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Influence of Hook Types on Hooking Rate, Hooking Location and Severity of Hooking Injury in Experimental Handline Fishing in Kerala

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Abstract

Hooking rate, hooking location and severity of wound were assessed during 163 experimental handline operation, targeted for fishes like tilapia, pearlspot and snapper. Two barbed hook types *viz.,* circle hook (non-offset size 9/0) and J-hook (0° offset size 6) were deployed in an alternative fashion using natural dead baits *viz.,* oil sardine and chicken waste. Circle hook had significantly lower ($p<0.05$) hooking rate than J-hook. Type of hook affected hooking location as 78% of the fish caught by circle hook were lip hooked, 22% deep hooked and there was no foul hooking. With J-hook, 50% fishes were lip hooked, 43% deep hooked and 7% foul hooked. The difference in severity of wounds in the two types of hooks was statistically significant ($p<0.05$). In fishes caught by circle hooks, 67% had minor injuries, 22% had moderate injuries and 11% suffered severe injuries. In contrast, 43% fishes caught by J-hook had severe injuries, 36% moderate injuries and 21% had minor injuries. Results suggest that use of 9/0 non-offset circle hook in the handline fishery of Kerala, India may increase the survival of escaped or released fish due to lip hooking and low severity of injuries.

Keywords: Circle hook, J-hook, hooking rate, hooking location, hooking injury, handline fishery, Kerala

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Introduction

The size, shape and design of hook affect the performance of a hook set against a targeted species. Lokkeborg & Bjordal (1992) suggested that physical and mechanical properties of hook and biological aspects of the target fish affect catching efficiency of a hook. According to Baranov (1976), success of the catch in line fishing depends on the angle the spear of the hook makes with the direction of the pull. The main differences between circle hook and standard J-hook are their shape and the orientation of the point of the hook. Circle hooks are generally circular in shape and the point is turned inwards, towards the shank of the hook while the point of J-hook is generally parallel to the shank (Anon, 2004). The design of a circle hook reduces the likelihood of a hook being caught in the gut cavity or throat when the fish swallows it (deep hooking). The shape of the hook allows it to slide toward the fish's jaw as the angler starts reeling, typically hooking itself at the corner of the mouth of the fish. However, effectiveness of a circle hook for reducing foul-hooking is compromised when the hook point is offset *viz.,* if the point of the hook is not in the same plane as the shank of the hook (Malchoff et al., 2002). The term 'foul hooked' indicate a hook lodged outside of the mouth or anywhere on the exterior of a fish's body (Anon, 2004).

The practice of catch-and-release is becoming increasingly common in recreational fishery (Beckwith & Rand, 2005). Researchers are working on different methods to reduce the negative impacts of recreational fishing. Efforts have been underway to design terminal tackle that reduces severity of injury of hooked fish. Circle hooks gained attention owing to their ability to reduce bycatch and deep hooking (Grover et al., 2002; Kerstetter & Graves, 2006; Minami et al., 2006; Grixti et al., 2010; Pacheco et al., 2011).

India has vast source of streams, rivers, lakes, lagoons, reservoirs and seas with rich sources of some of the finest game fishes in the world providing ample scope for freshwater and marine recreational fishing. Fifty-eight species of fresh and salt water sport fishes of India are listed (Anon, 2011). With the improved economy and changing life styles of Indian youth, there is a large potential for targeting the Indian market for recreational fishing (Thomas, 2012). However, the use of circle hook in angling is almost nil except in marine angling practiced in an organized way in Andaman & Nicobar islands (Gopal & Thomas, 2012). In Indian waters there have been few studies that have investigated on circle hooks (Edappazham, 2009; Kumar et al., 2013). This study has been taken up to compare the circle hooks and standard J round bent hooks with respect to fishing performance, difference in hooking locations and severity of injuries in fishes through experimental handline operations in selected brackish and marine waters at Cochin, India.

Materials and Methods

Experimental fishing was carried out in brackish and marine waters at three randomly selected sites *viz*., Fort Cochin, Njarakkal and Vypeen in Ernakulam district of Kerala, India at depths ranging from 4 to 13 m. A total of 163 fishing operations were carried out with handline fishing gear using selected hooks as the terminal gear.

Two commercially popular barbed hooks, non-offset circle hook of 9/0 size (Mustad style 39960) and straight shank J-hook of no.6 size (Mustad style 2315) (Fig. 1) were set alternately. Though the commercially-listed sizes of the two hooks used in this study were different, the overall dimensions of the hooks matched almost identically (Table 1).

The gear configuration used was identical with the handline configuration followed by the artisanal fishers and same configuration was followed at all locations (Fig. 2). The hook was rigged at the terminal end of a leader line of 50 cm which in turn was connected to polyamide monofilament line of 0.8 mm diameter having 28.5 kg breaking strength as per Beckwith & Rand (2005), using a leaded swivel of 100 g to avoid twisting of the line. Only a single hook was rigged to the gear.

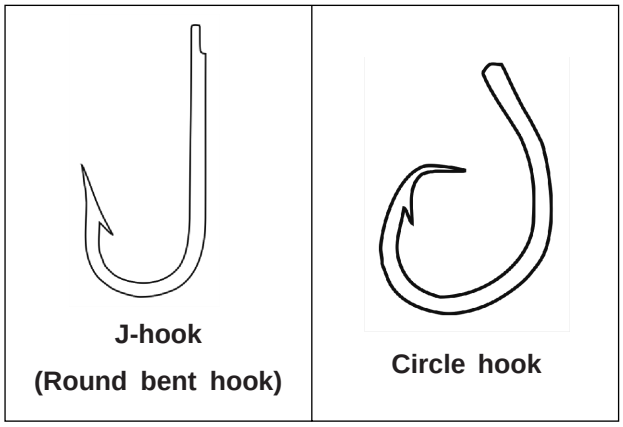

Fig. 1. Illustration of J-hook and Circle hook

Natural dead baits *viz.,* oil sardine and chicken waste, popular baits of respective locations were selected to bait the hooks. Care has been taken to operate the two types of hooks in identical conditions, using the same type and size of bait to avoid interferences due to difference in bait types, sizes and location. Both the type of hooks were operated at same area and depth for a given trial.

The hooks were rigged, baited and operated in the traditional way except for the hook setting technique. The traditional hook setting technique of jerking the fishing line was used for J-hooks while, the circle hooks were operated in a more passive approach, by simply hand-reeling the line tight as the fish swims away with the bait. This modification was done according to the design peculiarity of the circle hooks and their mode of hooking.

Table 1. Physical properties of hooks selected for the study

Hook # / style	Gape (mm)	Wire Diameter (mm)	Length (mm)	Bite (mm)	Weight (g)
6 (J-hook)	17.47 ±1.11	2.03 ±0.03	44.53 ±0.93	19.34 ±1.08	1.94 ±0.08
9/0 (Circle)	18.60±0.58	2.35±0.00	28.30±0.58	18.10±0.00	2.39±0.00

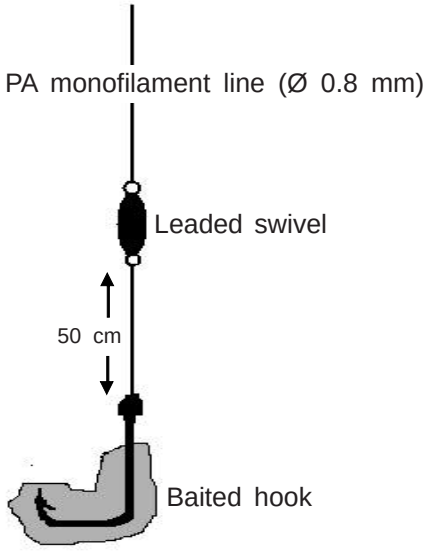

Fig. 2. Schematic diagram of the handline gear configuration used for the study

The baited handlines were cast by the same person, casting one line with one type of hook and once a fish has been caught in it, the line with the second type of hook was set. Each casting was recorded as one attempt. A fish bite was considered to be a strike that resulted in the line being pulled out of the water, or when a bite is witnessed visually. Hooked fish was pulled out of water, the mouth was opened, and the hook location and amount and source of bleeding were noted. Locations of hooking were categorized as 'lip hooked', 'deep hooked' and 'foul hooked' as per Anon (2004). The severity of wounds was classified based on the bleeding observed in the captured fish after removal of the hook on a four point grade scale from 0 to 3 as per Rapp et al. (2008). Based on the score, a wound was classified as of 'minor' severity for a score of 0 (no bleeding), or 1 (light bleeding); 'moderate' for a score of 2 (medium bleeding); and 'severe' for a score of 3 (severe bleeding) (Malchoff et al., 2002).

CPUE for circle and J-hook was calculated as number of fish caught per 100 hooks as per Zagaglia et al. (2004). The hooking rate was expressed as the ratio of number of successful hooking divided by the number of fish bites as per Prince et al. (2002). Sufficient quantity of each species of fish was unavailable to allow true comparison of hook types with respect to each parameter species wise. Hence, comparison was made irrespective of the species and the catch was considered as mixed species. Statistical analyses were done using Statistical Package for the Social Sciences (SPSS, version 10). One-way Analysis of Variance (ANOVA) test was used to assess the relationship between the different types of hook combinations experimented. Test results were considered significant at ($p<0.05$).

Results and Discussion

J-style hooks caught 28 fishes out of a total of 180 fish bites experienced. *Lutjanus argentimaculatus*, *Oreochromis mossambicus* and *Etroplus suratensis* of size ranging from 200-300 g weight were caught during the experiment. The hooking rate was very low in the case of circle hooks with only 18 fishes caught out of 208 bites experienced. CPUE for the circle hooks was 5.06 while it was 7.87 for J-hook. Circle hooks had a hooking rate of 8.65% while it was 15.56% for the J-hook. Circle hooks showed significantly lower ($p<0.05$) hooking rate compared to the J-hooks. Falterman & Graves (2002) reported that circle hooks had a higher CPUE of 5.05 while it was only 2.28 for J-hooks. Circle hooks had 1.83 times higher hooking rate compared to J-hooks for sailfish in a study carried out by Prince et al. (2002).

There was significant difference between the two types of hooks in terms of hooking location ($p<0.05$). In circle hooks, 77. 8% of the fish caught was lip hooked and only 22.2% deep hooked (Fig. 3). No fish caught with circle hook was foul hooked.

In contrast, only 50% of fishes caught with the J-hook was lip hooked, 42.9% deep hooked and 7.1% was foul hooked. In a study by Prince et al. (2002), in circle hooks, 85% of sailfish hooked was at the corner of the mouth while in J-hooks 46% of fishes

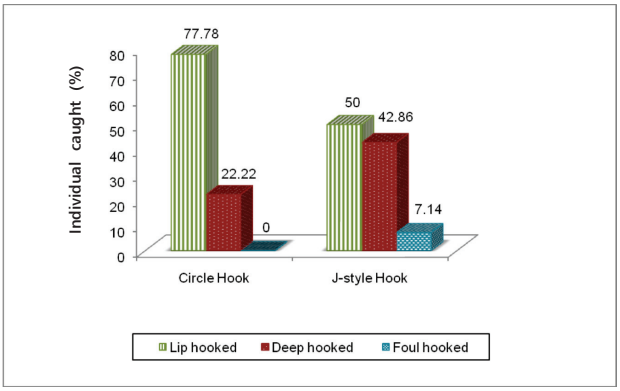

Fig. 3. Hooking locations in fishes hooked in circle hook and J-hook

was deep hooked in the throat and stomach. Higher incidence of 'jaw hooking' in circle hooks and 'deep hooking' in J-hooks was observed by others (Falterman & Graves, 2002; Lukacovic & Uphoff, 2002; Swimmer et al., 2011). A direct association between hook type and hook location was established by Skomal et al. (2002). Handling of deep hooked fishes is difficult as removal of hooks cause tissue damage resulting in severe injury (Stein et al., 2012). Lennox et al. (2015) concluded from an angling study on blue gill in Lake Opinicon, Canada using circle and J-hook that deep hooking and capture of bluegill are significantly affected not by both hook types alone but by hook-set techniques also. However, in our study, such an observation could not be made as the hook-setting technique followed was same for both the hook types.

Higher incidence of minor injuries (66.67%) was observed in fishes caught with circle hooks, while 22.22% of fishes suffered moderate injuries and only 11.11% suffered severe injuries (Fig. 4). In contrast, 21.43% of fish caught using the conventional J-hook had minor injuries, 35.71% had moderate injuries and 42.86% severe wounds (Fig. 4).

The difference in the severity of wounds on fishes caught in circle hook and J-hook was found to be statistically significant ($p<0.05$).

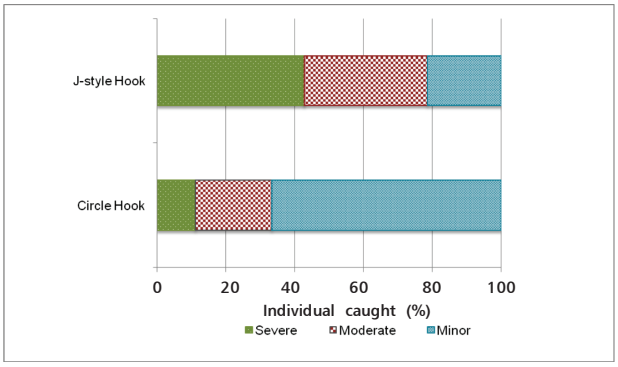

Fig. 4. Severity of hooking injury in fishes caught with Circle hook and J-hook

Circle hooks are designed to move to the corner of the fish's mouth and set themselves as the fish swims away. The more a fish swims away from the pull point, the more likely the hook will move to the rear corner of its mouth (Anon, 2005). There was a release mortality rate of 9.1% for fish caught on conventional hooks against 0.8% mortality for fish caught in circle hooks (Lukacovic, 1999). Post-release mortality in striped bass caught in non-offset circle hooks, was reported to be significantly lower as against J-hooks (Cooke et al., 2003). Hook location has a direct influence on post release survival. A study on short term survival of pearl perch by Campbell et al. (2014) revealed that hooking location is the best predictor of survival, with the survival of throat or stomach-hooked pearl perch significantly ($p<0.05$) lower than those hooked in either the mouth or lip. Owing to the low incidence of severe injuries, circle hooks seem to be a promising type of hook to reduce release mortality (Cooke & Suski, 2004) as the hooked fish remains alive for long, till they are taken out. Importance of using circle hooks as a conservation measure has already been reported (Prince et al., 2002; Kerstetter & Graves, 2006; Curran & Bigelow, 2011; Pacheco et al., 2011).

The present findings indicate circle hook as a better choice than J-hook for responsible fishing favouring post release survival of fishes. Angling as a recreational activity is on the increase among the younger generation of India. Currently the anglers mostly use J-hook. Present study suggests that J-hooks can be replaced with circle hooks in recreational angling so that the released fish would have a better survival.

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