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COLLISION COURSE:

Snubfin dolphin injuries in Roebuck Bay

A report prepared by Dr Deborah Thiele
for WWF–Australia, July 2010

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Injured snubfin dolphin © Marequus Pty Ltd / Deborah Thiele

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Injured snubfin dolphin

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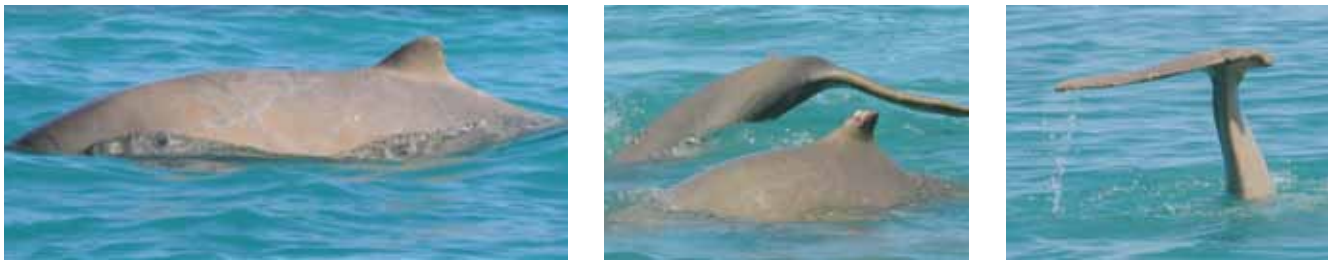
General summary

The magnificent azure waters of Roebuck Bay, on the Kimberley coast, support a rich and diverse community of marine wildlife. Dugongs, migratory waders, turtles, three species of dolphin, rays and sharks are supported by the great abundance of fish, crustaceans and invertebrates. A total of 161 snubfin dolphins have been individually identified to date in Roebuck Bay, making this a hotspot of concentration for this little known endemic cetacean, found only in northern Australia. The abundance of fish in this area also attracts an enormous number of recreational fishers and supports a commercial fishery for threadfin salmon. Our recent research has revealed that all is not well for the snubfin dolphins in this remote environment: a high proportion show evidence of injuries from vessel strikes and fishing gear.



Injured snubfin dolphins

In this preliminary analysis we have made a simple calculation of the number of individually identified snubfin dolphins with markings indicative of interactions with fishing gear, or vessel strike. Of the 161 known individuals, 124 had images suitable for injury assessment. The images were classified as: a) animal had no markings that could be attributed to human interactions (42/33.8%); b) animal had markings due to predator interactions (4/3.3%) and c) animal had wounds and/or scarring indicative of human interactions (78/62.9%). Images from (c) were examined and categorised into three broad injury source categories: fishing gear, vessel strike or both. Evidence of vessel strike can be inferred from marks left by blunt trauma or propeller cuts, while the distinctive marks from line and net entanglements from fishing gear are readily identified. The number and proportion of snubfins in each of these categories was then calculated as a percentage of the total number of known individuals available for assessment (124): (i) marks indicative of fishing gear only (52/41.9%); (ii) marks indicative of vessel strike only (12/9.6%); or marks indicative of both fishing gear and vessel strike (14/11.2%).

These are very high rates of injury to dolphins when compared with other studies and are likely due to the clear overlap between key foraging and socialising areas for snubfins in the shallow, nearshore waters of the bay with high use vessel transit and fishing areas identified in our habitat use studies.

While many of these injuries are not life threatening, the high incidence of interactions, and the severe nature of some of the injuries clearly indicate that some mortality must occur, and some proportion of the population will be debilitated while healing of large wounds occurs. The extent to which this impacts on the rate of mortality, health and viability of the Roebuck Bay dolphins will be explored in further analysis of these data. However, the ongoing loss of only a very small proportion of animals from such small and possibly geographically isolated populations can result in the loss of a species in a relatively short time frame.

The positive aspect of these observations is that there are some simple actions we can take as a community to greatly reduce the incidence of injuries to the snubfin dolphins of Roebuck Bay. These include simple behavioural changes such as reduced boat speeds and maintaining a stable course (no sudden change in direction) in critical habitat areas.

There are also a number of conservation management actions that can be implemented by governments at a national level to better protect the snubfin dolphin across its entire northern tropical Australia distribution. These include; spatial habitat modelling to rapidly identify other critical habitat areas; protection of these areas through the appropriate designation of sanctuaries, Indigenous Protected Areas and/or other spatial/temporal management frameworks; and uplisting the current conservation status of the snubfin dolphin to 'threatened' at a state, territory and federal level.

Opposite: Roebuck Bay, Broome, Western Australia © Tanya Vernes

Snubfin dolphin

Introduction

Interactions between cetaceans and humans are well documented throughout the world (Wells & Scott 1997, Visser, I. 1998, Wells et al. 1998, Baird & Gorgone 2005, van Waerebeek et al. 2007, Wells et al. 2008, Azevedo et al. 2008, Kiszka et al. 2008, Nery et al. 2008). A number of thorough scientific reviews have highlighted the serious implications of the huge increase in injuries and mortality from vessel strikes and fishing interactions for cetacean populations (Perrin et al. 1994, Read & Wade 2000, DeMaster et al. 2001, Wells et al. 2008, Read et al. 2006, van Waerebeek et al. 2007, Read 2008). These issues are of concern throughout the world's oceans and in coastal and nearshore environments, wherever cetaceans and human activities co-occur.

Many small cetaceans are at great risk of extinction, primarily dolphins and porpoises that reside in nearshore, estuarine and riverine areas where human activities and traffic are at their highest concentrations (Elliot et al. 2009). The scale and severity of impacts on these species is increasing exponentially as human populations and the scale of marine activities increase and expand into new areas. The greatest cause of death and injury for small coastal cetaceans is from human interactions – primarily interactions with fishing gear (nets, line, hooks) and also from vessel strikes (slices, cuts and blunt trauma) or a combination of these, where monofilament line becomes trapped in existing propeller cuts worsening the existing condition of the individual. Dolphins are caught in nets or become entangled in discarded line, and hooks can become embedded in the flesh, or worse, in the gape, throat or esophagus. Many of these interactions can produce severe injuries and some cause death. Skin lesions and skin deterioration on individuals with injuries have been noted in this study and may be linked to reduced vigor caused by primary damage by cuts or nets, but requires further research to determine. The most frequent cause of mortality in small cetaceans comes from entanglement in fishing gear (Forney et al. 1999, Read & Murray 2000). As noted by Read & Murray (2000) the physical markings left after entanglements are specific to the type of fishing gear, and to each cetacean species, and these marks, along with those associated with propeller cuts and blunt trauma from vessel strikes provide a powerful method for determining the source of injuries. Determining the source of injuries is critical to the development of effective mitigation actions to reduce negative impacts on these species and to increase the resilience of populations to rapid, human-induced environmental change (see Moore, S. E. 2008).

Roebuck Bay, on the Western Australian Kimberley coast, is a 'hotspot' of snubfin dolphin concentration with a known population of at least 161 individuals identified. Research since 2005 has shown that this relatively high density is rare, if not unique to the Kimberley Coast, and possibly Australian waters.

Injured snubfin dolphin

Methods

Numerous studies have used photo-identification methods to record the incidence of injuries to small cetaceans from human interactions (Visser, I. 1998, Wells et al. 1998, Baird & Gorgone 2005, Friedlaender et al. 2001, Kiszka et al. 2008, Nery et al. 2008, Wells et al. 2008, Azevedo et al. 2008), however this is the first study to investigate the incidence and source of injuries to snubfin dolphins.

Photo-identification of individual snubfin dolphins has been conducted over several years during line transect surveys over grids designed to sample the range of habitat types in the areas of highest dolphin concentration in Roebuck Bay. These data have been used for the injury assessments presented here. We attempt to obtain photographic records for all individual dolphins for each group encountered. Our effort is not focused on obtaining images of injured animals, and in fact the high rate of injury only became apparent on inspection of photographs collected for use in population and mark-recapture analysis. We attempt to capture the entire surfacing sequence of all animals, and an additional randomness to the data collection is inherent in this sampling as we must photograph whichever animals are surfacing at the time until as many as possible have been captured.

The images are edited for picture clarity and archived in a photo-identification database. Injury assessments are conducted by examination of all high quality images available for each individual dolphin. Images are examined by at least two people and all markings on the animal are described and then allocated to a source (intra-specific and con-specific scratches and marks, predator wounds and scars, and the scars and wounds from fishing gear and vessel interactions). We have used the methods outlined in Read & Murray (2000) and Wells et al. (2008) as the basis for our assessments of the source of anthropogenic injuries to snubfin dolphins in Roebuck Bay.

Figure 1 A

LEFT: **Figure 1 A).** Mutilated and broken dorsal fin flopped over identifies a classic fishing gear interaction injury. Also clear net marks on body where a net has been caught over the front of the animal.

BELOW: **Figure 1 B)**. Mother and young/ juvenile – note deep V cut at posterior base of dorsal fin and abraded dorsal fin tip on adult – indicative of line or net interaction and matching parallel scarring lines on both animals along dorsal posterior back region – indicative of net entanglement.

Figure 1 B

Figure 1 C

ABOVE: **Figure 1 C).** Propeller slices on dorsal surface–these are only shallow wounds. Also note V-shaped nick in dorsal fin indicative of interaction with line.

LEFT: **Figure 1 D).** Blunt trauma bruising most likely due to vessel strike.

Figure 1 D

Images were classified as: a) animal had no markings that could be attributed to human interactions; or b) animal had wounds and/or scarring indicative of human interactions. Images from (b) were examined and categorised into three broad injury source categories: fishing gear, vessel strike or both. The distinctive marks from line and net entanglements from fishing gear are readily identified (Read & Murray 2000), and are characterised by abraded linear dorsal fin mutilation, linear markings on the body, or linear/cross-shaped net patterns embedded in the skin as scars and smaller nicks in the dorsal fin area (Baird & Gorgone 2005, Kiszka et al. 2008; see Figures 1.A, .B, .C and .D). Evidence of vessel strike can be inferred from marks left by blunt trauma or propeller cuts, visible as wounds, bruising and tearing on the dorsal fin and/or body. Propeller cuts from vessels are readily identified from parallel curved slices into the dorsal fin, backbone and body (Figures 1. C & D).

Results

Numbers of individuals showing injuries

In this preliminary analysis, we have made a simple calculation of the number of individually identified snubfins with markings indicative of interactions with fishing gear, or vessel strike.

Of the 161 known individuals, 124 had images suitable for injury assessment. Of these, 42 (33.8%) did not have marks that could be attributed to human interactions, while 4 (3.3%) had marks due to predator interactions, and 78 (62.9%) showed wounds or scarring indicative of human interactions.

The number and proportion of wounded or scarred snubfins in each of the following categories was then calculated: (i) marks indicative of fishing gear only (52/41.9%); (ii) marks indicative of vessel strike only (12/9.6%); or marks indicative of both fishing gear and vessel strike (14/11.2%).

Above: Injured snubfin dolphins

Habitat use and behaviour

The results of ongoing snubfin habitat use and behavioural studies in Roebuck Bay have provided important context to the injury results. Snubfin dolphins are found in the shallow, nearshore waters right around Roebuck Bay, but the highest density area, where the dolphins socialise, overlaps directly with both the hotspot fishing locations of Crab Creek and Dampier Creek and the transit routes to these areas from Port and the Entrance Point boat launching areas (see Figure 2.).

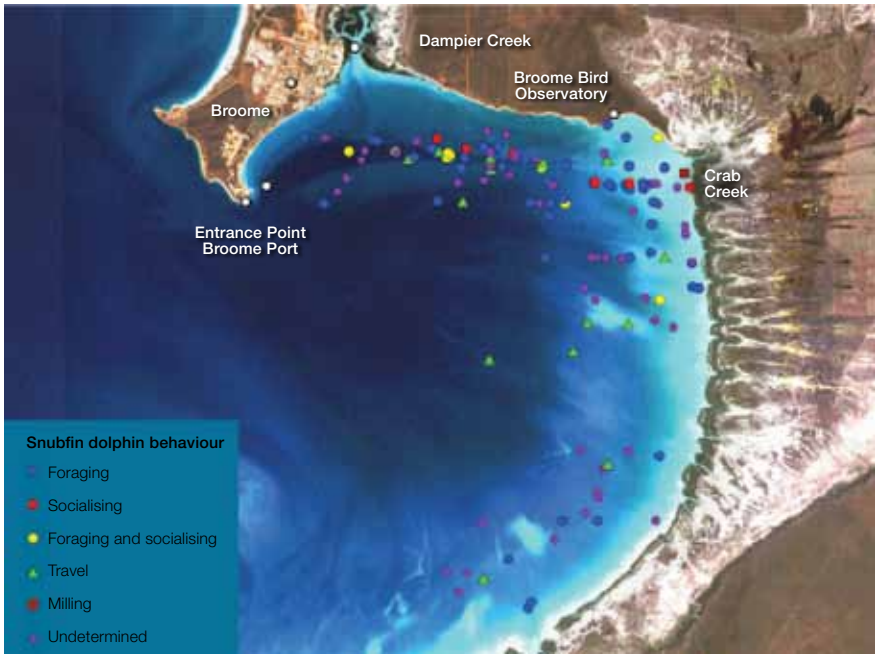


Figure 2. Habitat use and behavioural data for snubfin dolphins in Roebuck Bay. *Data sourced as part of on-going surveys supported by the Federal Government's Caring for Our Country Program (Surveys from May 2009-May 2010).*

Discussion

The rate of injuries we have recorded for snubfin dolphins in Roebuck Bay exceeds that for any comparable small cetacean population that we have encountered in the literature to date (Table 1.). A critical piece of the puzzle (Why injuries to snubfin dolphins in Roebuck Bay are so high?) becomes clear when the socialising behaviour of these dolphins is explained. When snubfins socialise, they form tight groups and roll around interacting intensely. At these times they are apparently oblivious to anything other than each other, and this makes them particularly vulnerable to vessel strikes. The combination of busy (inattentive) dolphins, very shallow waters and high speed and/or sudden changes in boat direction, means that the dolphins are unlikely to be able to react in time to get out of the way of boats. In addition, the overlap between key snubfin foraging areas, such as Crab Creek (see Figure 2.), increases the potential for injuries from vessels and fishing gear in these popular fishing areas. van Waerebeek et al. (2007) concluded that "all highly impacted species have a neritic, estuarine or fluviatile habitat, areas where vessel traffic is concentrated" in their comprehensive global review of vessel collisions with small cetaceans.

Table 1. Comparison between this study and published results for percentage (%) of injuries in other studies from across the world.

Literature source	Cetacean species	Study area	% with evidence of fishery interaction (FI) &/or vessel strike (VS)
Nery et al. 2008	Marine tucuxi	South East Brazil	5% (FI)
Baird & Gorgone 2005	False killer whales	Hawaiian offshore	3.75% (FI)
Kiszka et al. 2008	Indo-Pacific bottlenose dolphin	North East Mozambique Channel	<19% (FI)
Kiszka et al. 2008	Melon-headed whale	North East Mozambique Channel	1.6% (FI)
Kiszka et al. 2008	Short-finned pilot whale	North East Mozambique Channel	4.4% (FI)
Azevedo et al. 2008	Marine tucuxi	Rio de Janiero Brazil	9% (FI)
Heimlich-Boran 1990 (reported in van Waerebeek et al. 2007)	Short-finned pilot whales	Canary islands	~ 10% (VS)
Felix 1994 & 1997 (reported in van Waerebeek et al. 2007)	Common bottlenose dolphin	Gulf of Guayaquil, Ecuador	2.2% (VS)
Jefferson 2000a, Parsons & Jefferson 2000 (reported in van Waerebeek et al. 2007)	Indo Pacific humpback dolphin	Hong Kong/Pearl River Estuary	10.7% (VS)
Pattanaik et al. 2007 (reported in van Waerebeek et al. 2007)	Irrawaddy dolphin	Chilika Lagoon, Eastern India	35.6% (VS)
Kreb 2002 (reported in van Waerebeek et al. 2007)	Irrawaddy dolphin	Mahakam River, Kalimantan, Indonesia	2.9% (VS)
This study	Snubfin dolphin	Roebuck Bay, Western Australia	62.9% (FI & VS)

This work provides a conservative estimate of the frequency of interactions, as any animals that have died from injuries of this nature are unlikely to be found in this area of huge tidal fluxes. Thus, only survivors are photographed and assessed. Also, observations of animals in the wild with entangled fishing gear are uncommon and likely only reflect a small proportion of the total number of entanglements. In addition, where line and nets are identified as a source of injury to cetaceans, fishing hooks are also found. Hooks can become embedded internally, and where this occurs it is generally fatal, as are multiple line wraps around the body or single wraps around the gape (Read & Murray 2000, van Waerebeek et al. 2007, Wells et al. 2008). Determining the presence of hooks requires internal examination of dolphins, and thus we have no data on the frequency of this deadly source of injury. This report is a preliminary assessment produced to highlight this issue of considerable concern, and will be followed by a peer reviewed journal article which is currently in preparation. The scientific article will include a severity grading of injuries and a calculation of likely mortality rate using methods adopted by the United States National Marine Fisheries Service (NMFS) to calculate potential biological removals from living animals (Wade & Angliss 1997, Angliss & DeMaster 1998.).

Given the clear susceptibility snubfin dolphins have to site-specific threats, longer term research and conservation strategies are also required to protect them not only in Roebuck Bay but throughout their distribution across northern tropical Australia. These include; rapid population assessment and spatial habitat modelling as recommended by the Convention on Migratory Species (CMS) to identify all critical habitat areas of 'hotspots' for the Kimberley, Northern Territory and Queensland coasts (e.g. see Grech & Marsh 2008); protection of the areas identified as critical to long term conservation, through the appropriate designation of sanctuaries, Indigenous Protected Areas or other management frameworks; and uplisting the current conservation status of the snubfin dolphin to 'threatened' at state, territory and federal levels.

Recommendations

Roebuck Bay, on Western Australia's Kimberley coast, truly is a rich and biodiverse embayment and is home to what appears to be the largest known concentration of snubfin dolphins in Australian waters. Because of this, it is critical that the appropriate conservation management objectives are put in place to help ensure it remains this way – for both the dolphins and people to enjoy into the future.

Dr Deborah Thiele for WWF–Australia

Above (and left): Roebuck Bay, Broome, Western Australia © Tanya Vernes

Through our research we have determined where habitat use by humans and dolphins overlaps, providing the basis for positive management actions which will significantly reduce the incidence of these injuries and of undetected fatalities. Snubfin dolphins feed, breed and socialise in the bay. Mapping snubfin habitat use and behaviour for a one-year period in the bay has indicated the primary areas used by these dolphins. Although foraging occurs throughout the nearshore waters of the bay, socialising behaviour overlaps exactly with the main transit routes to popular fishing areas in Roebuck Bay (between the Port and Entrance Point area to the Dampier Creek/Crab Creek areas (Figure 2.). High boat speeds and erratic or freewheeling boating in these areas is highly likely to increase vessel strikes.

The positive aspect of these observations is that there are some simple actions we can take as a community to greatly reduce the incidence of injuries to the snubfins of Roebuck Bay. Most of these have already been identified in the Interim Management Guidelines developed by the Roebuck Bay Working Group (http://www.roebuckbay.org.au/pdfs/Interim-Managment-Guidelines.pdf).

Consultation *with* and cooperation *of* the local community are both paramount to helping determine and implement the most effective form of protection for the snubfin dolphin in Roebuck Bay. However, should the voluntary uptake of the Interim Management Guidelines fail and long term science continues to show the persistence of injuries related to human activities then more stringent management actions such as dolphin sanctuary zones should be considered.

For boating and fishing in Roebuck Bay

Critical socialising habitat has been identified to overlap directly with high-density vessel transit and fishing areas. Reducing the impact of injuries and death from human interactions in these areas is possible but will require Broome's boating community to adhere to the recommendations for boat speed and boat driving behaviour recommended here and in the Roebuck Bay Interim Management Guidelines, so that boating and fishing activities can continue to co-exist in the bay without damage to this unique and important population of Australia's only endemic dolphin.

RECOMMENDATION 1:

Maintain a stable course (no sudden direction change) and implement a speed limit of less than five knots around creeks, mangroves, seagrass and shallow turbid waters and reduce speed to five knots in identified socialising and foraging habitat for these dolphins in Roebuck Bay.

RECOMMENDATION 2:

Keep a lookout for dolphins and other wildlife ahead, and slow down or stop (idle engine when stopped – do not turn off engine) when dolphins or other wildlife are detected, and until sure they are well clear of the boat.

RECOMMENDATION 3:

Minimise the loss of monofilament line by not fishing up against the mangroves, or other areas where line is likely to be lost, and make the effort to retrieve line and hooks.

For the management of Roebuck Bay

Long term scientific research is required to understand and measure effectiveness of guidelines and behavioural change for boating in mitigating injuries. Life history and migration data partnered with other environmental information will help promote the species as an indicator of changes in the quality, patterns and productivity of the Kimberley nearshore coastal ecosystems. Alongside this, an effective educational program is required to raise awareness of the importance of Roebuck Bay as a hotspot for snubfin dolphins, and community action is needed for the protection of Australia's only endemic dolphin and to allow coexistence of activities.

RECOMMENDATION 4:

Develop a long term scientific research program to monitor population levels, habitat use and migration in Roebuck Bay and along the Kimberley coast.

RECOMMENDATION 5:

Community input by recording/ photographing any sightings of animals with fresh wounds or fishing gear attached to debthiele@bigpond.com.au.

RECOMMENDATION 6:

Develop a community education program to raise awareness of Roebuck Bay as a unique hotspot for snubfins in Australia and how snubfins can coexist and be protected through community action and management.

Above: Injured snubfin dolphins

For the protection of snubfin dolphins nationally

Because coastal dolphins live in some of the world's most heavily fished, polluted and developed marine environments, they are also the most threatened of all the world's cetaceans. In Australia, snubfin dolphins face a range of threats including coastal development, fisheries interactions and climate change across their entire range. It is therefore paramount that longer term research and conservation strategies are implemented at the state, territory and national level to protect them.

RECOMMENDATION 7:

Use spatial habitat modelling to rapidly identify 'hotspots' of snubfin dolphins across northern tropical Australia and protect these areas through the appropriate designation of sanctuaries, Indigenous Protected Areas or other management frameworks (utlising existing policies such as the National Network of Whale and Dolphin Sanctuaries and National Representative Network of Marine Protected Areas to implement these).

RECOMMENDATION 8:

Review and uplist the current conservation status of the snubfin dolphin to 'threatened' at a state, territory and federal level.

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