# COLLISION COURSE

## THE INCREASING RISK OF SHIP STRIKE TO WHALES IN THE GREAT BARRIER REEF

IFAW

International Fund for Animal Welfare

Photo: ©IFAW/S. Portelli

## Contents

# Summary

## Concerns over the rapid industrialisation of the Great Barrier Reef are widespread and have attracted the attention of the World Heritage Committee.

These concerns include expanding port development and the corresponding emergence of a "shipping superhighway" through the Great Barrier Reef Marine Park and World Heritage Area. While this has led to much discussion of the risk of ships colliding with each other or grounding on the reef, there has been limited focus to date on the direct impact of shipping on whales and other animals, including collisions with marine life, or 'ship strikes' as they are known.

This report analyses shipping traffic and demonstrates the danger this presents to humpback whales that come to the reef to give birth and nurse their young. The analysis shows ships travelling directly through areas of critical importance to humpback whales and travelling at speeds that are likely to kill whales in the event of a collision.

Records of ship transits between June and September 2013 show over 1,340 ships passed through humpback whale habitat in the reef; an average of 11 ships per day. These vessels were recorded travelling at speeds up to 64 knots and included tankers, pleasure craft, fishing, cargo, military and passenger vessels.

**The most commonly recorded ship speeds were between 12 and 14 knots. Should a ship strike occur at these speeds, the chance of it being fatal to a whale is approximately 50–70 percent.**

The direct overlap between key shipping lanes and humpback whale habitat means strikes are almost certainly happening. Incidents are likely to increase with the projected growth in shipping through the reef and an increase in whale numbers as they continue to recover from past whaling.

**Shipping passages through the reef are estimated to almost double by 2020 to approximately 8,500 transits, or 23 times a day, and the humpback whale population is growing at a rate of around 11 percent a year.**

The risk of ship strike is largely unrecognised and unreported. The relative lack of reports of ship strikes is likely to significantly under-represent the threat they pose. Mariners are either unaware of hitting whales – even adult humpback whales at 18 metres long pale into insignificance against 300 metre cargo vessels – or are unaware of the requirement to report an incident.

**A ship strike may kill a whale immediately, but whales may also survive with horrific and serious injuries; blunt trauma resulting in major internal injury, deep propeller scars and severed spines, tail flukes and fins** are just some of the injuries recorded in live and stranded animals that have been victims of collisions. A whale that has sustained a serious injury from ship strike may suffer a slow, painful death. Given that the reef is a calving ground for humpback whales, if a pregnant female or a mother with a dependent calf is struck, the survival of the calf is also at risk.

As with the injuries sustained by a pedestrian hit by a vehicle on our roads, the speed at which a ship is travelling has a strong bearing on the likelihood of a fatal injury occurring to a whale.

**On roads we use 'school zones' to control speed and reduce the risk of fatal injuries to children. Similar practical solutions exist to reduce the risk of ship strike to whales and are already being used elsewhere around the world. This report recommends:**

- introducing 'whale zones' within core humpback whale habitat in the Great Barrier Reef to reduce ship speeds and reduce the risk of fatal collisions with whales;
- increasing awareness among mariners about whale habitats, the risk of ship strikes and the need to report incidents;
- assessing whether shipping lanes can be moved to avoid areas of core whale habitat; and
- prioritising the Australian government's planned ship strike strategy to protect humpback whales and other marine life at risk.

A lack of action will put both adult humpback whales and their calves in danger in the current and future breeding seasons.

# Introduction

## Today, many whale species are vulnerable to collisions with vessels, known as ship strikes, and unfortunately these collisions often result in severe injury or death.

**Globally, both the number of ships and the speeds at which ships are able to travel have increased in the last few decades and this means a greater risk of ship strikes and injuries to whales, particularly where shipping activities overlap with critical whale habitat.**

For those whales that are not killed immediately, a collision can result in horrific and serious injuries. Examples of such injuries recorded in live and stranded animals include severed spines, fins and tails, major internal trauma and haemorrhaging and propeller wounds. A whale that has sustained a serious injury from a ship strike may suffer a slow, painful death.

Certain whale populations are more vulnerable to ship strikes, particularly those found close to developed coastal areas or those whales found in high numbers in areas with large volumes of shipping traffic. Global efforts to reduce ship strikes are underway in several regions, particularly where ship strikes are known to negatively impact endangered whale populations. For example, ship strikes have been recognised as the major cause of mortality for the North Atlantic right whale, leading the US government to put ship speed reduction measures in place in the areas most important to these critically endangered whales.

In Australia, the east coast population of humpback whales is increasing at a rate of approximately 11 percent per annum (Noad et al., 2011) and each year, these whales migrate north from Antarctica to critical mating and calving grounds within the Great Barrier Reef.

**Significant coastal development, including several planned port expansions adjacent to the Great Barrier Reef, has led to predictions of shipping activity levels approximately doubling in this area by 2020 (PGM, 2012).** A growing whale population, still recovering from the devastating impacts of whaling, and an increasing number of ships travelling through key coastal breeding areas has the potential to lead to an increase in ship strikes.

While records show just a handful of reports of ship strikes of humpback whales in Australia, it is widely recognised that these figures likely under-represent actual incidents. **Many mariners do not know about reporting requirements for ship strikes and in many cases ship strikes may go unnoticed; even an animal as large as a whale pales into insignificance against a 300 metre cargo vessel.**

This report reviews current shipping activities within the Great Barrier Reef and assesses the potential for lethal ship strikes within important areas for humpback whales.


Bulk carriers moored off Hay Point, Queensland.

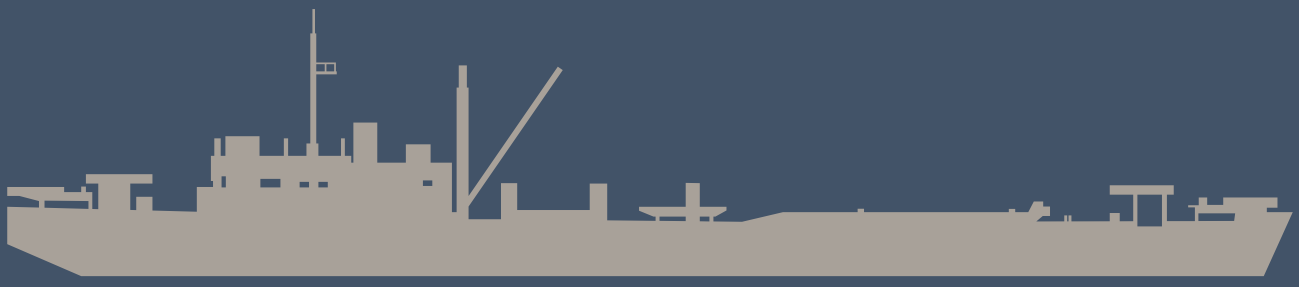

Abbott Point, Queensland.

Photo: ©Ros Butt / Cat Balou Cruises, Eden NSW

A humpback whale showing horrific scarring from a boat propeller injury. This whale was lucky to survive and has been nicknamed “Bladerunner”. Many other ship strike victims are not so fortunate.

## Ships v whales

The graphic below compares the size of a 300 metre cargo vessel to an adult humpback whale. Given the size of vessels travelling through the Great Barrier Reef, it is unsurprising that ship strikes may go unnoticed.



300 m

14.6–19 m

# Humpback whale habitat in the Great Barrier Reef

## Until recently, the locations of humpback whale wintering grounds were poorly defined in eastern Australia, with mating and calving assumed to occur within the southern part of the Great Barrier Reef Marine Park (GBRMP).

In 2012, Smith and colleagues used whale sighting data and environmental variables to identify the location of suitable humpback whale breeding grounds in the GBRMP. Their report revealed two core areas of very high probability humpback occurrence (greater than 70 percent) in the southern area of the GBRMP (Figure 1).

These two core areas are:

- A main breeding area from Mackay northwards to Proserpine within the inner reef area, extending out approximately 100 kilometres.
- An important migratory route around the Capricorn and Bunker island groups 100 kilometres offshore from Gladstone.

We used these core areas as sample zones to examine current shipping traffic activity in humpback whale habitat within the GBRMP (see Figure 2).


Humpback whale and calf.

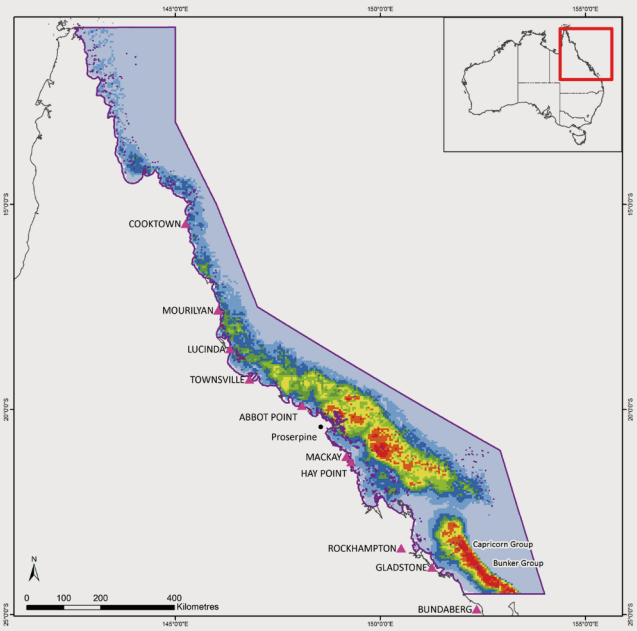



**Figure 1**

**Environmental suitability for humpback whales within the GBR Marine Park**

Data source: Smith et al., 2012

- Ports
- AUSREP Shipping Records 2013
- Great Barrier Reef Marine Park

**Environmental suitability for humpback whales:**

- 0.71–0.82
- 0.61–0.7
- 0.51–0.6
- 0.41–0.5
- 0.31–0.4
- 0.21–0.3
- 0.11–0.2
- 0–0.1

# Shipping in core humpback whale habitat

## In 2012, over 4,500 ships transited the GBRMP to access Queensland ports (GBRMPA, 2013). This figure is rising annually and is expected to continue increasing as the mining and liquefied natural gas industries in Queensland expand along with available port capacity.

Estimates vary for the rate of increase in shipping but a recent study has suggested it will lead to almost a doubling in port calls from 3,947 in 2012 to 7,448 by 2020 (PGM, 2012). On this basis, transits through the GBRMP would increase to approximately 8,500 by 2020.

Monthly shipping records for large commercial vessels operating in the GBRMP in 2013 (obtained from Australian Maritime Safety Authority) were plotted to better understand ship numbers and speed within humpback whale habitat. A subset of all monthly shipping traffic within the area surrounding the two core humpback habitat areas (identified by Smith et al., (2012)) was extracted for the months of June to September 2013 and is shown in Figure 2.

Records show that over 1,340 ships passed through these two core habitat areas; an average of 11 ships per day. These vessels were recorded travelling at speeds of between 0 and 64 knots and included tankers, pleasure craft, fishing, cargo, military and passenger vessels.

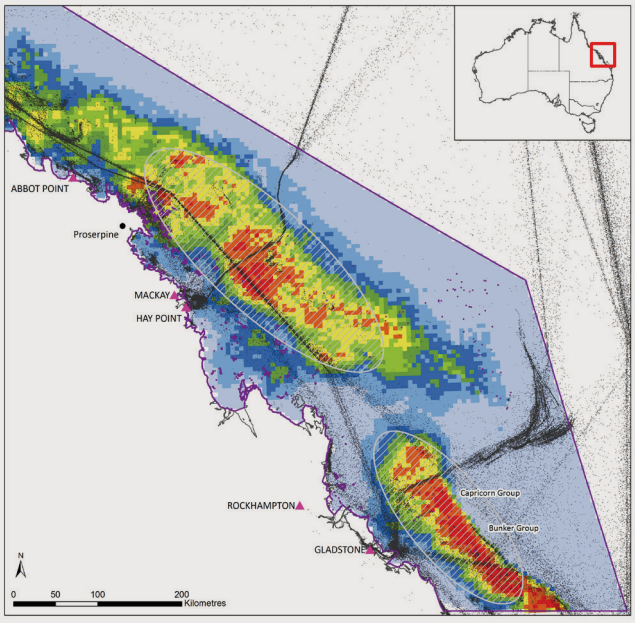



**Figure 2**

**Map showing environmental suitability for humpback whales (Smith et al., 2012), June – Sept 2013 shipping traffic records and the core habitat sample zones in the southern Great Barrier Reef**

- Ports
- AUSREP Shipping Records 2013
- Great Barrier Reef Marine Park

**Environmental suitability for humpback whales:**

- 0.71–0.82
- 0.61–0.7
- 0.51–0.6
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- 0.21–0.3
- 0.11–0.2
- 0–0.1
- Sample zones

# Ship strike risk

Analysis of ship strike records worldwide demonstrates that humpback whales are the second most frequently reported whale species to be struck by a ship (Vanderlaan and Taggart, 2007). Several factors can make a species more vulnerable to the risk of ship strike, including surface behaviour, movement patterns and habitat use.

Also, the speed a ship is travelling when it strikes a whale is directly linked to the severity of the injury the whale will sustain. The probability of a large whale sustaining a lethal injury if struck has been estimated for ships travelling at a variety of speeds. It was found that the severity of the injury to whales increased with ship speed and that the likelihood of a lethal injury was significantly higher when ships were travelling over 8.6 knots (Vanderlaan and Taggart, 2007). This is shown in Figure 3 and demonstrates that the probability of lethal injury increases dramatically with ship speed.

Figure 3

Probability of a lethal strike for a ship striking a whale at various ship speeds. Calculated using equations from Vanderlaan and Taggart (2007)

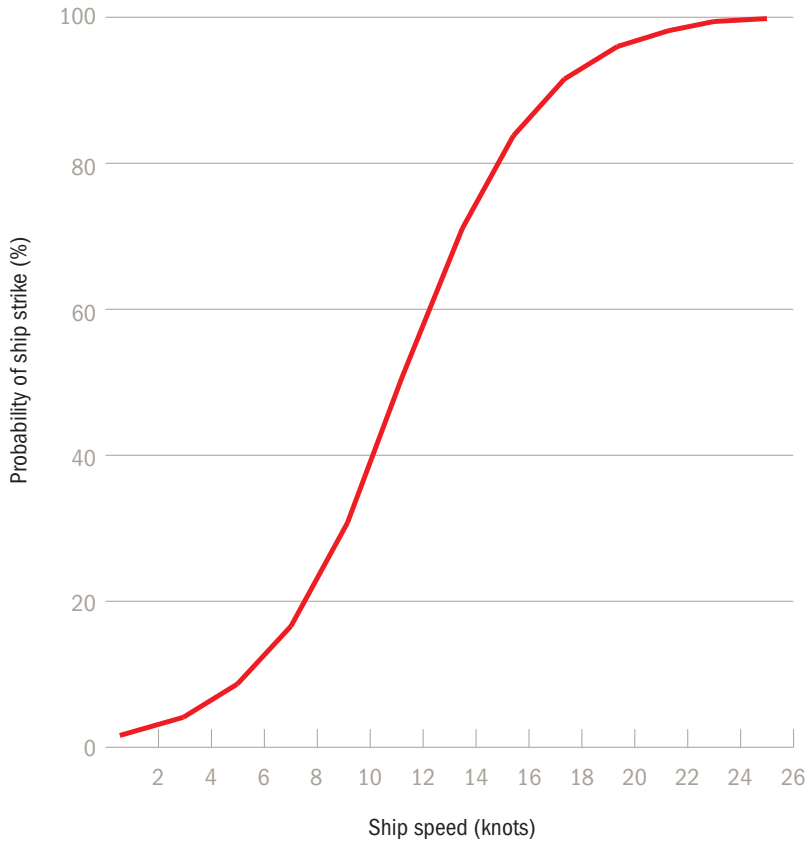


Photo: ©David Paton, Blue Planet Marine

A humpback whale in the Great Barrier Reef soon after being struck by a vessel. The whale's spine appears to have been severed by the collision. This incident was not reported by the ship involved in the collision but instead by scientists who happened to be working in the area and captured this image. This whale will almost certainly have died from this injury.

## Effects of ship speed on whale fatality rates


A humpback whale showing deep scarring from a boat propeller injury to her tail fluke.


Humpback whale

Efforts to reduce incidence and lethality of ship strikes elsewhere in the world, for example on the US east coast and in the Hauraki Gulf in New Zealand, have identified 10 knots as a speed limit that greatly reduces the chance of a lethal ship strike but is also practical for shipping purposes. Research has shown that speed restrictions introduced off the US east coast has reduced total ship strike mortality risk levels by close to 90 percent (Conn and Silber, 2013) and no ship-struck right whales have been found inside or near designated areas since the rules were introduced (Laist et al., 2014).

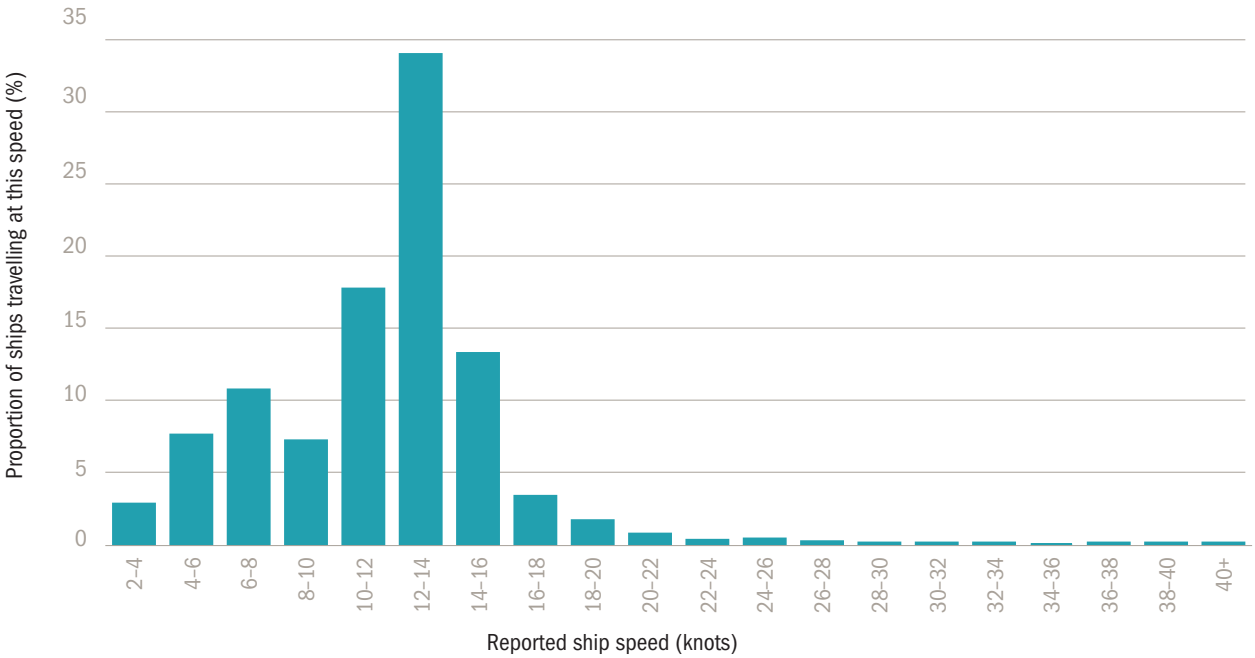
For the GBRMP, analysis of the reported ship speeds for those sampled within the core habitat zones shows that over 70 percent of ships in these core areas were recorded travelling at over 10 knots (see Figure 4).

**The most common speed travelled within these core humpback whale habitats is 12-14 knots (see Figure 4). At this speed the chance a whale will die as a result of collision will be approximately 50-70 percent.** While Figure 3 represents only the probability of a fatality occurring from a ship strike, a small reduction in speed would not only be expected to reduce the severity of injury but also the number of collisions (Conn and Silber, 2013).

Where ship speed restrictions have been introduced elsewhere in the world, these have had minimal impact on the shipping industry. In fact, **slower speed offers advantages not only to whales but also directly to the shipping industry by enabling more efficient fuel consumption and lowering fuel costs and emissions.** This has been embraced by some in the shipping industry for this reason alone.

## Figure 4

Reported ship speeds in the core humpback whale habitat sample zones in the Great Barrier Reef Marine Park for June to September 2013



# Example ship voyages through humpback whale habitat

Here we detail examples of three voyages carried out by cargo ships in the GBRMP. These examples look at three of the most common shipping routes that intersect core humpback whale habitat and focus on bulker or bulk carrier ships (large transport vessels). These account for approximately 50 percent of commercial ship traffic through the reef. The majority of ships will be transporting coal, grain, ore and cement around Australia and to offshore markets. The examples also discuss the potential implications for humpback whales in the event of a ship strike.

**EXAMPLE 1: VOYAGE 16933**

- 22 June 2013, a 289 metre long cargo ship travels south through the GBRMP to join the queue at Abbot Point.
- 29 June 2013, cargo loaded and ship leaves port travelling southwards towards Gladstone.
- Records speeds of up to 12.7 knots when travelling through the middle of the core humpback whale habitat off the coast of Mackay.
- **If the ship hit a humpback whale at this speed there would have been a less than 50 percent chance of the whale surviving the strike.**
- 30 June 2013, arrives Gladstone and queues for a number of days before entering port.
- 11 July 2013, leaves Gladstone harbour and travels offshore, passing through core humpback whale habitat around the Capricorn island group.
- Records speeds of 10.5 to 11.4 knots on this leg of the journey.

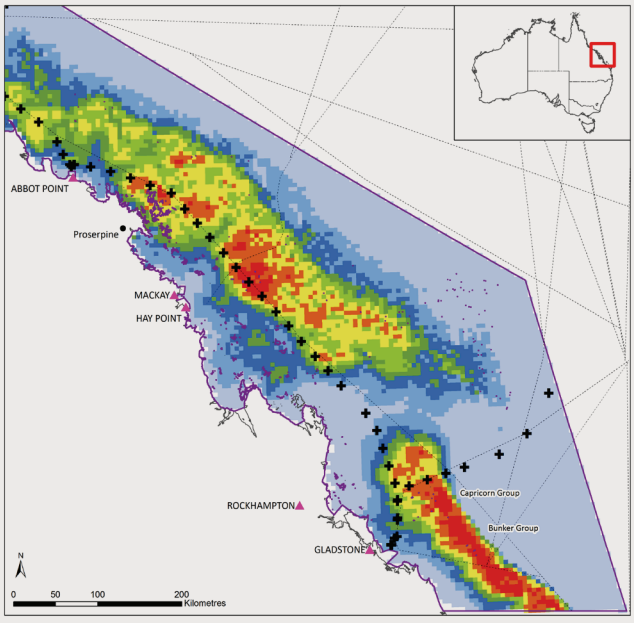



Figure 5

**Voyage 16933 within the Southern GBR Marine Park**

- Cargo ship 16933
- Ports
- Shipping routes
- Great Barrier Reef Marine Park

**Environmental suitability for humpback whales:**

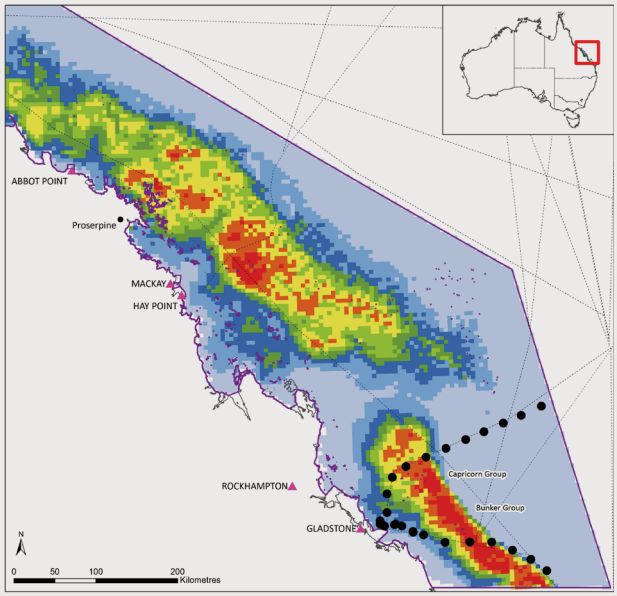
- 0.71–0.82
- 0.61–0.7
- 0.51–0.6
- 0.41–0.5
- 0.31–0.4
- 0.21–0.3
- 0.11–0.2
- 0–0.1

## EXAMPLE 2: VOYAGE 2091843717

- 11 July 2013, a 192 metre cargo vessel enters the southern end of the GBRMP and travels north-westwards across humpback whale habitat, stopping outside Gladstone Harbour.
- Records speeds of up to 14.3 knots while travelling through this core humpback whale habitat.
- **If the ship hit a humpback whale travelling at this speed, there is over a 70 percent chance that the strike would have been fatal.**
- Waits almost one month before cargo loaded.
- 7 August 2013, leaves port and follows a northeast shipping route across the GBRMP.
- Travels through the same core humpback whale habitat at speeds of 11.3 to 12.6 knots.

## EXAMPLE 3: VOYAGE 2876845858

- 18 July 2013, a 292 metre cargo ship enters the GBRMP from the Coral Sea and heads towards Hay Point, passing through core humpback whale habitat at speeds as high as 18.4 knots.
- **If the ship hit a humpback whale at this speed, there is a 92 percent chance that the strike would be lethal.**
- At these speeds, the ship traverses the GBRMP in less than 24 hours to arrive at Hay Point before waiting 12 days to be loaded with cargo.
- 30 July 2013, ship heads back out to the Pacific following the same route.
- Fully laden, the ship travels slower on the return journey, but is still recorded travelling at over 15 knots across the core whale habitat area.



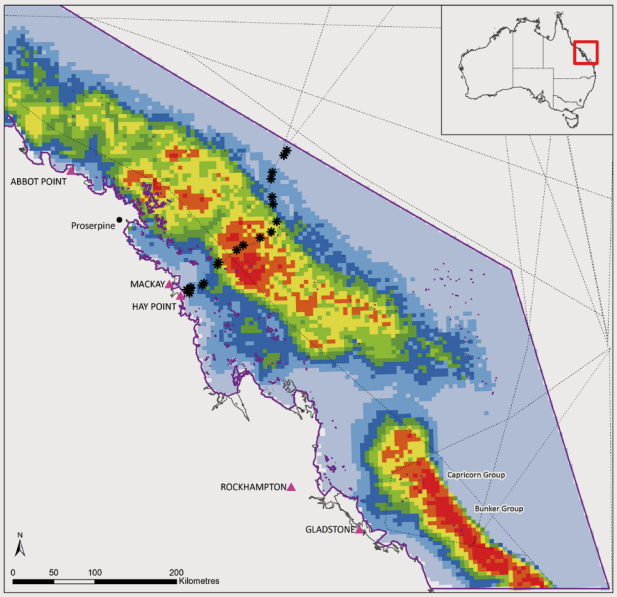

### Figure 6

**Voyage 2091843717 within the Southern GBR Marine Park**

+ Cargo ship 2091843717
▲ Ports
---- Shipping routes
— Great Barrier Reef Marine Park

**Environmental suitability for humpback whales:**

- 0.71–0.82
- 0.61–0.7
- 0.51–0.6
- 0.41–0.5
- 0.31–0.4
- 0.21–0.3
- 0.11–0.2
- 0–0.1




### Figure 7

**Voyage 2876845858 within the Southern GBR Marine Park**

+ Cargo ship 2876845858
▲ Ports
---- Shipping routes
— Great Barrier Reef Marine Park

**Environmental suitability for humpback whales:**

- 0.71–0.82
- 0.61–0.7
- 0.51–0.6
- 0.41–0.5
- 0.31–0.4
- 0.21–0.3
- 0.11–0.2
- 0–0.1

# Conclusions and recommendations

## Analysis of shipping routes within the Great Barrier Reef demonstrates that there is significant overlap between major shipping lanes and important habitat that supports the majority of the East Australian humpback whale breeding population.

This alone should raise concerns over the risk of ship strike to humpback whales. However, further analysis of ship behaviour shows that **the majority of these ships are travelling at speeds with an elevated risk of fatally injuring a whale in the event of a collision.**

The risk to humpback whales from ship strikes in the Great Barrier Reef will be exacerbated further by the predicted growth of both shipping traffic and humpback whale numbers. Shipping transits through the Great Barrier Reef are predicted to almost double over the next decade, while the humpback whale population is increasing at around 11 percent per year as it continues to recover from decades of commercial whaling.

The brutal reality of a ship strike injury means even if a whale is not killed immediately, horrific and serious injuries may lead to the animal suffering a slow and painful death. Given that the area in question includes a nursery for humpback whales, it needs to be considered that if a pregnant female or a mother with a dependent calf is struck by a ship and suffers a fatal or debilitating injury, the survival of the calf is also at risk. So the implications of ship strikes in the Great Barrier Reef to both individual whales and the population may be greater than first assumed.

This analysis presents a snapshot of the current situation. IFAW is supporting work being developed under an Australian Marine Mammal Centre grant to create an in-depth risk assessment framework for humpback whales in the Great Barrier Reef. However, even without further detailed scientific analysis, there are measures than should be taken now to address the growing risk to humpback whales; one of Australia's few conservation success stories and of vital economic importance to Australia's multi-million dollar whale watching industry.

**The risk of ship strike exists for other marine mammal species around Australia.**


Southern right whale calf killed by ship strike, Ulladulla, NSW.


Dead common dolphin found at Point Lonsdale, Vic, with obvious propeller injury.

## IFAW recommends the following practical steps:

### 1. Introduce 'whale zones', restricting vessel speeds through core humpback whale habitat within the Great Barrier Reef.

Such measures should be introduced as part of the Government's forthcoming North East Shipping Management Plan and should be submitted to the International Maritime Organization (IMO) for endorsement as this will provide for wider awareness of and compliance with the measures by the maritime community. Australia has already declared the Great Barrier Reef Marine Park a Particularly Sensitive Sea Area (PSSA) under the IMO, meaning speed restrictions could be put in place through this mechanism.

### 2. Improve mariner awareness of humpback whale habitats, the risk of ship strikes and the requirement to report incidents.

At present many ship owners and captains are unlikely to be aware of where core humpback whale habitat areas are within the Great Barrier Reef or of the requirement to report any ship strike incidents. The Government should amend navigational charts to identify core areas for humpback whales and use the REEF Vessel Traffic System (REEFVTS) to disseminate information to ships and assist in planning passages through these areas. Ports, shipping companies and shipping agents can also assist in disseminating information about ship strike risk and aid in safer passage planning. The example voyages in this report demonstrate some ships are waiting considerable time in queues to enter ports. With appropriate passage planning some queues could be avoided and the time used instead to allow for slower passage through humpback whale habitat.

### 3. Investigate the feasibility of shifting shipping lanes to avoid core humpback whale habitat within the Great Barrier Reef.

Moving shipping lanes in a constricted topographical environment such as the Great Barrier Reef, where reefs themselves may pose shipping hazards, may not always be feasible. However, it requires further investigation as an addition or alternative to speed restrictions. As with speed restrictions such changes should be endorsed through the IMO.

### 4. Prioritise the Australian government's planned ship strike strategy.

A Ship Strike Strategy has been in development for some time and should be prioritised to provide the policy basis for the measures outlined above and to help guide their implementation. While this analysis has focused only on humpback whales, the risk of ship strike exists for other marine mammals and turtles in the Great Barrier Reef and in other areas of high vessel traffic around Australia, so such a strategy should also address these areas.

**The risk of ship strikes to whales in the Great Barrier Reef is a pressing welfare and conservation concern.** The significance of the reef for humpback whale calving is also recognised in the Statement of Outstanding Universal Value qualifying the reef for World Heritage status. Therefore, a failure to address this issue has implications for Australia's World Heritage obligations. **A lack of action will put both adult humpback whales and their calves in danger in the current and future breeding seasons.**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