HOOKS USED IN LONGLINE FISHING

Steve Beverly
Fisheries Development Officer
SPC, Noumea
New Caledonia
(SteveB@spc.int)

A fish hook is a seemingly simple thing but it does have discernable parts. The Mustad website (http://www.mustad.no/about hooks/index.php) describes a typical hook as having an eye, shank, bend, bite/throat, a point and barb, and a gape (sometimes called gap). Four different dimensions are given in Figure 1: total length, front length, gape, and bite/throat. According to Mustad, the most important of these are the size of the gape and the size of the bite/throat. Nothing, however, in the Mustad hook size numbering system readily appears to correspond to these dimensions. In fact, they report there is no uniform system of hook measurements.

Fish hook numbering systems

Mustad hooks, as well as most hooks manufactured in Europe or the United States, come in a range of sizes from 22 (the smallest) to 20/0 (the largest). Small hooks are numbered in a descending order so a #21 is bigger than a #22, a #20 is bigger than a #21, and so on right up to a #1 which is the biggest small hook. Large hooks are numbered in an ascending order starting with the smallest, 1/0, and going to the largest, 20/0. Not every hook style is available in the full range of sizes from 22 to 20/0, however. Furthermore, there is little consistency in methods for applying this ranking system in the profusion of fishing gear catalogues. A 10/0 hook made by one company may not correspond in actual size to a 10/0 hook made by another. Generally, the 22 to 20/0 system is just a ranking system and has little to do with actual hook dimensions. There are exceptions to this, however (see discussion below on circle hooks).

Hooks used in pelagic longlining

Japan tuna hooks

Basically there are three kinds of hooks used in pelagic longline fishing: Japan tuna hooks, circle hooks, and J hooks (Beverly et al. 2003). Japan tuna hooks (Fig. 2) have been the most popular for years, especially with tuna longliners. They come in a variety of sizes but are usually described by a Japanese measurement called sun, which is about 3.3 cm (OFCF 1993) and is used to measure the length of the hook. A 3.4 sun hook, for example, is 3.4 sun x 3.3 cm/sun long. In other words, a 3.4 sun hook is 11.2 cm long. This is the entire length of the wire making up the hook from the eye to the tip of the point (not to be confused with total length in Fig. 1). This measurement says nothing about the shape of the hook or the size of the bite/throat or gape, however. The most popu-

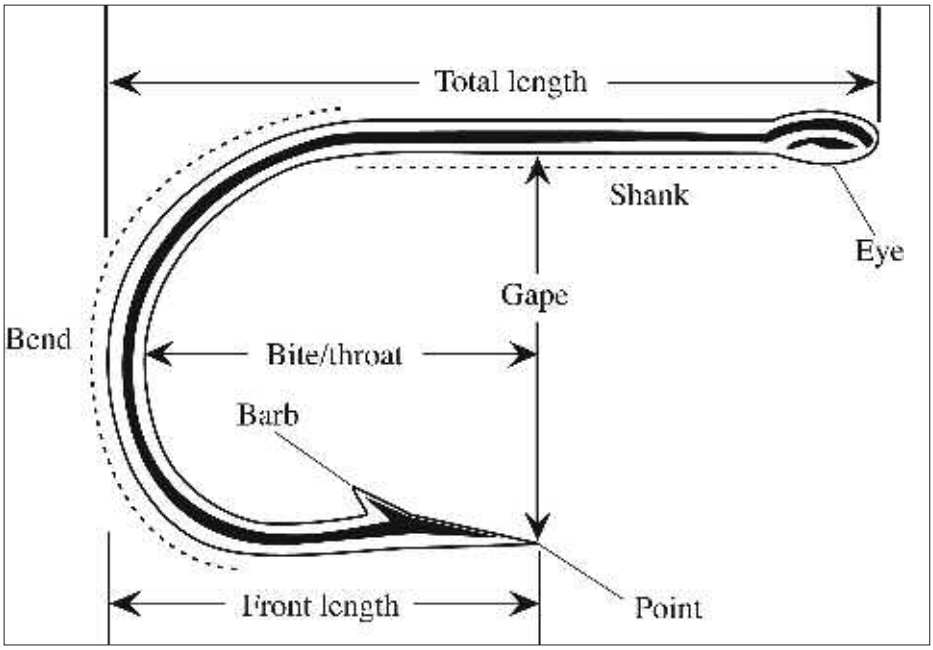


Figure 1: Hook anatomy from Mustad website (http://www.mustad.no/abouthooks/index.php)

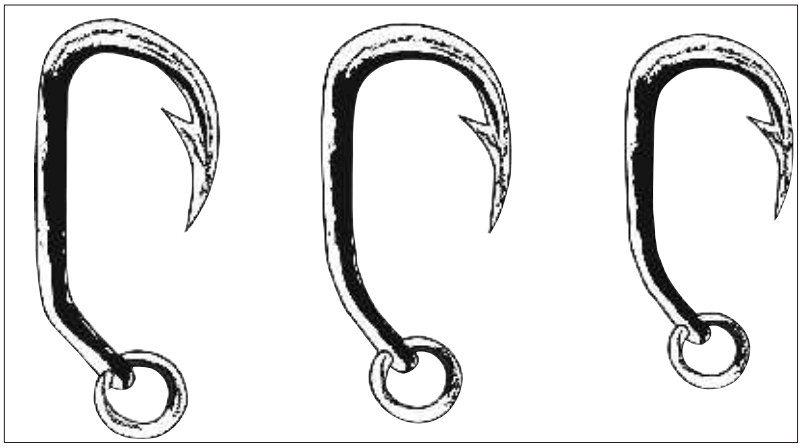
lar sizes of Japan tuna hooks for longlining are 3.4, 3.6, and 3.8 sun. Japan tuna hooks come either with a ring or without a ring in the eye. The most popular hook for tuna longlining is a 3.6 sun stainless steel Japan tuna hook with ring.

Circle hooks

Circle hooks (Fig. 3) are also called G hooks or tuna circle hooks, and are generally measured the same way that Japan tuna hooks are measured. Japanese made circle hooks used in longline fishing generally come in sizes ranging from 4.2 sun to 5.5 sun. Again, the number refers to the entire length of wire making up the hook from the eye to the point, just as with the Japan tuna hook. Most Western made circle hooks are numbered and measured in a similar way. The difference is that the numbers refer to centimetres, not sun. Thus, an 18/0 circle hook measures 18 cm from the eye to the tip of the point. This is equal to a 5.5 sun Japanese made circle hook (conversely, a 3.4 sun Japan tuna hook would be an 11/0 in the Western system). Some manufacturers, however, use a completely different numbering system for circle hooks. Tankichi and Maruto brand hooks, for example, are numbered from 28 to 44 (POP 2004). Table 1 compares Western and Japanese circle hook sizes. Circle hooks are commonly used for fisheries other than pelagic longline, such as deep water snapper fishing. They are popular because of their rotating effect, which makes them self setting. In fact, circle hooks are also called rotating hooks. When a fish bites and applies pressure, the circle hook rotates and sets itself. Sizes for circle hooks generally range from 8/0 to 16/0 but recently, larger sizes such as 18/0 and even 20/0 have been available. The most popular sizes for longline fishing range from 14/0 to 18/0. Circle hooks do not usually come with rings. A good discussion of circle hooks can be found in ASMFC (2003).

J hooks

J hooks are very similar to big game trolling hooks used to catch marlin and other big game fish species (Fig. 4). J hooks come in sizes ranging from 1/0 to 12/0, and are usually associated with longline fishing for swordfish. The most common sizes of J hooks used for swordfish are 8/0 and 9/0. A 9/0 J hook measures 15 cm from the eye to the point so it is not easy



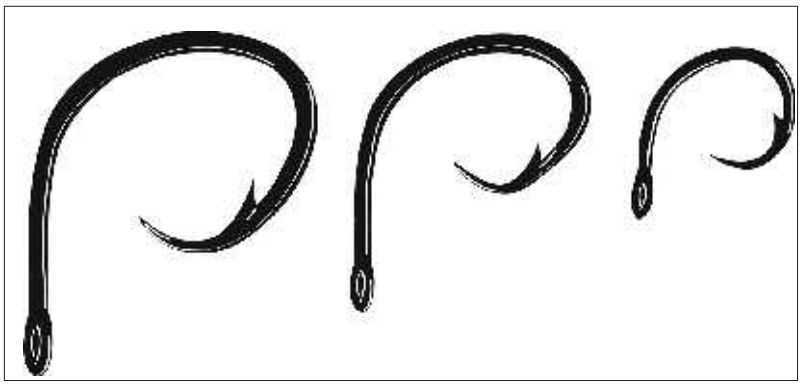


Figure 2 (top): Japan tuna hooks with ring from Hi-fishing Tackle Company website (http://www.hi-fishing.com/tuna_fr.htm). ***Hooks not drawn to scale***

Figure 3 (bottom): Circle hooks from Mustad website (http://www.mustad.no/abouthooks/index.php). ***Hooks not drawn to scale***

Table 1. Comparison of Western circle hook sizes with Japanese circle hook sizes.

Western circle hook (cm)	Japanese circle hook (*sun*)	Tankichi and Maruto
12/0	3.6	28
14/0	4.2	36
16/0	4.8	44
18/0	5.5	na

to compare numbers for J hooks with other hook designs. A 9/0 J hook, in fact, is similar in size to a 16/0 circle hook. Swordfish fishermen prefer J hooks because swordfish have a soft lower jaw. The jaw is easily torn, causing loss of the fish. J hooks tend to hold better than other hooks in a swordfish mouth (Beverly et al. 2003). They also have a better chance of hooking the hard bill of the swordfish because of their straight shape. The main feature of a J hook that makes it different from Japan hooks or circle hooks is that the barbed point is almost parallel to the shank of the hook. With Japan tuna hooks, the shank is bent towards the tip of the hook while circle hooks have a point that is bent until it almost points directly at the shank at a 90º angle. What this means is, of the three hook designs, the J hook has the largest gape. This could be one of the reasons that J hooks are implicated in higher turtle bycatch rates than the other hook designs.

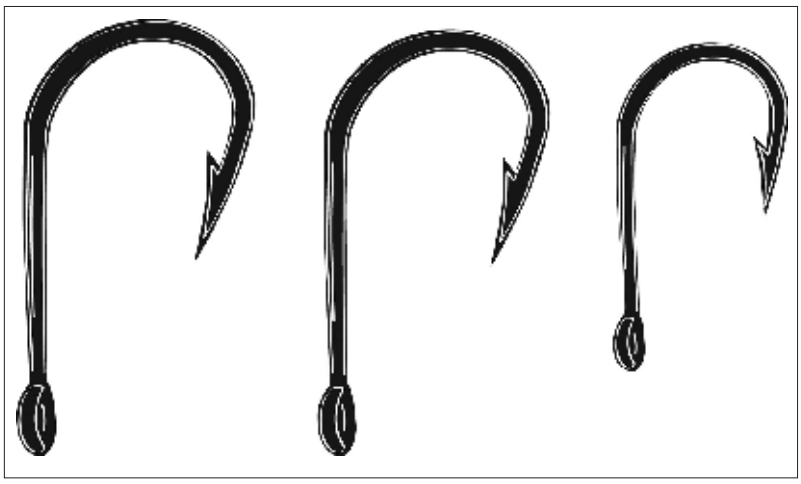


Figure 4: J hooks from Mustad website (http://www.mustad.no/abouthooks/index.php).
Hooks not drawn to scale

Hooks and bycatch

Hook types in longline fisheries have received attention recently because of the problem of sea turtle bycatch. It has been found that using 18/0 circle hooks with mackerel bait can reduce the bycatch of turtles while maintaining the catch of tunas and swordfish (Watson et al. 2005). Notwithstanding all that has been said about hook parts and dimensions, however, the most important hook dimension in regards to turtle bycatch is probably none of the dimensions listed in Figure 1. The US National Oceanic and Atmospheric Administration has determined, in a study using captive loggerhead turtles, that the overall (narrowest) width of the hook is the most important measurement because it is what determines whether or not a turtle can swallow the baited hook (Watson et al. 2003). The study concluded that using hooks larger than 51 mm in width has the potential to significantly reduce post-capture mortality of loggerheads 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 16/0 circle hook) has a width of only 41 mm. Just based on this one reference point, the 16/0 circle hook would be preferable to the 9/0 J hook for reducing post-capture mortality of sea turtles.

Another confounding factor with hooks is the fact that they can be either offset or non-offset. With non-offset hooks (straight), the point lies in the same plane as the shank of the hook. With offset hooks, the point is bent away from the plane of the shank by anywhere from 5–25º. If the point is offset to the left, the hook is kirbed. If the point is offset to the right, the hook is reversed (Fig. 5). Japan tuna hooks, for example, typically have a 10–20º (kirbed) offset. Circle hooks and J hooks, however, can be either offset or non-offset. Both offset and non-offset hooks have been tested in regards to turtle bycatch rates in pelagic longline fishing, and some issues have been raised. There are implications for acceptability by fishermen. For example, fishermen found it difficult to thread bait on non-offset circle hooks in one study (Watson et al. 2005). There are also possible implications with respect to the effects on target species and bycatch species catch rates, and on post-capture injury and mortality rates of turtles. Another complication is that before about 1995, longline hooks were available only in galvanised high carbon steel. Now they are available in stainless steel as

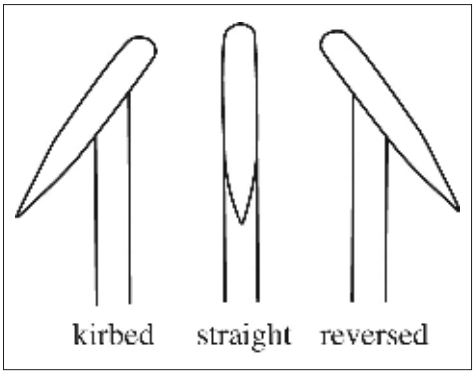


Figure 5:Offset (kirbed and reversed) and non-offset hook points, from In-Fisherman website (http://www.in-fisherman.com/magazine/exclusives/IFM0502_AboutHooks/)

well. This means that they last longer, especially when coming into contact during storage with other fishing gear such as the stainless steel snaps used on the branchlines (with two similar metals there is no galvanic reaction and, thus, less corrosion); but this also has implications for bycatch post-capture mortality. Stainless steel may last longer than galvanised steel in a turtle's mouth or esophagus. In fact, stainless steel hooks are not allowed in the US Atlantic swordfish fishery (Federal Register 2004).

Further research is being carried out in Hawaii and in Australia, comparing circle hooks with J hooks and Japan tuna hooks in tuna and swordfish longline fisheries. It well may be that this inexpensive and low tech solution to bycatch in the longline fisheries will be adapted on a wider scale. Any solution to bycatch in fisheries has to fulfill these simple criteria: be simple to implement, be inexpensive, contribute to lower bycatch rates, increase or not change target species catch rates, and be sustainable. So far the circle hook has met or surpassed all of these criteria, at least in swordfish fisheries. The Japan tuna hook probably still has a place in deep-set tuna longline fisheries and the J hook probably still has a place in troll fisheries for large tuna and other game fish such as marlin. The J hook, however, has most likely seen its last days as a longline hook."

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