WHAT'S A WHALE WORTH?

Valuing whales for National Whale Day

Final report

Prepared for the International Fund for Animal Welfare

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ADDING VALUE TO SOCIETY

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Executive summary

On the eve of National Whale Day 2011, this report demonstrates the value that whales have to Australia. This report uses tourism revenue data from earlier IFAW reports and estimates of local whale populations to estimate tourism values per whale, providing a quantifiable answer to the question "What is a whale worth?".

Humpback (*Megaptera novaeangliae*) and southern right (*Eubalaena australis*) whales are important species for whale watching in Australia and are the focus of the case studies in this report. Populations of humpbacks migrate up the east and west coasts, while southern rights migrate mainly to the south coast. Each distinct population of both species has been recovering since being seriously depleted by commercial whaling last century, but still face significant challenges.

Australia has a well-established commercial whale watching industry, with operations in every state. While a wide range of species is sighted, humpback whales are the focus of whale watching on the west and east coasts, while southern right whales are the focus along the southern coast. Over 1.6 million people went whale watching in Australia in 2008, generating AUD $47 million in ticket expenditure and AUD $264 million in total tourism expenditure. This represents an increase in direct expenditure of nearly 600%.

Year	Direct expenditure (AUD millions)	Total expenditure (AUD millions)
1991	$6.8	$71.2
1994	$8.9	$85.7
2000	$19.9	$98.6
2003	$34.2	$321
2008	$47.1	$264.3

Assigning a value to natural resources is complex and involves many assumptions, beginning with the acknowledgement of the limitations of the approach – that we are choosing to exclude a range of tangible and intangible values that whales have both for humans and for the wider ecosystem.

We have calculated total tourism revenue related to whale watching in three locations and averaged this figure across the local whale population. This annual value is then used to calculate the present value of each whale's average tourism revenue through its lifetime, at an appropriate, normative discount rate.

The three research locations are Hervey Bay, Warrnambool and Broome. The final results for each area are presented in the table below.

Area	Number of tourists (2008)	Local whale population	Average present value per whale*
Hervey Bay (QLD)	64,260	3,956	AUD $97,000
Warrnambool (VIC)	37,190	50	AUD $1,259,000
Broome (WA)	2,000	383	AUD $32,000

* based on whale life expectancy at 2.65% discount rate.

Hervey Bay in Queensland is the oldest humpback whale watching location in Australia, with many operators taking visitors to see the part of the eastern Australian humpback population that enters the bay. With its well-established industry and recovering whale population, we estimate the present value of a humpback whale to the Hervey Bay economy to be $97,000.

Southern right whales visit Warrnambool in Victoria every year, with mother and calf pairs often staying for extended periods in bays close to town. Whale watching is undertaken mainly from a viewing platform on land. With large numbers of tourists coming to see a relatively small population of whales, we estimate the present value of a southern right whale to the Warrnambool economy to be $1,259,000. This value is significantly higher than the values in Hervey Bay and Broome because revenue from whale watching in Warrnambool is high and the population is very small compared to the other two regions.

Broome in the north of Western Australia is a relatively new whale watching location, with around 10 boat-based operators taking visitors to see whales from the western Australian humpback population. This humpback population is thought to be the largest in the world. With a relatively large population of whales and a new whale watching industry, we estimate the present value of a humpback whale to the Broome economy to be $32,000.

The whale watching industries in each town are at different stages of development and offer different whale watching experiences. The difference between the locations is evident in the estimated values per whale for each location, ranging between $32,000 and $1.25 million. Tourism revenues and whale populations are clearly related since without whales, the industry wouldn't exist. Beyond that obvious statement, the link between tourism revenue and whale populations is more complex. What is certain is that healthy and abundant populations of whales are important to support a large and diverse whale watching industry along Australian coastlines and to enhance the intensity of the tourism experience in a particular location.

Despite their high value to the Australian economy and the growing Australian whale watching industry, whale populations are still under threat. Resumption of whaling, climate change, prey depletion, habitat loss and increased marine activity pose multiple threats to whale populations in the future. A robust, coordinated policy response to these threats, in Australian State and Commonwealth waters as well as in the Antarctic, will be essential to ensure their continued recovery and their continued contribution to the economies of Australian coastal communities.

Introduction

National Whale Day 2011, July 2nd, involves almost 100 community groups around Australia. Many of these are coastal communities with a deep love for and connection with the whales that migrate past headlands and beaches each year. The International Fund for Animal Welfare (IFAW) has commissioned Economists at Large to investigate the value that whales bring to whale watching locations. This is the latest in a series of IFAW reports on the economic value of conserving whales.

This paper asks, "What is a whale worth"? Specifically, what are the average tourism revenues per whale? The purpose of this investigation is to show that whales bring financial benefits to communities, tourism businesses and Australia in general. Economic values associated with the whale watching industries in these locations have been estimated in earlier reports, (O'Connor et al, 2009) and (O'Connor, 2004). However, this paper is the first to estimate economic values attributable to individual whales. Much of the primary data for this report comes from earlier IFAW research, some of which was published in O'Connor et al (2009). Here, location-specific information has been disaggregated, updated and published for the first time.

We focus on three whale watching locations: Hervey Bay, Warrnambool and Broome. All three are well-known whale watching sites, but each has different characteristics. Hervey Bay is the longest-running commercial whale watching area in Australia, with many operators offering trips to view migrating humpback whales (*Megaptera novaeangliae*). Warrnambool has also had whale watching for many years, but is focused on land-based watching of southern right whales (*Eubalaena australis*), usually mother and calf pairs that spend long periods close to shore. Broome has a handful of boat-based whale watching businesses that have been operating since 2008. They observe what is possibly the largest population of humpback whales in the world, off the spectacular Kimberley coastline.

In this report, we discuss the relationship between the whale populations at each location and the tourism expenditure that arises from viewing them. We examine the results from each location, discuss the differences between them, and compare these results to those of similar studies.

Background

Commercial whaling

The International Whaling Commission (IWC) was established in 1946 to manage the global whaling industry. In light of severely depleted populations, southern right whales were legally protected in 1935, and in 1963 the killing of humpback whales was also banned. Despite this, Russian whalers killed more than 3,000 southern right whales and 30,000 humpback whales illegally in the 1950s and '60s (Reilly et al, 2008a and Reilly et al 2008b).

After some decades of setting whaling quotas, in 1982 the commission set catch limits to zero for the 1986 season and beyond (IWC, 2010) for all large whale species. This zero quota allocation is known as the moratorium on commercial whaling. 2011 represents the 25th anniversary of the moratorium.

During its 25-year history, the moratorium has come under increasing pressure, with pro-whaling nations lobbying to end the moratorium and reinstate commercial whaling. Whaling by aboriginal communities and for scientific purposes has continued throughout this period. In 2007 the Japanese government proposed the killing of 50 humpback whales a year for 'scientific' reasons. Furthermore, the USSR, Norway, Japan and Iceland have at times objected to the moratorium and self-allocated whaling quotas (IWC, 2010).

Australia considers the moratorium on whaling to be one of the IWC's "most resounding whale management successes", one that has "allowed some whale populations to begin to recover" (Dpt Sustainability and Environment, 2008). While the Australian Government's support for the IWC reflects Australian public opinion on whale conservation, it also reflects Australia's large and growing whale watching tourism industry, which is dependent on whale populations (O'Connor et al, 2009).

Whale watching tourism in Australia

Tourism is one of Australia's largest industries, accounting for around 4% of GDP in most years (Dpt Resources, Energy and Tourism, 2010). Australia has a well-established commercial whale watching industry, with operations in every state. While a wide range of species is sighted, humpback whales are the focus of whale watching on the west and east coasts, while southern right whales are the focus along the southern coast. Over 1.6 million people went whale watching in Australia in 2008, generating AUD $47 million in ticket expenditure and AUD $264 million in total tourism expenditure (O'Connor et al, 2009). This represents an increase in direct expenditure of nearly 600%.

Table 1: Growth of whale watching tourism in Australia (1991 - 2008)

Year	Direct expenditure (AUD millions)	Total expenditure (AUD millions)
1991	$6.8	$71.2
1994	$8.9	$85.7
2000	$19.9	$98.6
2003	$34.2	$321
2008	$47.1	$264.3

Source: O'Connor (2004), O'Connor et al (2009).

Note: Figures above are adjusted to 2008 dollars based on the Australian consumer price index and include dolphin watching tours.

Communities selected for this study

The three whale watching communities selected in this study represent different areas, both geographically and within the history of whale watching in Australia. All are focused on watching of large whales – specifically humpback and southern right whales. Whale watching began in Hervey Bay in 1987 and today 10 operators offer trips to see humpback whales. Warrnambool has also had whale watching for many years, primarily based upon watching southern right whales from land and some boat-based trips. Broome is a new location for humpback whale watching, with commercial operations beginning in 2008.

Humpback whales in Australia

Humpback whales are moderately large baleen whales that are often the focus of whale watching trips due to their charismatic behaviour, their aggregations close to the shore and their predictable

migration patterns. They can grow to be 12 metres in length and weigh over 30 tonnes. Humpbacks often "breach", throwing themselves out of the water, and slap their tails and fins on the water surface. This behaviour makes them particularly attractive for whale watching tourism (Dpt of Sustainability Environment Water Population and Communities, 2011a).

Humpback whales migrate every year between Antarctic feeding grounds and warmer tropical waters for mating, calving and social activities (Franklin et al, 2010; Franklin et al, in press; Jenner et al, 2001). Distinct northern and southern hemisphere groups do not interact. Groups migrating to different areas in the southern hemisphere also tend to be discrete, although exchanges of individuals between populations have been observed, (Franklin et al, in press; Jenner et al, 2001). Two distinct populations travel along the Australian coastline; one group travels up the east coast and another up the west. In technical literature the Australian eastern population of humpback whales – relevant to Hervey Bay – is often referred to as breeding stock Ei and feeds in Antarctic area V. The western population – relevant to Broome – is known as breeding stock D and feeds in Antarctic area IV, (Reilly et al, 2008).

Both populations migrate annually along the Australian coast between April and December, (Dpt Environment and Heritage, 2005; Jenner et al, 2001). The whale watching season generally lasts from June until November (O'Connor et al, 2009). A distinct northern and southern peak in migration is typically observed and some behaviour, such as the whales entering Hervey Bay or Exmouth Gulf, only occurs on the southern migration (Franklin et al, 2010; Jenner et al, 2001).

Southern right whales in Australia

Southern right whales are large baleen whales, genetically distinct from northern hemisphere populations. One of the largest whales, they can grow to over 17m and weigh 80 tonnes. Usually black but frequently with irregular white patches on their underside, they also have characteristic white protrusions known as callosities on their heads that enable researchers to identify individuals (Dpt Sustainability Environment Water Population and Communities, 2011b). Southern right whales are known to be present across the entire southern coastline of Australia. There are also sightings along the western and eastern coastlines, and recent sightings have occurred as far north as Hervey Bay (Franklin & Burns 2005).

Southern rights are generally solitary during their migration, although mothers and calves stay in pairs. They will often spend extended periods in the same locations feeding and resting. Mothers also exhibit strong preferences for particular calving grounds, with many returning to the same location over many years (Dpt Environment and Heritage, 2011).

Major calving grounds for southern right whales are located at Doubtful Island Bay and Israelite Bay in Western Australia and at Head of Bight in South Australia (Dpt Sustainability Environment Water Population and Communities, 2011b). Warrnambool in Victoria is discussed extensively below.

Compared with humpback whales, outside of the calving grounds, migratory movements of southern right whales is less well understood (Dpt Sustainability Environment Water Population and Communities, 2011b).

Threats to whale populations

The slow recovery of Australia's whale stocks is a cause for celebration on National Whale Day, but threats to this recovery still remain. The Department of Environment and Heritage (2005a; 2005b) lists a range of issues that continue to threaten whale populations in Australia:

- Climate change – it is unknown how changes in the world's climate will affect ocean ecosystems, in particular the impact on quantity and distribution of whales' prey species.
- Prey depletion – unsustainable management of whales' prey species, such as krill or fish species could lead to whales being unable to find sufficient food, or having to migrate greater distances to feed.
- Habitat degradation – areas where whales calve and feed are often close to shore, in areas such as Warrnambool, that come under pressure from increasing coastal population, land reclamation, boat activity, oil and gas production etc. Agricultural and urban runoff reduces water quality and may compromise habitat.
- Marine activity such as shipping and geological exploration. Ship strike and acoustic pollution relating to boating and geological exploration are growing concerns among cetacean researchers.
- In certain areas excessive whale watching also leads to stress on migrating whales. The Australian government has recently announced a whale watching monitoring program, CETUS, to address this challenge (Office of the Minister for Sustainability, Environment, Water, Population and Communities, 2011).

All these factors, and any moves toward resumption of commercial whaling, have the potential to put pressure on whale populations. The Department of Environment and Heritage (2005a; 2005b) also suggests some responses to the threats above including:

- The prevention of commercial whaling and banning of scientific whaling.
- Protection of habitat important to the survival of the species.
- Monitoring and managing the potential impacts of prey depletion due to over harvesting.
- Monitoring climate and oceanic change.

Methodology

Valuing Wildlife and Individual Animals

Estimating the economic value of any animal or of wildlife generally is difficult and involves many assumptions. The first thing to note is that we are valuing whales in human terms, without any consideration of how whales might value their own existence. Nor do we consider the value of whales to other species and ecosystems. While some disagree with such an anthropocentric approach, it is unavoidable in this report given the focus on whale watching tourism.

Economists often use an approach to valuing natural resources known as Total Economic Value (TEV). TEV includes valuation of direct use, indirect use and non-use values. Whale watching tourism is an example of a direct use value, and is the only use considered in this report. Indirect use values, such as the role whales play within wider ecosystems, are difficult to assess and are beyond the scope of this report. Non-use values refer to the value humans place on knowing that a natural asset exists, even if they never plan to see or use it. People may also value the idea of passing on natural assets to future generations, or having the option to use the asset in the future. Such non-use values are often invoked in conservation discussions, and can be very large. In the case of whales, the non-use values that people attach to them can be demonstrated by public donations to conservation organisations, which people make regardless of whether they ever plan to actually see whales. Estimating non-use values, while possible, is beyond the scope of this report.

Putting a value on animals such as whales is particularly challenging as they are large, generally wild, and untraded. To estimate their value, we are using the revenues attributable to whale watching of particular species that are generated for tourism operators and flow-on businesses. This report estimates the financial values whales bring to local economies. Specifically, the present value of tourism revenue is averaged across the local whale population to give a present value of each individual whale.

Methodology and terminology in this report

In this report we take tourism revenues and whale population numbers to estimate values to answer the question “What is a whale worth?”. As mentioned above, this is not a complete assessment of how much whales are worth to humanity, much less to the whales themselves or other species. It is an attempt to highlight how much tourism expenditure might be attributed to an individual whale.

Most of the data used in this report comes from an IFAW study into the worldwide whale watching industry – O'Connor et al (2009). The authors of the O’Connor report surveyed whale watching businesses by phone and email in 119 countries, including the sites in this study. Contact was made by phone with operators and local authorities to confirm annual whale watching passenger numbers. This research updated earlier studies by Hoyt (1992; 1995; 2001).

The expenditure figures in this report draw on total expenditure calculated by O'Connor et al (2009). Total expenditure in O'Connor et al referred to the sum of direct and indirect expenditures by whale watchers.

For these purposes, "direct expenditure" referred to the ticket revenue accruing to whale watch operators. O'Connor et al (2009) calculated "indirect expenditure" in a way that departs from usual economic usage, in line with earlier studies of global whale watching tourism (Hoyt, 1992; 1995; 2001). It was calculated as additional expenditure that a tourist would spend in a local economy — such as food, accommodation, souvenirs, etc. — related to their whale watching excursion. For Australian locations this was based on statistics from the government agency Tourism Research Australia. The indirect expenditure for a day's whale watching was calculated by averaging daily and overnight expenditure for each relevant region, and multiplying this figure by the total number of whale watching tourists in the region. For a full description of O'Connor et al's methodology see O'Connor et al (2009), p34.

In this report we present the present value of the total expenditure from O'Connor et al's research divided by the local whale population to give a value per whale in each location. Methods used to estimate whale populations relied on secondary sources and personal communications with local researchers. Calculations of population are further discussed in each section.

Total expenditure value per whale

To arrive at our value per whale, we have calculated the average total expenditure per whale in 2008 as shown below.

Total expenditure value per whale	$\frac{Te}{Pe}$ *Where:* Te = Total whale watching expenditure in region Pe = Population estimate of target species. *Note: for population estimates, we used estimates available for years as close as possible to 2008.*

Present value per whale

From total expenditure value per whale, we calculated the present value of this expenditure over the estimated life expectancy of the whale.

Present value calculations are used to express future revenues (or costs) in a single figure. This is done by discounting future values at a certain rate. We discount values to reflect uncertainty and the "time value of money" – the idea that money you have now is more valuable than money you expect to receive in the future. The sum of each period's discounted revenue over the relevant time period is the present value of the revenue stream.

Present value per whale	$$PV = \Sigma \frac{AvR}{(1+r)^t}$$ *Where:* PV = present value of individual whale's tourism expenditure AvR = local whale watching industry's average expenditure per whale r = the discount rate t = the time period, in this case the lifespan of the whale species.

The discount rate and the time period over which the present value is calculated are important variables. We have selected a discount rate of 2.65%, in line with the upper bound used by the Garnaut Climate Change Review. Garnaut selected this rate to reflect a *normative* discount rate – ie what the discount rate *should* be to account for the interests of future generations and their use of natural resources.

Other researchers such have used a rate of 5% or higher to reflect long-term bond rates, or rates of risk-free investment, for example Vianna et al (2010). This represents a positive approach – i.e. discounting at a rate similar to rates observed in the real world. The normative approach, as described above, estimates what a discount rate *should* be to better consider future generations' interests. See Garnaut (2011, p17) for a discussion of normative and positive approaches to environmental valuation.

Recent work on aging techniques for humpback whales by Gabriele et al (2010) indicates that individual whales could live for more than 90 years, based on age estimates by Chittleborough (1965). We have used a conservative life expectancy of 60 years for present value calculations as possible lifespan is greater than average life expectancy. Very little data exists on average life expectancy of whales, so we have assumed a life expectancy equal to two thirds of a potential life span.

Similarly, we have used a 40-year life expectancy for calculations relating to southern right whales. This is based on approximately two thirds of the maximum life span of 65 years reported for a northern right whale by Hamilton et al (1998). Although it is possible that southern right whales

may live for as long as 150 years, (George et al 1999), we have based our estimates on Hamilton et al's lower estimate since the 150-year estimate is for bowhead whales, a related but different genus.

Summary of terms and definitions in this report:

Direct expenditure	Expenditure by tourists on whale watching tickets.
Total expenditure	The sum of direct and indirect expenditure, where indirect expenditure refers to other tourism-related expenditure by whale watching tourists.
Present value	The value of future annual tourism revenue streams expressed as a single value in today's dollars. This is based on total expenditure per whale, the estimated life expectancies of the two species, and a 2.65% discount rate.
Total population	The total regional population of each species identified by literature on whale populations.
Local population	The number of whales known to enter a particular area (e.g. Hervey Bay, the area off Broome, Logan's beach), based on recent literature and communications with local researchers.

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HERVEY BAY

Queensland, Australia

Hervey Bay

Species

The whales that visit Hervey Bay are part of the eastern Australian population of southern hemisphere humpback whales. Other species of cetaceans are also spotted in Hervey Bay, including the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), Pacific humpback dolphin (*Sousa chinensis*), minke (*Balaenoptera bonaerensis*) and pilot whales (*Globicephala macrorhynchus*). However, humpback whales are the focus of the trips in the season between June and November.

Population

Eastern Australian Humpback population

Estimates vary as to the pre-whaling population of humpback whales on the eastern Australian coast. Figures range from 10,000 to 40,000 individuals (Noad et al, 2008). As a result of commercial whaling, the population declined to between 3.5% and 5% of pre-whaling levels (Dpt Environment and Heritage, 2005). Based on these estimates, between 350 and 2,000 individuals remained in the eastern Australian population by the time the International Whaling Commission (IWC) implemented a ban on humpback whale hunting in 1963. The lower figure of 350 individuals is in line with estimates cited by Noad et al (2008), which put the population at between 34 and 500 individuals in the mid-1960s.

The eastern population of humpback whales has begun to recover since the ban on whaling for humpbacks in 1963 and the moratorium on whaling in 1986. Population growth rates have been around 10.9% per year (Noad et al, 2005) as "populations continued to recover at, or close to, the optimum biological rate" (Dpt Environment and Heritage, 2005, p1). According to Hoffman et al (2010), the most important factor in this population growth was the survival rate of reproductive or post-yearling whales. This is more important than the number of calves born since natural mortality rates are high in humpbacks' first year of life. The high mortality rate is due to the rigours of their 7,000 km migration past natural and man-made hazards such as orcas, sharks and shipping (Jenner, 2011, pers comm.; Hoffman et al, 2010).

The most recent estimate of the eastern Australian humpback whale population is 9,683 individuals in 2007 (Noad et al, 2008). This estimate is based on applying the long-term growth rate of 10.9% to a 2004 estimate of 7,090 individuals with 95% confidence that the population estimate lies between 8,556 and 10,959 individuals. A similar estimate was made by Paton et al (in press), who estimated that in 2005, the population of humpbacks migrating past Eastern Australia was 7,041 individuals, with a 95% confidence interval between 4,075 and 10,008.

Humpbacks visiting Hervey Bay

Every year on the southern migration, large numbers of humpback whales enter Hervey Bay (Franklin et al, 2010). To consider the question "What's a whale worth?" in relation to Hervey Bay, we first need to estimate how many whales visit the area where whale watching trips take place.

Chaloupka et al (1999) estimated that 554 post-yearling humpbacks were present in Hervey Bay in 1988. Updating this figure based on the long-term population growth rate, we estimate that 3,956 humpback individuals entered Hervey Bay in 2007. This is consistent with Chaloupka et al's estimate that 30% to 50% of the eastern Australian humpback population enters Hervey Bay. This can be seen by applying Chalouka et al's estimate to Noad et al (2008)'s more recent population estimates for 2007, resulting in between 2,927 (30%) and 4,879 (50%) individuals in the bay. This assumes that the number of individuals entering Hervey Bay has increased at the same rate as the long-term growth rate for the entire population and is the best estimate available for this research.

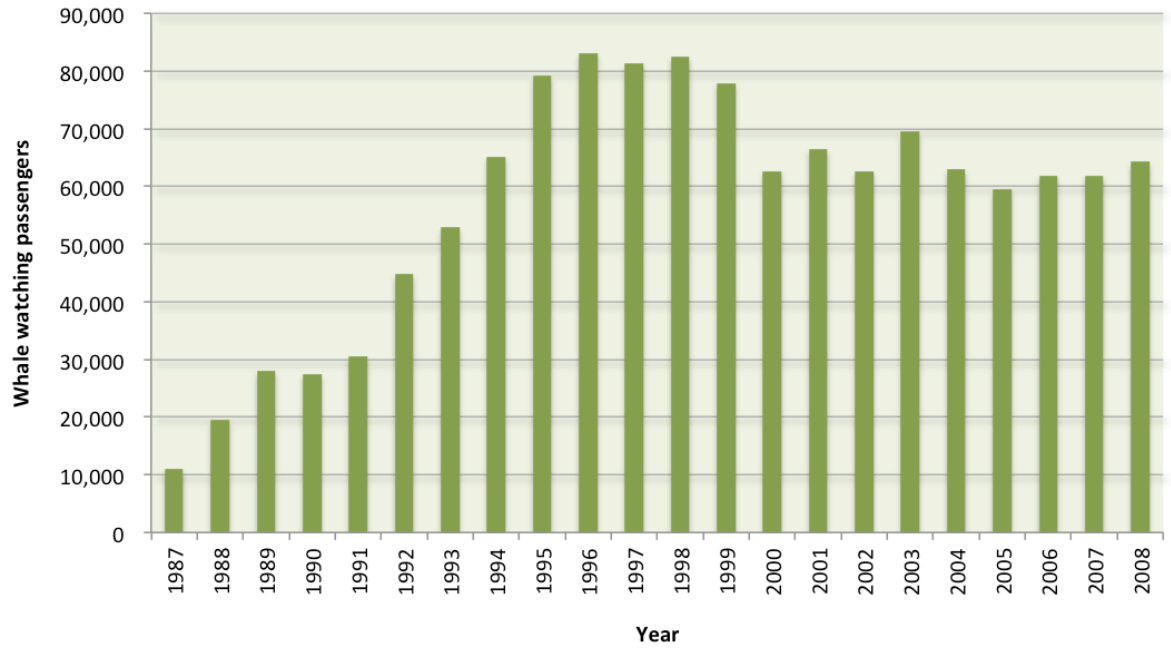
Whale watching tourism

Whale watching began in Hervey Bay in 1987 when a charter fishing business noticed how excited passengers were to see humpback whales (Stoeckl et al, 2005). The business decided to offer dedicated whale watching trips and has been operating in Hervey Bay ever since. Around 11,000 tourists went on whale watching trips in the early years of the development of the industry in Hervey Bay.

Annual whale watching passenger numbers increased to a peak of 83,000 in 1996. Since then, numbers have declined slightly. The reason for the decline in numbers at Hervey Bay since the late 1990s is thought to be the growth of whale watching closer to major cities further south (O'Connor et al 2009).

In 2008, 10 operators took approximately 65,000 tourists on whale watching trips in Hervey Bay (O'Connor et al 2009). Trips last between four and eight hours, and take place aboard multi-storey vessels or sailing yachts. A six-week research expedition is also offered, and is the only known multi-week whale research eco-tourism expedition in Australia.

Figure 1: Historical passenger numbers to Hervey Bay



Sources for chart on previous page: Stoeckl et al (2005), Wortel (2008, pers. comm), O'Connor et al (2009). Years 1988, 2006 and 2007 had no data and are averaged from the years either side by reference to these sources.

What's a whale worth to Hervey Bay?

Data collected by O'Connor et al (2009) valued direct ticket revenues from whale watching in Hervey Bay at $5.9 million in 2008[1]. Indirect expenditure associated with whale watching was estimated at $7.0 million, giving a total of $12.9 million. From these figures and the above population estimates, we calculated present value per whale of AUD $97,000.

Present value per whale*	AUD $97,000

* 60 years at 2.65% discount rate.

[1] O'Connor et al (2009) converted AUD to USD for a global audience. The original AUD results are used here. Data for Hervey Bay was not published separately in O'Connor et al, but was aggregated into the Queensland section.

Expenditure directly attributable to whales

An interesting use of data on Hervey Bay whale watching revenues is to apply them to the work of Wilson & Tisdell (2002) and Stoeckl et al, (2005). Both these studies surveyed whale watching tourists about their motivations for visiting Hervey Bay. Wilson & Tisdell (2002) conducted two studies in 1999 and 2000 respectively, with whale watching operators distributing surveys to their customers. 42% of respondents stated that their visit depended on the presence of whales in Hervey Bay. Of the 54% of respondents for whom their visit was not dependent on whales, 22% responded that they stayed longer because of the whales, for an average of 1.58 extra days.

Stoeckl et al (2005) also surveyed whale watchers in Hervey Bay, finding that close to 23% of respondents would have spent less time in the region, and 41% would have travelled somewhere else, if whales weren't in Hervey Bay. Both studies show that whales are a significant drawcard for Hervey Bay. From these results we can calculate not only the value that is spent on whale watching by tourists that are visiting the area, but the value whales explicitly attract to the local economy. While general tourists may have spent their money on other activities had they not gone whale watching, these tourists came to the region specifically for whale watching. See a similar approach in Vianna et al (2010).

From the results of these two studies we can estimate Hervey Bay tourist expenditure that would not arisen were it not for whales. From Wilson and Tisdell, 44% of Hervey Bay's whale watching tourists would not have come were it not for whales. Of the remaining 54% that would have come regardless of whales, 22% stayed longer in order to watch whales. To estimate the expenditure that was directly attributable to the presence of the whales, we used the equation below and arrived at an estimate of $7.2 million.

Expenditure directly attributable to whales	$(Te \times 54\% \times 22\%) + (Te \times 54\% \times 22\%)$ *Where:* Te = Total whale watching expenditure in Hervey Bay

Table 2: Annual value of Hervey Bay whale watching tourism expenditure attributable exclusively to whales

Total expenditure value	AUD $7,200,000

Similar values were obtained by Stoeckl et al (2005), who concluded that between $6.5 and $11.5m of tourism revenues were attributable to whales in Hervey Bay. Some caution needs to be taken with these results due to different calculations of expenditure and some differences in survey techniques.

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WARRNAMBOOL

Victoria, Australia

Warrnambool

Species

Victorian whale watching is mostly land-based watching of southern right whales, with the main area being around Warrnambool (O'Connor et al, 2009). These whales are part of the eastern Australian population of southern right whales (Dpt Sustainability Environment Water Population and Communities, 2011b). Logan's Beach is one of six identified calving grounds for southern right whales in Australia, and is currently the only nursery area for the species in all of eastern Australia (Dpt Environment, Water, Heritage and the Arts, 2005b).

Humpback whales can be sighted off the Victorian coast on their northward and southward migration, but tend to be sighted much further off shore and do not spend significant amounts of time in any one location (Dpt Environment, Heritage 2005a). Blue whales (*Balaenoptera musculus*) are also known to aggregate in the area and this is one of two important feeding areas known for this species in Australian waters (the other being the Perth Canyon). Unlike southern right whales, the blue whales off the southern Australian coast are found further off shore and are not readily visible from land, (O'Connor et al, 2009; Jenner, C 2011, pers comm.).

Population

Global and Australian population

The global population of southern right whales was estimated at 7,000 in 2001, with an estimated 17% or 1,200 individuals in Australian waters (Dpt Sustainability Environment Water Population and Communities, 2011b). Updating these figures for estimated population increases and more recent Australian counts, the population in Australia may be between 2,100 and 2,500 (ibid). The population using eastern Australia is very small and has been found to be genetically distinct through photo-identification and genetic research (Watson, Pers. Comm 2011).

Whales visiting Logan's Beach

At Logan's Beach, the average annual number of whales sighted is four, consisting of two mother-calf pairs. The largest number of mother-calf pairs recorded in any one year was seven in 2009. In the same year, the maximum daily count recorded was 21 individuals (Watson, pers comm, 2011). The same mother-calf pairs typically reside in the area between June and September, although sightings can occur as early as May and as late as November. Photo-identification research over a ten-year period has identified approximately 150 individual southern right whales in eastern Australia (ibid, 2011).

Although Warrnambool is considered "Victoria's Southern Right Whale Nursery", intermittent whale watching is also possible at other locations such as Lorne, Apollo Bay, Port Fairy and Portland, where individual or small groups of southern right whales spend short periods of time (O'Connor et al, 2009) during the season.

The whale watching that occurs in Warrnambool is based on the mother and calf pairs that stay for extended periods at Logan's Beach. For individual values estimated in this report, we have used a

population of 50 whales. This is the size of the local population of individuals known to visit Logan's Beach, (Watson, pers comm, 2011). While whale watching is often centred on mother and calf pairs, these pairs are drawn from the local population of 50. If a particular pair did not use Logan's Beach, another pair from this population would probably take their place. The portion of the entire Australian southern right population that uses Australian waters east of Adelaide is thought to be about 10%, or between 150 and 250 individuals (Dpt Sustainability, Environment, Water, Population and Communities, 2011b).

Whale watching tourism

Whale watching is important for Warrnambool as it attracts tourists outside the main summer visitor season. Hoyt (1995) mentions whale watching in Victoria being focused on southern right whales, presumably referring to Warrnambool. Hoyt (2001) found annual visitor numbers of between 70,000 and 75,000 "in a good year" at Warrnambool. This may have been based on a 1998 study by Tourism Victoria, which estimated that as many as 77,000 people visit Logan's Beach each year to view whales.

In 2001, state and local governments provided funding for the construction of an upgraded viewing platform on Logan's Beach (Office of the Premier, 2001). In the same year, the Victorian government increased protection to whales, with new regulations prohibiting all boating activity around Logan's Beach when whales and their calves are in the area (Office of the Minister for Environment and Conservation, 2001).

Changes in methodology to estimate whale watcher numbers in later studies have led to large differences in estimates. In 2003 O'Connor (2004) estimated that 118,000 people visited the lookout at Logan's Beach, based on visitation figures to the Warrnambool Visitor Centre. However, more recent estimates by O'Connor et al (2009) for whale watching visitors are based on car counts to the Logan's Beach lookout car park. In 2008, the number of cars counted was 14,876, with O'Connor et al (2009) estimating 37,190 individual tourists, an average of 2.5 per car. This is considerably lower than previous estimates.

In addition to land-based whale watching, local fishing charter boats take visitors out opportunistically to see whales. Land-based whale watching is more popular, however, due to the good views from the viewing platform, the cold winter weather that prevails during the whales' stay and the rough seas off the southern coast of Australia.

What's a whale worth to Warrnambool?

Data collected by O'Connor et al (2009) found that total expenditure by whale watching tourists was $2.6 million in 2008[2]. From this total revenue figure and the local population we estimated the following an average present value per whale of AUD $1,259,000. This value is significantly larger than the values in Hervey Bay and Broome because revenue from whale watching in Warrnambool is high and the population is very small by comparison to the other two regions.

Average present value per whale*	AUD $1,259,000

* 40 years at 2.65% discount rate.

[2] O'Connor et al (2009) converted AUD to USD for a global audience. The original AUD results are used here. Data for Warrnambool was not published separately in O'Connor et al, but was aggregated into the Victoria section.

BROOME

Western Australia, Australia

Broome

Species

Humpback whales are the main species for whale watching off the Kimberley coast from Broome north to the NT border. A number of other cetaceans can also be seen, including Australian snubfin dolphins (*Orcaella heinsohni*), pygmy killer whales (*Feresa attenuate*), bottlenose dolphins (*Tursiops trucatus*) and long-snouted spinner dolphins (*Stenella longirostris*) (Costin & Sandes, 2009).

Population

Western Australian humpback population

The whales visiting the Kimberley are part of the breeding stock D population of Antarctic area IV humpback whales. This report refers to them as the Western Australian population of humpback whales. The whales migrate from Antarctic waters (Area IV between 70^{o} E and 110^{o} E) every year, travelling along the western coast of Australia to warmer northern waters to mate and calve (Dpt Sustainability, Environment, Water, Population and Communities, 2011a).

The pre-whaling population is difficult to estimate, but could have been between 30,000 and 50,000 (Jenner, 2011, pers comm.). As a result of whaling off the western coast of Australia the population was estimated to have been reduced to around 500 whales in 1963 – between 1% and 1.6% of pre-whaling levels (Jenner et al, 2001). Recovery rates have been higher than those reported for the east coast (Hedley, 2009; Salgado-Kent et al, 2011). In 2008 the population was estimated to be 26,100 with a 95% confidence interval of 20,152 to 33,272 (Salgado-Kent et al, 2011).

Whales between Broome and Camden Sound

The Kimberley Cetacean Survey was conducted by local operators and other stakeholders in 2009 (Costin and Sandes, 2009). They estimated the number of whales from south of Broome to the Prince Regent River, an area including Camden Sound, an important resting and calving area and the northernmost point of the western Australian humpback population's migration (Jenner et al, 2001). Costin and Sandes sighted 969 humpback whales between Broome and the Prince Regent River. Many of these whales were sighted in the Camden Sound (Jenner et al, 2001).

Whales between Broome and Eco Beach

For the calculations below, we have used an estimated local population of 382 individual humpback whales. Costin and Sandes estimated this population around Broome, based on raw counts by operators between 7 July and 6 September 2009 and an aerial survey on 30 August 2009.

Whale watching tourism

Boat-based humpback whale watching tours operate between June and October each year. The first dedicated operator began offering trips off the coast of Broome in 2008. O'Connor et al (2009) found that a further six opportunistic operators ran whale watching trips off the coast of Broome. Curtin Sustainable Tourism Centre (2010) found that there are 10 operators offering whale watching trips, including indigenous-owned businesses.

What's a whale worth to Broome?

O'Connor et al (2009) found direct ticket revenues from whale watching around Broome were $169,000 in 2008. Indirect expenditure associated with whale watching was estimated at $244,000 giving a total of $413,000[3]. From these figures and the above population estimates, we estimated average present value per whale at AUD $32,000.

Average present value per whale*	AUD $32,000

* 60 years at 2.65% discount rate.

[3] O'Connor et al (2009) converted AUD to USD for a global audience. The original AUD results are used here. Data for Broome was not published separately in O'Connor et al, but was aggregated into the Western Australia section.

Discussion

The variance in results found across the three locations highlights the difference in tourism industries and whale populations in the three locations.

Table 2: Summary of results

Area	Number of tourists (2008)	Total revenue (2008)	Local whale population	Average present value per whale*
Hervey Bay (QLD)	64,260	$12,900,000	3,956	AUD $97,000
Warrnambool (VIC)	37,190	$2,600,000	50	AUD $1,259,000
Broome (WA)	2,000	$413,000	383	AUD $32,000

* over whale life expectancies at 2.65% discount rate.

These figures should be understood in the context of both increasing whale populations and increasing whale watching revenue at an Australia-wide level. Between 1991 and 2008, direct ticket expenditure on whale and dolphin watching has growth in real terms from AUD $6.5 million to AUD $47.1 million. Over the same time, total expenditure has increased in real terms from AUD $71.2 million to AUD $264.3 million.

In Broome, a relatively large but little studied population is being viewed across a large area of coast. The industry in this region, although promising, is based on only a handful of small-scale operators. While tourism has been increasing in the region (Tourism Western Australia, 2011), the area is remote and is unlikely to generate the whale watching revenues seen at established sites like Hervey Bay. While our results show these whales have lower average present values based on tourism revenue, the value that Australians place on the existence of the western whale population – non-use or existence value – is probably large and not greatly different to the value they place on the eastern population. This is not reflected in this approach due to our focus on direct-use values, i.e. the local tourism industry.

The opposite situation is evident at Warrnambool. A smaller population is viewed by large numbers of tourists, partly due to their location close to Melbourne and the Great Ocean Road. In some years Warrnambool's whale watching is entirely based on a single mother and calf pair. If expenditures were attributed entirely to these whales, their present value over their life expectancy (assuming they always returned to the same place), would be over ten million dollars.

The middle values of Hervey Bay – a location with a long established, specialised whale watching industry, along with a well defined population that has a recovering population – offer the most stable average tourism revenues per whale.

All of these values we have calculated relate solely to revenue generated for the case study areas. The figures do not include revenues generated in other areas on the whales' migration. This is

particularly relevant to Hervey Bay, where whales have migrated up the more populated east coast, passing whale watching towns from Eden in southern NSW to north of Hervey Bay in Queensland. If all these values could be calculated, the value of a humpback whale to the east coast of Australia could be much higher.

What is clear from the large variance between sites is that the value of an individual whale is dependent on two variables – whale numbers and tourism revenue – both of which are in turn dependent on a number of other variables. The factors that determine whale populations and tourism revenue are not connected, although a relationship between whale populations and tourism revenue exists. Clearly a whale watching industry is not possible without a strong population of whales, but an increase in whale numbers will not necessarily bring about an increase in tourism revenue for established sites like Hervey Bay. However, increasing population numbers might increase revenues for places with smaller populations, like Warrnambool. In the case of Broome, a large population clearly exists with great tourism potential; the important factor in this case is tourism demand, itself influenced by information and marketing of whale watching.

Increasing whale populations may play a bigger part in increasing whale watching revenues in marginal locations where trip operators are often unable to guarantee whale sightings. In such marginal locations, operators may be unable to increase the specialisation of their trips by employing naturalist guides, or fitting out boats with specialist equipment. See Hu et al (2009) for an interesting discussion on values associated with specialisation of dolphin watching trips. An increase in whale populations in marginal locations may allow a previously opportunistic operator to offer higher value dedicated whale watching trips. This has been observed along the east Australian coastline with the development of dedicated whale watching trips at an increasing number of points along the coast since the original Hoyt reports, (O'Connor et al, 2009).

Comparison with other studies

The idea of placing a value on individual marine animals to demonstrate the financial benefits of their conservation has been used mainly in campaigns for shark conservation. The studies tend to focus on areas where scuba diving tourists can dive safely in areas with guaranteed shark sightings. The first of these studies, Anderson & Ahmed (1993), found that reef sharks in the Maldives had an average annual tourism revenue value of between $3,300 and $33,500 depending on the site. In a similar way to Warrnambool, the Maldives site with a small, defined population and a well established tourism industry had the much higher value ($33,500). The lower figure ($3,300) reflects a much larger area and population and incorporates less famous sites — a similar result to the Kimberley.

Nearly 20 years after Anderson and Ahmed, Vianna et al (2010) found average annual shark diving revenue per reef shark in Palau of $179,000. A summary of shark diving valuation studies is presented below.

Table 3: Summary of shark diving valuation studies

Study	Year	Location	Species	Average annual tourism revenue per animal	Net present value per animal*
Anderson and Ahmed	1993	Maldives	Grey reef shark, whitetip reef shark, scalloped hammerhead shark	USD$3,300 to $33,500	USD$43,000 to $432,000
Knowles & O'Connor	2007	Coral Sea, Australia	Whitetip reef sharks, grey reef shark	AUD$60,000	AUD$774,000
Norman & Catlin	2007	Ningaloo Reef, Australia	Whale shark	AUD$11,750	AUD$207,000
Vianna et al	2010	Palau	Whitetip reef shark, grey reef shark	USD$179,000	USD$2,310,000[4]
Anderson et al	2010	Maldives	Manta ray	USD$4,700	USD$77,000

* Based on average animal lifespan and 2.65% discount rate

[4] Note that Vianna et al used a 5% discount rate to give a value of USD$1,940,000

Replacement value

Another approach to valuation of whales and other wildlife was taken by Brown (1992), who calculated the cost of replacing lost wildlife in the wake of the Exxon Valdez oil spill. The cost was based on either breeding and releasing animals, or capturing wildlife elsewhere and introducing it to the spill site after the clean-up. Brown was not proposing this as a policy option and acknowledged the impossibility of ensuring relocated animals stayed in the area, but rather used replacement cost solely as a valuation tool. His results for replacement cost of cetaceans are in 1992 $USD below.

Table 4: Replacement value of individual animals

Species	Range of values	Best estimate
Humpback whales	$100,000	$100,000
Killer whales (orca)	$50,000 - $1,000,000	$300,000

Source: Brown, 1992

Conclusions

This report shows that whales are an important economic resource to the coastal communities of Australia. Australian whale watching has grown from humble beginnings in Hervey Bay in the late 1980s to a $264.3 million industry. Whales generate significant tourist expenditure and act as a tourism draw card at many locations around Australia.

This research focused on three coastal communities, Hervey Bay in Queensland, Warrnambool in Victoria and Broome in Western Australia. The whale watching industries in each town are at different stages of development and offer different whale watching experiences. The difference between the locations is evident in the estimated values per whale for each location, ranging between $32,000 and $1.25 million. Tourism revenues and whale populations are clearly related since without whales, the industry wouldn't exist. Beyond that obvious statement, the link between tourism revenue and whale populations is more complex. What is certain is that healthy and abundant populations of whales are important to support a large and diverse whale watching industry along Australian coastlines and to enhance the intensity of the tourism experience in a particular location.

Both humpback and southern right whale populations have increased since the IWC moved to protect them, but there are still threats to their survival. Climate change, prey depletion, habitat degradation and marine activities such as shipping or geological exploration all place pressure on whales in their natural environment. A robust, coordinated policy response to these threats, in Australian State and Commonwealth waters as well as in the Antarctic, will be essential to ensure their continued recovery and their continued contribution to the economies of Australian coastal communities.

Any resumption of commercial whaling, particularly in the Southern Ocean, could also have a direct impact on Australian whale populations and whale watching industry.

As we approach National Whale Day, 2011, this report highlights the value of whales to regional economies of Australia and reinforces the need for continued research into whale populations and continued conservation measures.

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