

CIRCLE HOOKS IN THE PACIFIC

Circle hooks were probably first used by Polynesian and Amerindian fishermen in the Pacific hundreds or even thousands of years ago.¹ Now they are widely used not only because they are good at catching fish, but also because they are “friendlier” to bycatch species in commercial fisheries and catch-and-release species in recreational fisheries. In ancient times circle hooks were very well adapted to catching small bottomfish from shore and from canoes using simple handlines. In more recent times, circle hooks are used as the hook of choice in commercial and recreational fisheries. They can be found almost anywhere there are hook-and-line fisheries, and their popularity among fishermen, fisheries researchers, fisheries managers, and conservationists is growing. Recent research has shown that the use of circle hooks in pelagic longline fishing can mitigate bycatch and reduce mortality of non-target discarded species (Watson et al. 2005). More recent research

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is showing that circle hooks are able to maintain the same catch rates of target species so fisheries that use circle hooks can remain viable.

No one knows who invented the circle hook but it was probably developed by fishermen from Oceania centuries ago. Circle hooks have been excavated from archaeological sites in French Polynesia, Hawaii (Fig. 1), and in the Channel Islands off the California coast where the Chumash Indians lived and fished. These ancient circle hooks were made from pearl and abalone shell, bone (including human bone), and sometimes wood.¹ Replicas of these ancient Oceanic hooks have become very popular as fashion accessories,

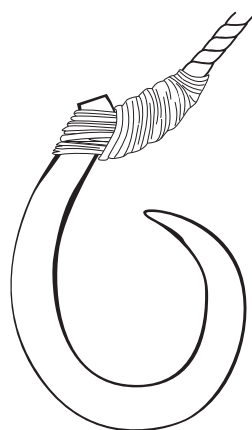


Figure 1. Bone circle hook from the Hawaiian Islands.

usually as hand-carved shell or bone pendants on necklaces.

A circle hook is defined as any round-shaped hook with a point that is perpendicular, or at a 90° angle, to the shank of the hook (Fig. 2). Figure 3 shows the parts of a basic fish hook, including the point and the shank. It can be seen by comparison to a circle hook, that the hook in the diagram — which is actually a J hook — has the point parallel to the shank. Circle hooks are sometimes called C hooks or G hooks because of their rounded shape resembling those letters of the alphabet. They are also often referred to as rotating, or self-setting hooks. Circle hooks rotate in the direction of the point when a fish takes the bait and pulls on the line (Fig. 4). Because of this rotating action, a circle hook will set itself with no action from the fisherman. The more the fish pulls, the deeper the hook is set, even if the line is untended. No jigging is required when using circle hooks.

Circle hooks were probably originally designed by fishermen to catch small bottomfish. In fact, circle hooks are preferred today by fishermen targeting deep-water bottom snappers. They are also used though for commercial tuna and swordfish fishing and for recreational catch-and-release fishing. Aside from their self-setting characteristic, circle hooks are less likely than J hooks to catch or injure bycatch species in commercial fisheries, and are less likely to injure either bycatch species or tag-and-release fish caught in recreational fisheries.

Pelagic longline fishing targets tuna and billfish species such as bigeye tuna, yellowfin tuna, albacore tuna and broadbill swordfish, but also catches non-target species. Some non-target

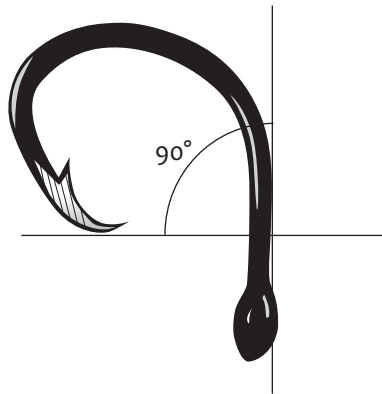


Figure 2. Circle hook showing the point at a 90° angle to the shank.

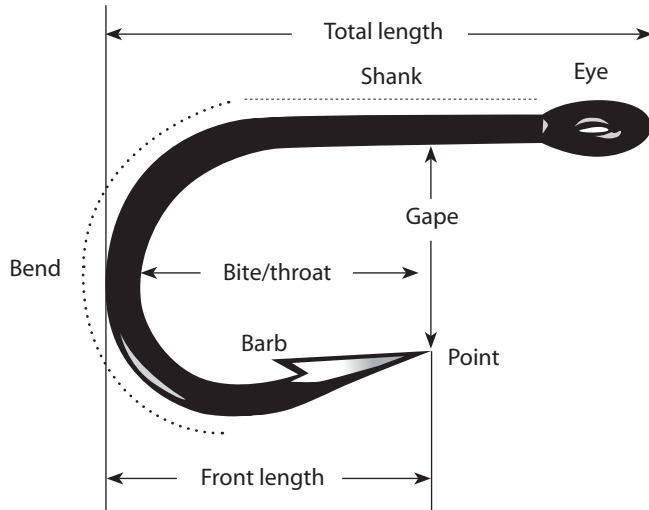


Figure 3. Hook anatomy (From Mustad website: www.mustad.no/abouthooks/index.php).

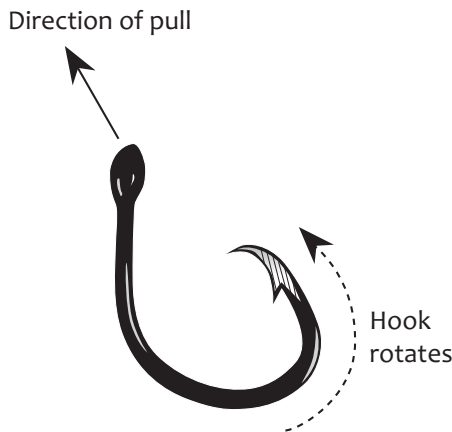


Figure 4. Circle hook showing direction of rotation when the line is pulled.

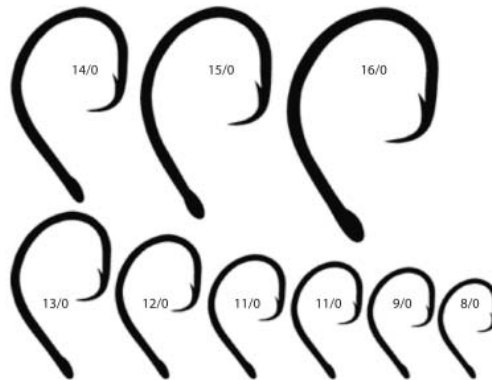


Figure 5. Different size circle hooks used in commercial and recreational fisheries (not to scale — from Mustad website: www.mustad.no/abouthooks/index.php).

species are retained but others are discarded. These discarded species are called bycatch and include fish that have no commercial value and other species that are endangered and are protected by law, including sea turtles, seabirds, marine mammals and sharks. Sea turtles that are caught as bycatch are of particular concern in pelagic longline fisheries because some turtle species are considered vulnerable to local and even global extinction because of their declining numbers. The two species caught most frequently on pelag-

ic longlines are loggerheads and leatherbacks, although olive ridley and green turtles are caught as well. Turtles can be lightly hooked in the mouth, deeply hooked (hook is swallowed), or externally hooked on the neck or flipper. Large tuna circle hooks have been shown to be useful in mitigating the catch of sea turtles in longline fisheries. Circle hooks used in commercial and recreational fisheries are made from high carbon galvanised steel or stainless steel, and range in size from 8/0 to 16/0 (Fig. 5) and sometimes even 18/0.

Recent experimental work in the Atlantic Ocean has shown that the use of 18/0 circle hooks (compared to J hooks) greatly reduces sea turtle catch and, in some cases, increases target catch (Watson et al. 2005). Furthermore, when turtles are caught on circle hooks, injury is reduced and turtles are more likely to survive being caught and released. Turtles caught on circle hooks are less likely to be seriously injured because these hooks are wide and are less likely to be swallowed. A recent study using captive loggerhead

turtles showed that the overall narrowest width of the hook is the most important measurement because that is what determines whether or not a turtle can swallow the baited hook (Watson et al. 2003). Mouth injuries compared with gut injuries are usually not fatal. The study concluded that using hooks larger than 51 mm in width has the potential to significantly reduce mortality of loggerhead turtles incidentally captured on longlines. A 16/0 circle hook, for example, has a width of 51 mm while a 9/0 J hook (which is similar in size to a 16/0 circle hook) has a width of only 41 mm. Another recent study, this time of recreational catch of bluefin tuna in the Atlantic Ocean, found that most of the fish caught on circle hooks were hooked in the jaw while J hooks were more often swallowed by the fish (Skomal et al. 2002). The estimated mortality for J hooks in the study was seven times greater than for circle hooks. The study concluded that circle hooks cause less damage than J hooks and can be a valuable conservation tool in recreational tag-and-release fisheries.

Circle hooks have now become mandatory in commercial longline fisheries in the United States that target swordfish, and may soon become mandatory for tuna longline fisheries as well. The US government also promotes the use of circle hooks by fisheries in other countries and may soon adopt rules that prohibit the entry of longline-caught fish using hooks other than circle hooks, into US markets. Research has already shown that circle hooks work to mitigate bycatch. Much of the research being carried out now on circle hooks is being directed towards quantifying the effects of circle hooks on target catches. To be successful, any bycatch

mitigation technique or gear modification must not affect the commercial viability of the fishery or else fishermen will not be inclined to use them. Experiments are being carried out in the Atlantic Ocean, the Mediterranean Sea, the Indian Ocean, and the Pacific Ocean, including Hawaii and many small Pacific Island countries and territories (PICTs), to show whether or not the use of large circle hooks will affect the commercial viability of pelagic longline fisheries.

The Secretariat of the Pacific Community (SPC) and Hawaii's Pacific Island Fisheries Science Center (PIFSC) are currently carrying out a series of experiments using large circle hooks. The studies are taking place in American Samoa, Cook Islands and New Caledonia. The purpose of the experiments is to compare the effectiveness of large (16/0) circle hooks with hooks normally used in Pacific Island domestic longline fisheries that target albacore tuna, bigeye tuna and broadbill swordfish. The experiments are very simple, with only one independent variable, 16/0 circle hooks. The studies have been designed to compare catch rates of the main target species using hooks normally used in the fishery (control hooks) with catch rates using 16/0 circle hooks (experimental hooks). No other changes are made to the fishing gear and no changes are made to the normal fishing strategies employed by cooperating fishermen. The fishing trials are being conducted on one or more vessels licensed to fish in the domestic longline fishery in three PICTs.

An investigator from either SPC or PIFSC is on every fishing trip during the experiments. The vessels involved are allowed to fish as they normally do with

no input from the investigators. Setting and hauling times, branchline length and material, number of hooks between floats, setting depth, location and bait type are all determined by the vessel operators. The investigators monitor all sets to ensure that control and experimental hooks are deployed evenly throughout each set and to record all data. Data, including fork length, are recorded using the SPC/Pacific Islands Forum Fisheries Agency Regional Longline Observer Catch Monitoring Form LL-4. Catch rates, or catch per unit of effort (CPUE), are expressed as the number of fish caught per 1,000 hooks, or kilograms per 100 hooks. Robust data sets are being accumulated by monitoring at least 65,000 experimental hooks in approximately 45–50 longline sets in each of the three fisheries where the experiments are taking place. A statistical comparison will be used to test the null hypothesis of no difference in CPUE for control hooks and experimental hooks at the conclusion of the field trials, and separate reports will be submitted. The reports will assist regional fisheries management organisations in deciding whether or not to mandate the use of large circle hooks in their fisheries, and they will help to convince fishermen of the efficacy of using circle hooks. There is a concern among some longline fishermen that 16/0 circle hooks are too large to catch albacore tuna. These experiments may end up putting that notion to rest.

The experimental hooks are stainless steel round shank 5° offset 16/0 circle hooks. The experimental hooks are alternated one-to-one with the control hooks at the onset of each experiment, but are allowed to be distributed randomly as the experiments progress. Investigators

check to be sure that there are equal numbers of control and experimental hooks deployed on every set. In order to ensure that hooks are sequenced properly and that data are recorded from the correct hook type, the snaps on all branchlines with experimental hooks are marked with small plastic cable ties. Control snaps are not marked.

So far, the investigators have compiled preliminary results from the experiments in Cook Islands and New Caledonia. Both experiments are ongoing as the experimental vessels conduct short trips of one-week duration and only set limited numbers of hooks. Therefore, it will take up to one year to collect all data from these two experiments. Vessels from American Samoa set more hooks and stay at sea longer so data from there will not take as long to collect. Preliminary results from New Caledonia are of special interest because the fishery there targets albacore tuna, as do most domestic longline fisheries in PICTs, including the American Samoa fleet. The domestic fleet in Cook Islands targets broadbill swordfish and bigeye tuna. The first fishing trip in New Caledonia in March 2010 consisted of only five sets with 9,130 hooks (4,430 control hooks and 4,700 experimental hooks). The control hooks (O) were smaller circle hooks, and the experimental hooks (X) were 16/0 circle hooks. Figure 6 shows the catch results. Although this is a small effort and results are not conclusive, it can be seen that the 16/0 hooks caught about 1.4 times more albacore tuna than the 15/0 hooks.

The experiment in American Samoa will compare the boat's normal hooks, which are 14/0 circle hooks, with experimental 16/0 circle hooks. In total,

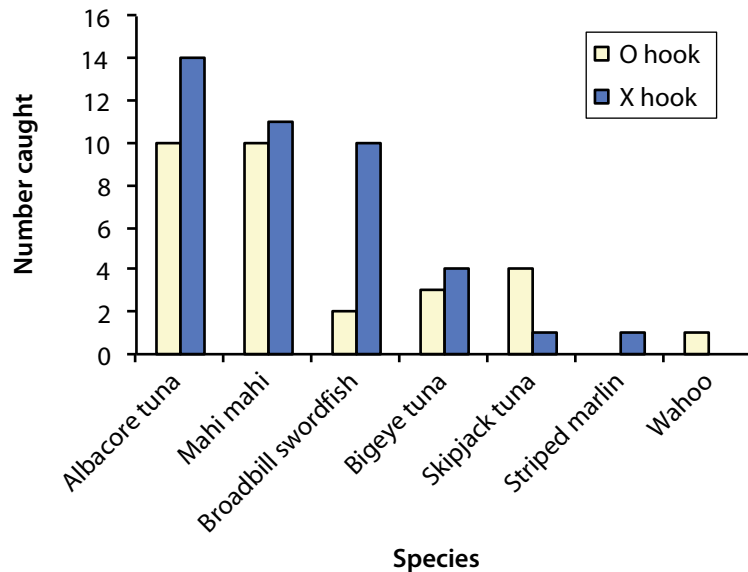


Figure 6. Comparison of number of fish caught by experimental and control hooks in the New Caledonia experiment.

65,000 hooks will be set during a normal fishing trip that will last from 45–50 days. The boat in American Samoa targets albacore tuna and delivers all of the catch frozen to the cannery in Pago Pago or to a mothership in Pago Pago Harbour. Since a good proportion of the catch from the American Samoa fleet is shipped to the US, and because the fishery is under the management of the Western Pacific Fishery Management Council in Hawaii), the boats there may be subject to future regulations that require the use of 16/0 circle hooks. The results of this large circle hook experiment, and the others being carried out in Cook Islands and New Caledonia, will have a profound effect on the future of domestic fisheries in the Pacific Islands region.

References

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1. See: <http://fishingfiles.com/forum/showthread.php?p=2934> (last accessed, June 2010)