

**PRINCIPAL INVESTIGATOR:** Prof. N.R. Loneragan  
**ADDRESS:** Centre for Fish and Fisheries Research  
Biological Sciences and Biotechnology  
Murdoch University  
Murdoch WA 6150  
Telephone: 08 9360 6453 Fax: 08 9360 6303

**Title:** Reducing Dolphin Bycatch in the Pilbara Finfish Trawl Fishery

**Author details:** Simon J. Allen and Neil R. Loneragan  
Murdoch University Cetacean Research Unit  
Centre for Fish and Fisheries Research  
School of Biological Sciences and Biotechnology  
Murdoch University  
South St., Murdoch  
Western Australia 6150

## **i. Non-Technical Summary:**

The incidental capture of cetaceans (whales, dolphins and porpoises) in fishing gear is a serious threat to populations and species worldwide. In Australia, several dolphin populations are being impacted by mortalities through interaction with fisheries, in particular, gillnets, purse-seining, long-lining and trawl fisheries. The capture of dolphins has been a conservation issue in the Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) that was first assessed in 2002 by the Department of Fisheries Western Australia (DoFWA). At that time, an estimated 50 to 100 dolphins were being caught each year. A number of bycatch mitigation techniques were trialed between 2004 and 2007, including pingers (acoustic deterrents) and different exclusion grids, meeting with varying degrees of success (FRDC 2004/068). Due to ongoing dolphin bycatch, successive Ministers for Fisheries have not been prepared to move the fishery beyond 'Interim Managed' status. In late 2007, Murdoch University was asked to provide expertise on cetacean behaviour and fisheries interactions in the Pilbara trawl fishery.

Two companies were active in the fishery in 2007, completing between 5-6,000 trawls per year, at a fishing effort equivalent to 4.3 full-time vessels. In that year, bycatch levels reported by independent observers remained as high as ~40 dolphins per year. Since the commencement of this project in May 2008, our aims were to: coordinate a directed program of research that maintained communication and collaboration between industry, resource managers and research; assess factors affecting dolphin bycatch using skipper logbook and observer data from late 2003 onward; trial modified exclusion grids and escape hatches in an attempt to further reduce dolphin bycatch; assess the extent and nature of interactions between dolphins and trawl nets; and assess the efficacy of different exclusion grids in allowing dolphins and other megafauna to escape from the trawl nets.

*Spatial and temporal extent of dolphin-fishery interactions:* Data from both skipper logbooks and independent observers indicate that dolphins are caught throughout the fishery and that dolphin bycatch rates: (a) Varied between the four vessels that conduct most fishing activity; (b) Did not vary spatially (management area and water depth) or seasonally (wet vs dry), but were significantly lower during the early morning period (00:00 to 05:59) than other times of day; (c) Decreased significantly (by ~50%) when exclusion grids and bottom-opening escape hatches were built into trawl nets; and (d) May have been further reduced when the grids and escape hatches were moved forward to the beginning of the net extension in June 2008. These data, however, include information only on those dolphins that are landed on the decks of the trawl vessels. We do not know how many dolphins are caught and then fall from the bottom-opening escape hatch prior to being landed on deck. Further work using video deployments is needed to determine whether the declines in dolphin catches observed by skippers and observers equates to less dolphins being injured and killed during all trawling operations.

*Grid designs and subsurface dolphin behaviour:* Using the nets with the grid placed forward, dolphin behaviour was studied by reviewing video footage collected from within actively fishing trawl nets as part of an Honours thesis by Ms. Vanessa Jaitch (co-supervised by Murdoch University and the University of Western Australia). Analyses of the footage collected from 36 trawls revealed high interaction rates: (a) Dolphins were recorded inside trawl nets during 29 trawls and for up to 98% of the

total trawl duration, and outside trawl nets in 34 trawls for up to 99% of the trawl time; (b) The behaviours displayed by dolphins inside and outside the net differed, with dolphins inside the net engaging predominantly in foraging activity, while those outside the net exhibited mostly travelling behaviours. Some socialising also took place both inside and outside the nets. These results indicate that dolphins are motivated by numerous factors to interact with trawl nets; (c) Furthermore, despite this subset of 36 trawls being taken across a broad extent of the fishery, only 29 dolphins were individually identified foraging inside the nets. Since these individuals were seen repeatedly both within and between trawls and fishing trips, it is likely that they are a small community of dolphins within the population in the fishery that are behaviourally specialising in foraging inside trawl nets. This has implications for the level of impact that bycatch has on the dolphin community or population as a whole, since there may be just a small proportion of the population subject to unnatural mortality through bycatch.

A further net design modification was made to two nets (one per fishing company) in March 2009. These nets were fitted with top-opening escape hatches. However, observers have not collected data on the use of these nets, except for one trip in which fish catch rate was higher than average and no dolphins were caught. Adequate observer coverage and net-mounted underwater video camera deployment (perhaps up to 2000 trawls; which would take around six months of fishing) will be required to monitor nets with top-opening escape hatches in the future.

*Analysis of wildlife interactions with exclusion grids:* The efficacy of two different grid designs (both placed at the forward-end of the extension) in allowing wildlife to escape was assessed by reviewing footage of 22 trawls with a larger, older grid in place, as well as 22 trawls with a new grid installed in a more upright position. Overall, this indicated that the diversity and abundance of bycatch is high in the PFTIMF, and that the two grids differed in their function: (a) The 44 trawls resulted in the incidental capture of at least 86 individuals from 19 species including dolphins, sharks, rays, turtles, sea snakes and pipefish; (b) Three dolphins interacted with the grids, resulting in the apparent death of all three. Two of these three fell out of the bottom-opening escape hatch prior to the net being hauled up and, as a consequence, were not reported by the skippers or observers, i.e. only one dolphin catch was recorded in the logbooks and observer reports. Dolphin and other bycaught species are therefore under-reported whilst the current net designs remain in use; (c) Results from the analysis of 22 trawls each with an old and new grid design showed that 50% and 24% of captured wildlife escaped from the hatches, respectively. Large sharks and rays typically escaped or fell from the bottom-opening hatch and the older grid model was more effective at excluding bycatch than the newer grid model. This seems likely to have been due to a combination of 1) the lower angle at which the old grid was placed in the net, which meant that bycatch was guided toward the escape hatch, and 2) the older grid featured a horizontal bar across the middle section, which prevented large animals from swimming through gaps between the vertical bars into the codend.

Further instances of dolphins, sea snakes, sharks and a turtle swimming upward upon interacting with the grid were observed, indicating that a top-opening escape hatch would be the logical next step in reducing the bycatch of megafauna. Since bycaught wildlife remains in the cod-end for the duration of the trawl, then spends time on deck

before being expelled overboard where scavenging sharks and dolphins occur, post-capture and post-discard mortality of bycaught wildlife is high. This highlights the need for further improvements in the design and positioning of exclusion grids and escape hatches. We recommend that trials be carried out with an exclusion grid featuring a top-opening escape hatch. This is likely to require a trial period of six months with observer coverage and video camera deployments to confirm the fishing efficiency and non-target wildlife excluding efficiency of these nets.

*Independent observer coverage:* Independent observer coverage has yielded dolphin capture rates that are typically 1.6 to 3.7 times higher than those reported in skippers' logbooks. The DoFWA established that observer coverage at a minimum of 22% of total fishing effort was required in order to provide robust estimates of dolphin and other bycatch levels from 2006-2007 onward. This level has never been attained and has subsequently fallen each financial year (17% in 2006-2007, 13% in 2007-2008, 13% in 2008-2009 and 8% to the present). This low coverage, combined with the relatively infrequent incidence of dolphin capture, means that the comparisons of dolphin catch rates between the different net designs have low power.

*Identification of the dolphins:* We used small biopsy samples from dolphins caught in trawls and samples taken from free-ranging dolphins over an east-west distance of 160 nm to assess the species identity and the genetic diversity of dolphins interacting with the fishery. The results of this research showed that: (a) Most dolphins interacting with the fishery are common bottlenose dolphins (*Tursiops truncatus*); (b) One bycaught individual shared a closer genetic affinity to the Indo-Pacific bottlenose dolphin (*T. aduncus*); (c) Four individuals appear more closely related to the Fraser's dolphins (*Lagenodelphis hosei*); and, (d) Population genetic diversity appears comparable to other dolphin populations, with 16 haplotypes identified across 43 sampled individuals. Further research is needed to assess the size of the dolphin population(s) that are impacted and the levels of gene flow and connectivity between the impacted population(s) and those in adjacent regions.

*Recommendations:* This research indicates that bycatch in the PFTIMF still includes protected dolphins (at 20 to 50 dolphins per year based on logbook and observer figures, respectively, from 2008-2009), sharks and rays, critically endangered sawfish and various other wildlife species. It also demonstrates that the current exclusion grid and escape hatch design leads to the under-reporting of injury and mortality of bycatch by both skippers and observers.

1. Further investigation into the efficacy of exclusion grids with top-opening escape hatches is needed to inform management action in the PFTIMF. Research based on footage obtained with trawl net-mounted video cameras will allow a more accurate estimates of actual (i.e. landed and non-landed) dolphin and other species bycatch to be made;
2. Differences between logbook and observer reported bycatch levels indicate that greater observer coverage is needed. A period of intensive observer coverage and video camera deployments (i.e. 6 months or approx. 2000 shots) will be necessary to evaluate upward opening escape hatches;
3. The spatial and temporal extent of interactions between dolphins and the fishery make it difficult for fishery management measures to reduce the level of interaction without reducing fishing effort across the fishery. Results

suggest that catch rates are higher in one vessel and lower in the early morning, but do not vary spatially or seasonally;

4. In order to quantify the level of threat that ongoing bycatch poses, a population study (including assessment of abundance and gene flow) of the dolphins inhabiting the fishing grounds and adjacent regions is required. Knowledge of a maximum allowable mortality rate will provide direction for future bycatch mitigation efforts and allow the fishery to better demonstrate the outcomes of such efforts;
5. A more detailed study quantifying the composition and biomass of landed bycatch would also provide direction for bycatch mitigation efforts. An electronic observer system could be trialled in addition to an intensive period of observer coverage;
6. Dolphin mortality events currently lead to immediate discarding of carcasses. This is a waste of invaluable sources of information and dolphins that are landed dead in future should be accurately measured and have samples taken by observers.

**KEYWORDS:**        **Bottlenose dolphin, fish trawling, protected species, bycatch**