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# Circle Hooks and Longline Catches

Peter Ward (Bureau of Rural Sciences) and Steve Hall (AFMA Observer)

**An Australian study has revealed that circle hooks can increase longline catches of target species as well as improving marine turtle survival.**

In 2001, reports of marine turtle catches resulted in the closure of major United States (US) longline fisheries in the Pacific and Atlantic Oceans. Subsequent research has shown that large circle hooks and whole fish baits can significantly reduce longline catches of turtles and improve their survival. These US fisheries reopened in 2005 with stringent measures to improve turtle survival, including the use of large circle hooks.

The US may move to ban imports of fish species, such as broadbill swordfish, from countries where longliners do not use measures to improve turtle survival. Mitigation measures used in Australia may eventually need accreditation if our longline fisheries want to maintain US markets, although interactions with turtles are quite rare here and line-cutters or dehookers are used to increase survival of unintentionally hooked turtles.



'J' hook

Japanese  
tuna hook

Circle hook

*The three types of hooks used by longliners. This study compared the performance of circle and tuna hooks*

## Large-scale experiment

The Australian Government conducted experiments to test the effects of circle hooks on longline catches. The commercial longliners fished for yellowfin tuna, bigeye tuna and swordfish in a broad area off south-eastern Queensland out to Lord Howe Island. Crew members alternated equal numbers of similar-sized circle hooks and Japanese tuna hooks along each longline. The experimental design, combined with the large sample size (14 trips and more than 95 000 hooks), allowed measurement of the performance of circle hooks.

## Key findings

- Circle hooks produced higher catch rates of most commercial species such as albacore, yellowfin tuna and striped marlin.
- Circle hooks produced higher catch rates of bycatch, including some shark species.
- For most species there was no difference in the size of fish caught on circle hooks and tuna hooks.
- Increased financial returns from higher catch rates outweighed the costs of gearing-up with circle hooks.

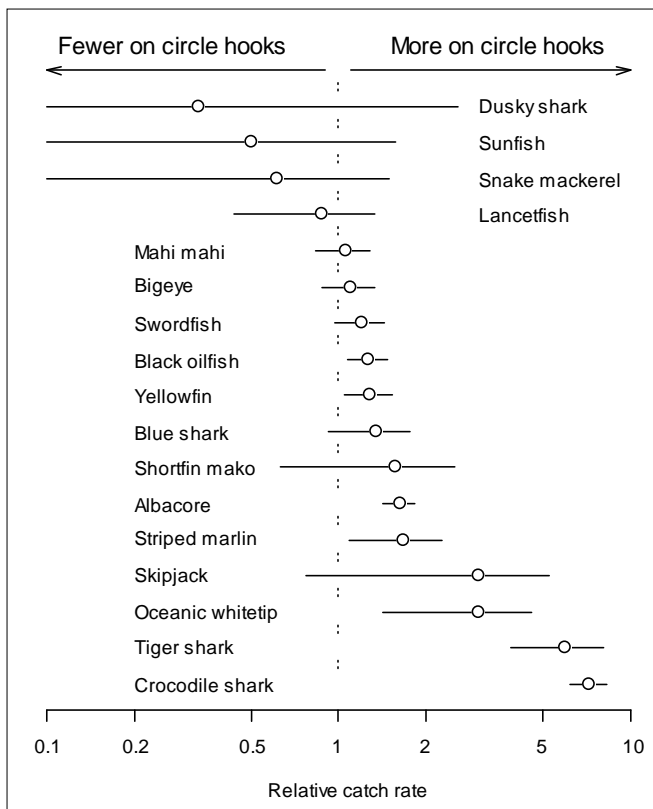
## Fish size

For most species, there was no difference in the average size caught on the different hook types. Some longline fishers have reported that they rarely catch large swordfish on circle hooks but there was no evidence of this in our results.

The size of striped marlin was different however. Striped marlin caught on tuna hooks were on average ten kilograms larger than those caught on circle hooks.

## Better financial returns

The higher catch rates on circle hooks resulted in larger total catches and improved financial returns for the longliners participating in this study. This outweighed the costs of gearing-up with circle hooks. The cost of converting to circle hooks is relatively small as no extra fishing gear is required and the cost of circle hooks is now only a few cents more than the cost of tuna hooks.



The effect of circle hooks on catch rates relative to the effect of tuna hooks. Circles indicate our best estimate of the circle hook effect and horizontal bars are the estimate's confidence intervals. A value of one indicates no difference between circle and tuna hook catch rates. Catch rates of oceanic whitetip shark on circle hooks, for example, are 3x those on tuna hooks, and we are 95% confident that the effect is somewhere between 1.5x and 4x.

The predictions of increased catch rates and financial returns are limited to the longliners participating in the study. Other longliners and fishing areas will have different mixes of species, which will result in different catch rates and financial returns from those reported here.

### Similar survival rates

In previous studies, circle hooks have been found to be effective in reducing bycatch mortality because they are more likely than J-shaped hooks to lodge in the jaw. J hooks can lodge in the jaw, but often lodge in other locations, including the throat and stomach.

In this study, however, more animals were alive on tuna hooks than circle hooks. The location of hooking might explain this unexpected result. Most fish were hooked in the lip or jaw, irrespective of hook type. Very few were hooked in locations that are likely to be fatal, such as the gills or stomach. This might be due to the small 14/0 hooks used in this study, which might function differently from the large 16/0 and 18/0 circle hooks required in the US.

### Marine turtles

Four turtles were caught during the study: three on circle hooks and one on a tuna hook. Crew members released three of those turtles alive. These numbers are too low to estimate the effect of circle hooks on turtle catches and survival. Nevertheless, studies of circle hooks elsewhere in the world have shown that they can reduce turtle catches and improve survival in longline fisheries.

## Why protect marine turtles?

All marine turtles in Australia are classified as threatened, endangered or critically endangered. Unlike many fish species, marine turtles are slow-growing, late maturing and produce relatively few eggs. Only one in 1000 hatchlings makes it to maturity. Loggerhead turtles, for example do not mature until 20 or 30 years of age. They can grow to more than 160 kilograms, when they are over 30 years of age.

Turtle populations have been significantly affected by human activities, including destruction of their habitat, introduction of feral animals, hunting and fishery bycatch.



## Management implications

Fishery managers, industry and other stakeholders need to consider the wider implications of bycatch reduction measures, such as their effects on other species, economic performance and crew safety. Numerous measures have been trialled to determine their effectiveness in improving marine turtle survival. Circle hooks are one measure that is considered effective. Other measures include large fish baits and deep sets. Line-cutters and de-hooking devices have proven effective in improving the survival of released turtles.

The results of this study indicate that the adoption of small circle hooks by Australian longliners will not reduce financial returns, at least for longliners targeting yellowfin and bigeye tuna off eastern Australia. However the use of circle hooks may result in increased catches of striped marlin and some shark species.

## Further information

Please contact Peter Ward, Fisheries and Marine Sciences Program, Bureau of Rural Sciences (BRS) at peter.ward@brs.gov.au (ph. 02 6272 4163) for further information. A detailed report on the circle hook study can be downloaded from <http://www.brs.gov.au/fisheries>. Belldi Consultancy (ph. 07 5447 9491) can provide advice on techniques for releasing turtles, including line-cutters and de-hooking devices.

## Acknowledgements

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