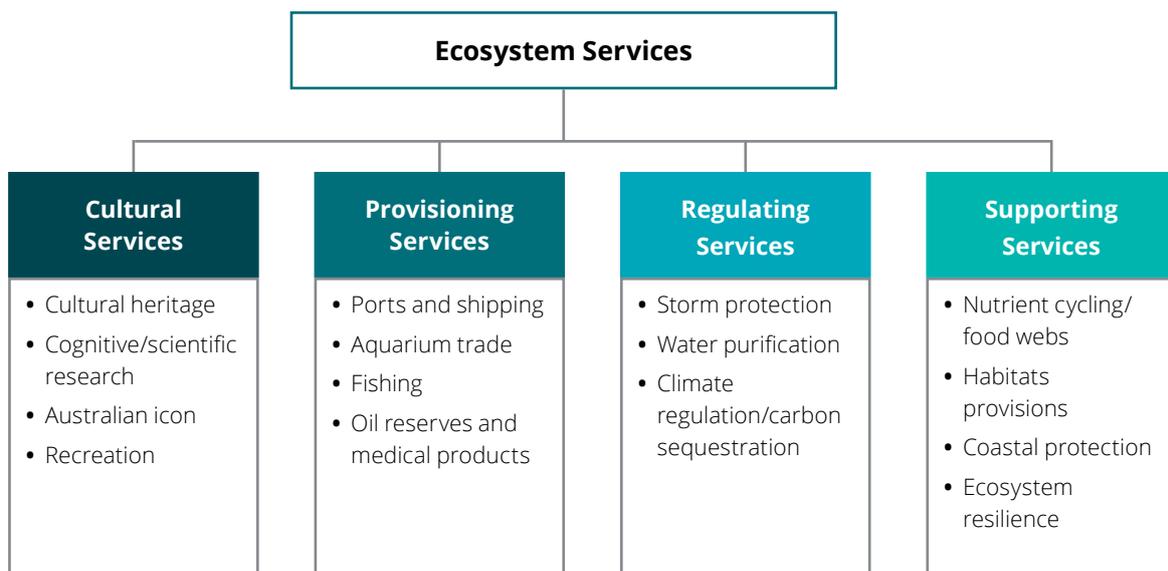
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4.3 Natural ecosystem management

Ningaloo Reef’s ecosystem services are central to the provision of tourism, recreational, commercial and research services that generate economic activity. These ecosystem services may be captured in the framework, adapted from a study by Stoeckl et al 2011.

Figure 4.1: Ecosystem services of coral reefs(a)



Notes: (a) In a separate study undertaken by Deloitte Access Economics, 65 percent of international residents considered the Great Barrier Reef to be the most iconic UNESCO World Heritage Site, only 1 percent of the same survey population believed Ningaloo reef to be the most iconic. Therefore, the discussion of an ‘Australian icon’ is excluded in this report.

Source: Stoeckl et al 2011.

While the ABS released an Experimental Ecosystem Accounting framework for the stock of ecosystem services and condition in both monetary and physical terms, the stock of ecosystem services is not measured for Ningaloo Reef. Instead, the role of ecosystem services addressed qualitatively in this report.

Cultural services and Provisioning services have been captured quantitatively and qualitatively in previous chapters, however the following ecosystem services have not yet been addressed:

- Regulating services – Services that regulate the surrounding climate such as carbon sequestration, storm protection and water purification
- Supporting services – ecosystem services that ensure habitat provision and ecosystem resilience.

Table 4.2. maps Ningaloo Reef’s ecosystem services to the description of how they are indirectly used, and therefore valued.

Table 4.2: **Regulating and supporting services**

Ecosystem service	Description of use
Regulating services	
Storm protection provided by the fringing reef	Protection of built capital in the region.
Climate regulation	When the temperature soars, coral reefs might cool off by creating their own clouds. Research from the Great Barrier Reef off the Australian coast shows that corals are packed full of the chemical dimethyl sulphide, ('DMS'). When released into the atmosphere, DMS helps clouds to form, which could have a large impact on the local climate. ⁴²
Carbon sequestration	Carbon dioxide is absorbed into (or released from) the oceans as part of a natural buffer system.
Supporting services	
Nutrient cycling	The movement and exchange of organic and inorganic matter back into the production of matter.
Habitat provisions	Habitat provisions for a diverse range of marine species, outlined in Chapter 2.1.1.
Ecosystem protection and resilience	Management of fish stocks is a key component in preventing phase shifts and managing reef resilience. ⁴³
Coral spawning season (march through to June)	The season attracts a diverse range of large mammals who feed of krill and other microorganisms and use the region as their nursery, providing a basis for tourism services.

4.4 Economic contribution – a measure of economic value

The annual GSP contribution of Ningaloo presented in this study presents one way to quantify the economic 'value' of Ningaloo – specifically, the gross value added to the State economy in FY2018-19 from reef-related expenditure.

It is a measure contingent on market transactions taking place – the exchange of goods or services that depend on the Reef's existence. It is just one way to value Ningaloo. As outlined in Chapter 2, the value of ecosystems – coral reefs – lie in the use and non-use value of their ecosystem services. While qualitatively described here, these services underpin the social, cultural and Traditional Owner source of value – from the protection the reef provides the sheltered bays for visitors and locals to enjoy, to the preservation of the landscapes of the traditional Thalu sites. For this reason, the \$110 million economic contribution is likely an underestimate of the value of Ningaloo.

Methodologies, such as Total Economic Valuation studies, exist in attempt to capture the economic value beyond market transactions in attempt to quantify the consumer surplus – the 'willingness to pay' to preserve Ningaloo. A previous study by Deloitte Access Economics found the Total Economic Value of the Great Barrier Reef was almost ten times the value of the economic contribution of the Great Barrier Reef for FY2015-16. Even then, some attributes of ecosystems – such as the 32,000 years of Traditional Owner knowledge – will not be reflected quantitatively.⁴⁴

What this study demonstrates is that the Ningaloo Reef an essential driver of local economic activity for Ningaloo – as well as one of Australia's best kept secrets.

Appendices

Appendix A:

Economic contribution studies

Economic contribution studies are intended to quantify measures such as value added, exports, imports and employment associated with a given industry or firm, in an historical reference year. The economic contribution is a measure of the value of production by a firm or industry.

A.1. Value added

Value added is the most appropriate measure of an industry's/company's economic contribution to gross domestic product (GDP) at the national level, or gross state product (GSP) at the state level.

The value added of each industry in the value chain can be added without the risk of double counting across industries caused by including the value added by other industries earlier in the production chain.

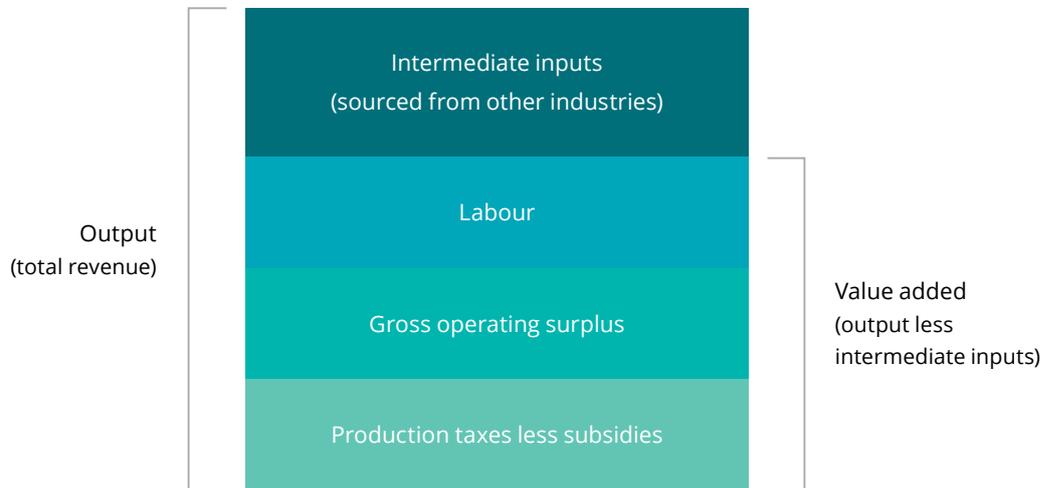
Other measures, such as total revenue or total exports, may be easier to estimate than value added but they 'double count'. That is, they overstate the contribution of a company to economic activity because they include, for example, the value added by external firms supplying inputs or the value added by other industries.

A.2. Measuring economic contribution

There are several commonly used measures of economic activity, each of which describes a different aspect of an industry's economic contribution:

- **Value added** measures the value of output (i.e. goods and services) generated by the entity's factors of production (i.e. labour and capital) as measured in the income to those factors of production. The sum of value added across all entities in the economy equals gross domestic product. Given the relationship to GDP, the value added measure can be thought of as the increased contribution to welfare. Value added is the sum of:
 - Gross operating surplus (GOS) – GOS represents the value of income generated by the entity's direct capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA)
 - Tax on production less subsidy provided for production – This generally includes company taxes and taxes on employment. Note: Given the returns to capital before tax (EBITDA) are calculated, company tax is not included or this would double count that tax
 - Labour income is a subcomponent of value added. It represents the value of output generated by the entity's direct labour inputs, as measured by the income to labour.
- **Gross output** measures the total value of the goods and services supplied by the entity. This is a broader measure than value added because it is an addition to the value added generated by the entity. It also includes the value of intermediate inputs used by the entity that flow from value added generated by other entities
- **Employment** is a fundamentally different measure of activity from those above. It measures the number of workers employed by the entity, rather than the value of the workers' output.

Figure A.1: Economic activity accounting framework



Source: Deloitte.

Figure A.1 shows the accounting framework used to evaluate economic activity, along with the components that make up gross output. Gross output is the sum of value added and the value of intermediate inputs. Value added can be calculated directly by adding the payments to the primary factors of production, labour (i.e. salaries) and capital (i.e. gross operating surplus (GOS), or profit), as well as production taxes less subsidies. The value of intermediate inputs can also be calculated directly by adding up expenses related to non-primary factor inputs.

A.3. Direct and indirect contributions

The **direct economic contribution** is a representation of the flow from labour and capital involved in the economic activity itself.

The **indirect economic contribution** is a measure of the demand for goods and services produced in other sectors as a result of demand generated by economic activity associated with the Ningaloo Reef. Estimation of the indirect economic contribution is undertaken in an input-output (IO) framework using Australian Bureau of Statistics input-output tables that report the inputs and outputs of specific sectors of the economy.

The **total economic contribution** to the economy is the sum of the direct and indirect economic contributions.

A.4. Limitations of economic contribution studies

While describing the geographic origin of production inputs may be a guide to a firm or activity's linkages with the local economy, it should be recognised that these are the type of normal industry linkages that characterise all economic activities.

Unless there is significant unused capacity in the economy (such as unemployed labour) there is only a weak relationship between a firm's economic contribution as measured by value added (or other static aggregates) and the welfare or living standard of the community. Indeed, the use of labour and capital by demand created from the industry comes at an opportunity cost as it may reduce the amount of resources available to spend on other economic activities.

This is not to say that the economic contribution, including employment, is not important. As stated by the Productivity Commission in the context of Australia's gambling industries:⁴⁶

Value added, trade and job creation arguments need to be considered in the context of the economy as a whole ... income from trade uses real resources, which could have been employed to generate benefits elsewhere. These arguments do not mean that jobs, trade and activity are unimportant in an economy. To the contrary they are critical to people's well-being. However, any particular industry's contribution to these benefits is much smaller than might at first be thought, because substitute industries could produce similar, though not equal gains.

In a fundamental sense, economic contribution studies are simply historical accounting exercises. No 'what-if', or counterfactual inferences – such as 'what would happen to living standards if this economic activity disappeared?' – should be drawn from them.

The analysis – as discussed in the report – relies on a national input-output table modelling framework and there are some limitations in this modelling framework. The analysis assumes that goods and services provided to the sector are produced by factors of production that are located completely within the state or region defined and that income flows do not leak to other states.

The IO framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. That is, an increase in economic activity in one area of the economy does not increase prices and subsequently crowd out economic activity in another area of the economy. As a result, the modelled total and indirect contribution can be regarded as an upper-bound estimate of the contribution made by the supply of intermediate inputs.

Similarly, the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment like a CGE model.

A.5. Input-output analysis

Input-output tables are required to account for the intermediate flows between sectors. These tables measure the direct economic activity of every sector in the economy at the national level. Importantly, these tables allow intermediate inputs to be further broken down by source. These detailed intermediate flows can be used to derive the total change in economic activity associated with a given direct change in activity for a given sector.

A widely used measure of the spill-over of activity from one sector to another is captured by the ratio of the total to direct change in economic activity. The resulting estimate is typically referred to as 'the multiplier'. A multiplier greater than one implies some indirect activity, with higher multipliers indicating relatively larger indirect and total activity flowing from a given level of direct activity.

The input-output matrix used for Australia is derived from the 2015-16 Australian Bureau of Statistics Input-Output Tables. The industry classification used for input-output tables is based on ANZSIC, with 114 sectors in the modelling framework.

Appendix B:

Approach to estimating economic contribution

This appendix outlines the specific approach taken to estimate each area of economic activity associated with Ningaloo.

B.1. Tourism

This analysis uses the Tourism Satellite Accounting (TSA) framework to measure the economic contribution of tourism activity in the Ningaloo region. The TSA framework is conceptually similar to the IO approach, and draws on the ABS IO tables to generate results. It is based on an international approach to defining the tourism sector and different tourism products and related industries depending on the extent to which they interact with visitors either directly or indirectly.

While conventional IO modelling can be applied to any sector of the economy (including tourism by using an appropriate sector-specific definition of the tourism sector), the TSA approach is Deloitte Access Economics' preferred approach to measuring the economic contribution of the tourism sector as it ensures that the analysis is consistent with international guidelines for measuring and reporting on the economic activity of the tourism sector.

B.1.1. Direct tourism contribution

A direct contribution occurs where there is a direct relationship, both physical and economic, between the visitor and the producer of the good or service. Direct tourism output is essentially the amount of tourism consumption less net product taxes, wholesale and transport margins and imports.

In the case of retail goods purchased by visitors, only the retail margin contributes to direct tourism output, value added and gross regional product. This is because it is deemed that only the retailer has a direct relationship with the visitor and is therefore part of the tourism industry. Output and value added attributed to industries other than retail is excluded from the value of direct tourism output.

Direct tourism output is therefore equal to internal visitor consumption at basic prices less the cost to retailers of domestic goods sold directly to visitors.

Direct tourism gross value added shows only the 'value' which a producer adds to the raw material goods and services it purchases in the process of producing its own output. Direct tourism gross value added is measured as the value of the output of tourism products by industries in a direct relationship with visitors less the value of the inputs used in producing these tourism products.

B.1.2. Indirect tourism contribution

The indirect effect of visitor consumption is a broad notion that covers upstream and supplier effects of visitor demand. Intermediate inputs represent those goods and services which support the supply of the tourism product – the cleaning services that are inputted to the hotel sector; the fuel that is inputted to the aviation industry; the fruit and vegetables that are inputted to the restaurant industry. Together with any upstream impacts, it is these flow-on effects which determine the tourism industry's indirect contribution.

The definition of direct and indirect are slightly different in the TSA approach as direct is defined as activity involving a direct interaction with visitors. Accordingly, the ratio of direct and indirect activity differs from results using a standard IO approach. However, estimates of total value added and employment should be similar across the two approaches.

B.1.3. Ningaloo tourism expenditure

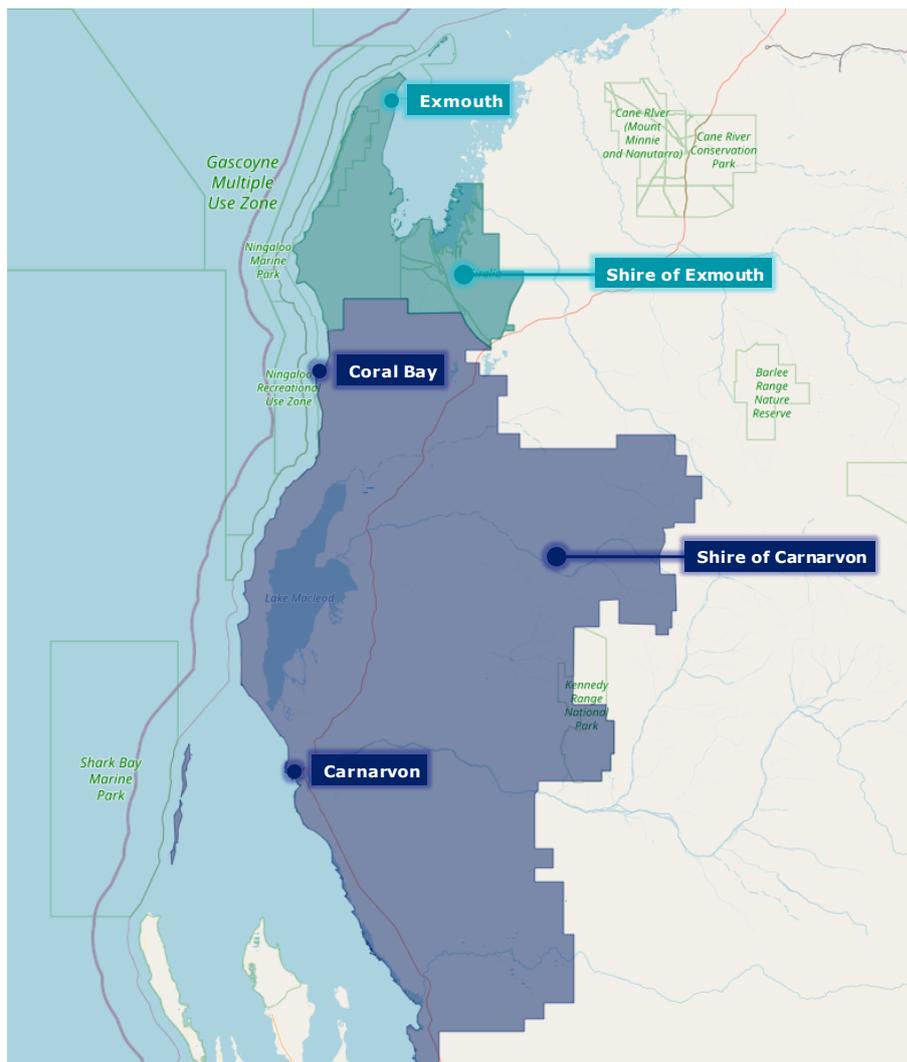
Data used to quantify the economic contribution of tourism activity in the Ningaloo region are drawn from Tourism Research Australia's National Visitor Survey (NVS), International Visitor Survey (IVS) and Regional Expenditure (REX) database.

Total expenditure by tourists associated with Ningaloo is the product of the estimated number of visitors or visitor nights (based on NVS and IVS data) and the estimated expenditure per visitor or visitor night (based on REX data). Total expenditure is disaggregated to individual tourism product categories according to expenditure profiles based on the type of visitor (international, interstate or intrastate overnight, daytrip), purpose of visit and type of accommodation.

The economic value added that corresponds to this expenditure is then estimated using the TSA framework.

All tourism activity in the Shire of Exmouth is assumed to be associated with Ningaloo; however, only a portion of trips and visitor nights to the Shire of Carnarvon are included in this analysis, reflecting that the town of Carnarvon and other tourist sites within the Shire of Carnarvon are not adjacent to Ningaloo. Figure B.1 shows the boundaries for the Shires of Exmouth and Carnarvon in the context of the Ningaloo coast, showing the relative locations of the towns of Coral Bay and Carnarvon.

Figure B.1: Shires of Exmouth and Carnarvon



Source: Deloitte.

Note that for the purposes of tourism analysis for Ningaloo, the Shires of Exmouth and Carnarvon are coextensive with the northern boundaries of Australia's Coral Coast tourism region. However, the tourism region extends as far south as Guilderton (near the Perth metropolitan boundary) and east to the boundaries of the Shire of Upper Gascoyne. Therefore, the approach adopted in this report – using LGA-level data for Exmouth and Carnarvon – is more precise than relying on data for the tourism region as a whole.

The apportionment of Shire of Carnarvon tourism activity to Ningaloo is based on supplementary data in the NVS and IVS databases that reflect visitation to the Ningaloo Marine Park. The factors applied to apportion Shire of Carnarvon data are summarised in Table B.1.

Table B.1: Share of visitors and visitor nights included in the 'Ningaloo region'

	Domestic		International	
	Visitors	Visitor Nights	Visitors	Visitor Nights
Shire of Exmouth	100.0%	100.0%	100.0%	100.0%
Shire of Carnarvon	45.7%	53.1%	62.8%	37.7%

Source: Tourism Research Australia; Deloitte.

Total visitor expenditure per visitor day/night is taken from REX data at the tourism region level (Australia's Coral Coast), while the apportionment of total expenditure to individual tourism products is based on expenditure profiles at the national level drawn from NVS and IVS data.

B.2. Commercial fishing

The estimated catch for the Exmouth Gulf Prawn Managed Fishery (EGPMF) is sourced from the EGPMF Final Season Report for 2018, provided by Department of Primary Industries and Regional Development. Gross value of product for the EGPMF was not available for the same period; instead, GVP per tonne by species was sourced from DPIRD's state of the fisheries publication for 2017-18. Catch and estimated GVP per tonne by species (the latter escalated to 2018-19 dollars) is shown in Table B.2.

Table B.2: Exmouth Gulf prawn fishery, estimated catch and gross value, 2018-19

Species	Catch (tonnes)	GVP per tonne (2018-19 dollars)
Brown Tiger	392	\$16.93
Blue Endeavour	313	\$9.38
Western King	174	\$14.78
Banana	1	\$13.32
Total	880	-

Source: DPIRD.

B.3. Recreational activity

Expenditure on recreational activity is estimated in three categories: recreational equipment, recreational fishing, and other activity including boating and sailing.

Expenditure on recreational equipment is estimated based on average expenditure by household drawn from the ABS Household Expenditure Survey 2015-16 (escalated to 2018-19 dollars). Expenditure per household for items used in this analysis is summarised in Table B.3.

Table B.3: **Expenditure per household on recreational equipment, 2018-19 dollars**

Expenditure category	Expenditure per household
Purchase of boat	\$1.16
Registration and insurance of boat	\$0.70
Boat purchase, parts and operation	\$1.28
Camping equipment	\$1.40
Fishing equipment	\$0.44
Water sport, snow sport and skating equipment	\$0.17
Recreational and educational equipment	\$1.72
Hire of recreational and educational equipment	\$0.05
Repair of recreational and educational equipment (excl AV equipment)	\$0.20
Total	\$7.11

Source: ABS.

The number of households in the Shire of Exmouth is estimated at 1,166, derived from an estimated resident population of 2,798 and average household size of 2.4 persons per household (drawn from 2016 Census data).

Recreational fishing catch and GVP is estimated using a similar approach to commercial fishing. The recreational catch is estimated using data provided by DPIRD from its survey of recreational fishing for 2015-16, while GVP per kg is sourced from the same state of the fisheries report for 2017-18 and escalated to 2018-19 dollars. Both recreational catch and GVP per tonne are shown in Table B.4.

Table B.4: **Estimated Ningaloo recreational fishing parameters**

Fish	Catch (tonnes)	GVP per tonne (2018-19 dollars)
Chinaman Rockcod	2.70	\$5.67
Coral Trout	1.19	\$15.45
Spangled Emperor	6.95	\$6.22
Spanish Mackerel	8.56	\$9.88
Total	19.39	-

Source: DPIRD.

Expenditure on recreational boating and sailing is estimated using an approach developed by Deloitte for its economic contribution study of the Great Barrier Reef, drawing on parameters estimated by Rolfe and Gregg (2012) for beach recreation in regional areas. This approach is applied in the absence of contemporary data specific to Ningaloo.

Estimation is based on dollar-per-household parameters weighted by factors that consider the frequency of each activity and the proportion of the population that participates in each activity by frequency. These are summarised in Table B.5.

Table B.5: **Recreational boating and sailing expenditure parameters**

	Share (%)		Expenditure per household (2018-19 dollars)	
	Boating	Sailing	Boating	Sailing
Frequency of activity				
More than once a week	2.3%	8.4%	\$15.70	\$15.70
About once a week	3.3%	3.5%	\$20.93	\$20.93
About once a fortnight	3.9%	4.2%	\$23.02	\$26.16
About once a month	14.3%	12.9%	\$31.40	\$31.40
Two or three times a year	34.3%	38.3%	\$41.86	\$52.33
About once a year	26.0%	14.5%	\$52.33	\$57.56
Once only	15.9%	18.2%	\$52.33	\$57.56
Population share				
Share of population participating in the activity	4.8%	12.2%	-	-

Source: Deloitte Access Economics (2017); Rolfe and Gregg (2012).

The number of households used as the basis for estimating total expenditure is as outlined above.

B.4. Management and research

Management and research expenditure data for 2018-19 was sourced from several organisations (see Table B.6). Management expenditure data provided by DBCA was in a detailed journal format, from which expenditure was assigned to input-output categories. In some cases, research expenditure data from other organisations was only available at a high level, in which case expenditure was disaggregated using the same input-output assignment as the DBCA expenditure.

B.5. Data sources

Table B.6 summarises the key data series used to estimate each area of economic contribution outlined in this Appendix.

Table B.6: **Key data series and sources**

Economic activity	Data series	Data source
Tourism	Visitors and visitor nights	Tourism Research Australia (TRA), International Visitor Survey (IVS) and National Visitor Survey (NVS)
	Total expenditure per visitor day/night and expenditure profile by tourism product	TRA Regional Expenditure (REX) database, NVS, IVS
Commercial fishing	Catch (volume) of prawns by species	Department of Primary Industries and Regional Development (DPIRD), 2018 Exmouth Gulf Prawn Managed Fishery Final Season Report
	Gross value of product per tonne	Derived from DPIRD, "Status reports of the fisheries and aquatic resources of Western Australia 2017/18: State of the fisheries"
Recreational activity	Recreational equipment expenditure per household	Australian Bureau of Statistics (ABS) Catalogue No. 6530.0 Household Expenditure Survey 2015-16
	Number of households; Population	ABS Estimated Resident Population (2018); ABS Census of Population and Housing (2016)
	Recreational fishing catch (volume)	DPIRD, "Statewide survey of boat-based recreational fishing in Western Australia 2015/16"
	Recreational activity (non-equipment) expenditure per person	Deloitte Access Economics (2017) "At what price? The economic, social and icon value of the Great Barrier Reef" derived from Rolfe, J. and Gregg, D. (2012) "Valuing beach recreation across a regional area: The GBR in Australia", <i>Ocean & Coastal Management</i> , 69, pp. 282—290.
Management and research	Management expenditure	Department of Biodiversity, Conservation and Attractions, supplied
	Research expenditure by scientific and not-for-profit organisations	Great Barrier Reef Foundation; Australian Institute of Marine Science; Commonwealth Scientific and Industrial Research Organisation, supplied
General parameters	Consumer price index inflation	ABS Catalogue No. 6401.0 Consumer Price Index, December 2019

Limitation of our work

General use restriction

This report is prepared solely for the internal use of Department of Biodiversity, Conservation and Attractions. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of set out in our engagement letter dated 1 October 2019. You should not refer to or use our name or the advice for any other purpose.

Endnotes

1. Management and research activities are public goods intended to protect and conserve Ningaloo as a natural asset. They are largely publicly funded. Therefore, the ratio of value added to total expenditure is lower than other activities, which are commercial in nature and driven by the purchase of consumer goods and services. Value added for all activities has been estimated using the same approach based on input-output tables and guidance published by the Australian Bureau of Statistics.
2. Economic expenditure is the sum of expenditure on salaries, wages and purchases of intermediate inputs. It excludes net taxes and transfers, internal expenditure and transfers, interest expense, depreciation and amortisation.
3. While most Baiyungu, Thalanyji and Yinikurtura people live in modernised communities today, the ecosystem remains important to preserving local traditions and activities, such as ceremonial rituals and hunting.
4. Economics, Deloitte Access. At what price? The economic, social and icon value of the Great Barrier Reef. Deloitte Access Economics, 2017.
5. UNESCO World Heritage Centre, World Heritage List (2020) < <https://whc.unesco.org/en/list/1369/>>.
6. Pitman, Totterdell Fearnbach, Balance Durban, Kemps, Whale killers: prevalence and ecological implications of killer whale predation on humpback whale calves off Western Australia (Marine Mammal Science, 2015) 31(2) 629-57.
7. Ningaloo Reef has not been exposed to severe or repeated heat stress in the last three years, unlike 72 per cent of coral reefs globally. Scott, H Eakin, M and Douvère, F, Impacts of Climate Change on World Heritage Coral Reefs: A First Global Scientific Assessment, (UNESCO World Heritage Centre, 2017).
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9. The Economics of Ecosystems and Biodiversity, The Economics of Ecosystems and Biodiversity in National and International Policy Making (2011).
10. The SNS is the international system we measure economic transactions and assets to calculate indicators of societal welfare and economic prosperity, such as Gross Domestic Product ('GDP'). The Economics of Ecosystems and Biodiversity, The Economics of Ecosystems and Biodiversity in National and International Policy Making (2011).
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12. The Economics of Ecosystems and Biodiversity, The Economics of Ecosystems and Biodiversity in National and International Policy Making (2011).
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21. Department of Jobs, Tourism and Science and Innovation (2019)
22. Department of Premier and Cabinet, *Diversify WA: Strong Economy Creating Job and Diverse Industries, Economic Development Framework for Western Australia*, (Government of Western Australia, 2019)
23. The share of global oil and coal consumption has declined in 20 years. In 2018, coal accounted for 27 percent of global energy consumption, its lowest level in 15 years. Meanwhile, renewables share has increased to 4 percent in the last decade. Source: BP Statistical Review of World Energy (2019)
24. Value added in the context of economic contribution studies is explained further in Appendix A.
25. For the purposes of tourism analysis, the Ningaloo region is defined as the area covered by the Shire of Exmouth and Shire of Carnarvon local government areas (LGAs), with the number of visitors and visitor nights weighted according to the likelihood of tourism activity in that LGA being attributed to Ningaloo; see Appendix B for more information.
26. Visitor and visitor night estimates are based on three-year averages from 2016-17 to 2018-19. This is because Tourism Research Australia surveys tend to have small samples at the LGA level, and data for individual years can be unreliable.
27. Daytrip visitors are those who do not stay overnight in the region.
28. This represents the number of households within the Shire of Exmouth. Households within the Shire of Carnarvon are not considered, given that the only settlement adjacent to the Reef is Coral Bay, which has a very small permanent population.
29. The Resilient Reefs Initiative is a collaboration between BHP Foundation, the Great Barrier Reef Foundation, UNESCO World Heritage Marine Programme, The Nature Conservancy, Columbia University's Center for Resilient Cities and Landscapes, Resilient Cities Catalyst, and AECOM.
30. The Ningaloo Outlook research program is a strategic marine research partnership between BHP and the Commonwealth Scientific and Industrial Research Organisation (CSIRO).
31. Most respondents were from Australia, with 92% of respondents from Western Australia.
32. All studies listed used a dichotomous choice response

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