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Note

Hooking pattern, injury type and post-release survival of Genetically Improved Farmed Tilapia (GIFT) caught by circle and 'J' hooks in recreational fishing

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ABSTRACT

Recreational fishing by angling is practised worldwide which is gaining importance in India as well. Circle hooks are getting more popular as it shows less injury with enhanced post-release survival, which promote catch and release as well as conservation. In the present study circle and 'J' hooks were compared for hooking pattern, extent of injury and post-release survival in Genetically Improved Farmed Tilapia (GIFT) in recreational fishing. Results depicted that overall hooking rate was lower for circle hooks (29%) than 'J' hooks (31%). Occurrence of lip hooking was more with circle hooks (73.6%) than 'J' hooks (58.8%), whereas jaw hooking was comparatively low in case of circle hooks than 'J' hooks. Circle hooks showed no throat hooking whereas 'J' hooks recorded 5.88% for the same. Foul hooking was not observed in case of both hook types. In the present study, with 'J' hooks, 52.9% of fishes showed no bleeding, slight and moderate bleeding was found in 17.6% fishes, whereas 11.7% had severe bleeding. For circle hooks, the corresponding values were 73.6, 21.05, 5.26 and 0%. There was 100% survival for the fishes upto 72 h post-release in both cases.

Keywords: Circle hook, Hooking pattern, 'J' hook, Recreational fisheries, Tilapia

Recreational fishing is one of the most sought after activity associated with tourism and is a booming business worldwide. Recreational fishing is gaining importance in different states of India like Kerala, Assam, Arunachal Pradesh, Nagaland, Himachal Pradesh, Karnataka and West Bengal (Harikumar and Rajendran, 2007; Gupta *et al.*, 2015a, b; 2016; Baruah *et al.*, 2017; Baruah, 2018; Baruah and Sarma, 2018; Mandal *et al.*, 2018).

Fishing hooks are the simplest and the most important gear as far as selectivity, ease of operation and cost effectiveness are concerned (Saly *et al.*, 2007). Shape, size and design of hooks have a large influence on target species and catching efficiency. Similarly, physical and mechanical properties of hooks and behaviour of target species also affect catching efficiency (Lokkeborg and Bjordal, 1992) whereas efficacy depends upon spear angle of hook and direction of the pull in lines (Baranov, 1976). On the basis of shape and orientation, hooks are of two types, 'J' hook and circle hook. In 'J' hooks point of barb is parallel to the shank while in circle hooks point is turned inwards, towards the shank of the hook (Serafy *et al.*, 2012; Gilman *et al.*, 2016). 'J' hooks are reported to cause deep hooking and more injury whereas circle hooks show lip or jaw hooking and minor injury to the fish (Huse and Ferno, 1990). Reports have shown that the probability of deep hooking (hooking in throat/gut) is comparatively low in circle hook due to its design characteristics (Grover

et al., 2002; Kerstetter and Graves, 2006; Pacheco *et al.*, 2011). In recreational fishing, the practice of catch-and-release is becoming obligatory and this would be a norm in the future (Beckwith and Rand, 2005) and anglers are adopting different methods to promote conservation in recreational fishing. Fish caught with circle hooks are found to have better survival when released and is gaining importance as an effective design in recreational fisheries (Minami *et al.*, 2006; Grixti *et al.*, 2010). The use of circle hooks in angling is very rare in the Indian angling sector (Saly, 2012; Gopal and Saly, 2012) and only a few studies have been carried out on the efficacy of circle hooks (Edappazham, 2009; Kumar *et al.*, 2013). In recreational fishing, handling time and physical injury/stress play a major role in survival of hooked fish. In this context, a study was undertaken to compare hooking pattern, injury and post-release survival in Genetically Improved Farmed Tilapia (GIFT) from recreational fish farms, caught by 'J' and circle hooks.

Experiments were conducted at two recreational fish farms, viz., Matsyafed Fish Farm and Green Aqua Fish Farm, Narakal, Ernakulam District in Kerala, India. A total of 116 angling operations were carried out with fishing rods using circle and 'J' hooks alternately. Two barbed hooks viz., circle hook of 1/0 size (Mustad) and straight shank J-hook of no.19/0 size (Mustad) baited with shrimp (*Metapenaeus dobsoni*, size range: 2.5-4 cm) were cast

alternately. Each shrimp was cut in to small bait pieces, considering the fact that the mouth opening of tilapia is small. Although brand sizes of the two hooks were different, the overall dimensions were similar. A single hook was rigged at the terminal end of a polyamide (nylon) monofilament line of 0.22 mm diameter. Operational conditions during the experiments were kept identical to avoid influence of operational parameters on the results. One casting was considered as one attempt. A strike or fish bite, which resulted in pulling the line out of the water, was considered as one bite. After each bite, the deployed hook was taken out of water with a jerk which resulted either in catch or nil catch. Hooking locations were categorised as lip hooked, jaw hooked, throat hooked, gut hooked and foul hooked. The severity of bleeding was classified based on visual observation of the captured fish. Four point grade scales from 0 to 3 was used. Based on the extent of bleeding, a score of 0 (no bleeding), 1 (slight bleeding), 2 (medium bleeding) and 3 (severe bleeding) was given as per Rapp *et al.* (2008). Catch per unit effort (CPUE) was calculated as weight of live fish caught per hour spent by the angler. Hooking rate was expressed as the ratio of number of successful hooking divided by the number of hooks deployed (Prince *et al.*, 2002). Captured fish was immediately taken out of water and parameters such as hooking locations and extent of bleeding were recorded. After recording the data, fish were immediately tagged and released to floating cages of dimensions 1 x 0.6 x 0.6 m placed in the same farm. Incidence of short-term mortality if any was monitored for 72 h.

The total catch landed was 8.04 kg (n=35). Average weight and length of fish recorded were 223.3±2.4 g and 21.7±0.5 cm respectively. No significant differences were noticed in the length ($t = 0.387$, $df = 32$, $S.E = 1.015$,

$p > 0.05$) or weight ($t = 0.271$, $df = 32$, $s.e. = 25.32$, $p > 0.05$) of the fishes caught by the two types of hooks. Average time between setting of hook and capture was 1.69±0.66 min, whereas average time between capture and release back to cage was recorded as 5.25±0.32 min. In the present study, circle hooks had a lower hooking rate (29%) than 'J' hooks (31%). Out of the 58 deployments of each type of hook, circle hook caught 17 fishes and 'J' hook caught 18 fishes. Prince *et al.*, (2002) reported that circle hooks had 1.83 times higher hooking rate compared to 'J' hooks for sailfish. CPUE (in terms of live weight) for the circle hooks was 1.82 kg h⁻¹ while it was 1.44 kg h⁻¹ for 'J' hooks. Falterman and Graves (2002) also reported higher CPUE for circle hooks, in longline fishery of yellowfin tuna.

Of the total fishes hooked, 66.6, 30.5 and 2.7% were hooked at lip, jaw and throat respectively (Fig. 1). With 'J' hooks, maximum fish (58.8%) were hooked at lip, 35.2% were hooked at jaw and 5.88% at throat. In the case of circle hooks, 73.6 and 26.3% fishes caught were hooked at lip and jaw respectively. (Fig. 2). The incidence of lip hooking was more in the case of circle hook than in 'J' hook, whereas jaw hooking was comparatively low in case of circle hook than 'J' hook. Mmaximum jaw and lip-hooking were recorded in circle hook which helped in increased post-release survival rate due to minimum injury (Kumar *et al.*, 2013). Efficiency of circle hooks in hooking by jaw region is widely reported (Huse and Ferno, 1990; Cooke and Suski, 2004). Yokota *et al.* (2006) and Curran and Bigelow (2011), reported no throat-hooking and deep-hooking while using circle hook. In the present study, circle hook showed no throat hooking whereas 'J' hook accounted for 5.88% for the same. One of the reasons of higher rate of incidence of jaw hooking with circle hooks is its tendency to slip over soft tissues and getting rotated



(a)



(b)

Fig. 1. (a) Lip hooking and (b) throat hooking in tilapia

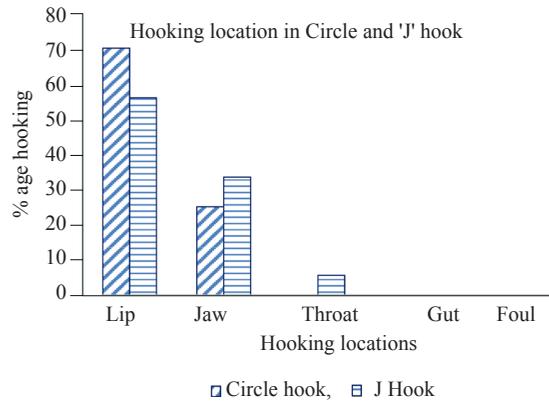


Fig. 2. Hooking location in tilapia caught by different hook types

resulting in jaw hooking (Cooke and Suski, 2004). Aalbers *et al.* (2004) reported hooking in delicate areas such as stomach, oesophagus and gills leading to post-release mortality than those hooking in non-critical areas. Several studies indicated that circle hooks can produce higher catch rates than traditional 'J' hooks (Yokota *et al.*, 2006; Kerstetter and Graves, 2006; Kerstetter *et al.*, 2007; Ward *et al.*, 2009; Swimmer *et al.*, 2011). Studies conducted by Yokota *et al.* (2006) and Pacheco *et al.* (2011) showed that changes in hook pattern have little effect on the catch composition. For both hook designs, hooking at gut and tail were not observed. In the present study, thus, no deep hooking was observed in either 'J' or circle hooks which could be attributed to the small mouth opening of tilapia.

The observation on bleeding occurrence and severity revealed that of the total fishes captured, 63.8% did not show bleeding. Slight, moderate and severe bleeding were recorded in 19.4, 11.1 and 5.5% fishes caught respectively. In case of 'J' hooks, 52.9% of fishes showed no bleeding, 17.6% each showed slight and moderate bleeding, whereas 11.7% had severe bleeding. For circle hooks, the corresponding values were 73.6% (no bleeding), 21.05% (slight bleeding), 5.26% (moderate bleeding) and 0% (severe bleeding) (Fig. 3). In circle hook, severe bleeding was not recorded in any of the fish caught. Edappazham and Saly (2016) reported 66.67% incidence of minor injuries in fish caught with circle hooks, while 22.22% of fish suffered moderate injuries and only 11.11% showed severe injuries, whereas 21.43% of fish caught using the conventional J-hook had minor injuries, 35.71% had moderate injuries and 42.86% showed severe wounds. One of the reasons for low injury recorded with circle hooks could be their design, which leads the hook to move to the corner of the fish's mouth as the fish swims away (Anon, 2005).

There was 100% survival for the fishes up to 72 h post-release in both cases. In view of the fact that circle

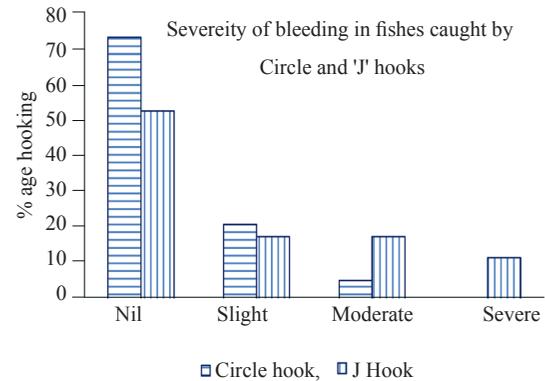


Fig. 3. Extent of bleeding/injury in tilapia caught in different hook types

hook causes minimum injury to the fish, post-release survival is enhanced (Watson *et al.*, 2005; Bacheler and Buckel, 2004; Gilman *et al.*, 2006; Kerstetter *et al.*, 2007; Read, 2007; Pacheco *et al.*, 2011; Swimmer *et al.*, 2011). Lukacovic (1999) reported post-release mortality rate of 9.1 and 0.8% for fishes caught on conventional hooks and circle hooks respectively. Findings of Cooke *et al.* (2003) revealed that post-release mortality was significantly lower in circle hooks as against J-hooks in striped bass. In the present study, no mortality was observed upto 72 h of observation. This could be due to the low physical injury coupled with less handling time and the sturdy nature of the experimental fish used.

The results the present study showed that the circle hooks were better than 'J' hooks with respect to lower injury due to hooking location. Though the post-release survival was assessed only for 72 h, based on the injury pattern observed in hooked fishes, it can be assumed that the survival of fishes released from circle hooks would be higher than that from J hooks. Further studies using target fishes for recreational fishing and long term monitoring of the released/escaped fish for survival estimations, would be required for corroborating the findings.

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