INSTITUTE OF OCEANOGRAPHY AND FISHERIES - SPLIT

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Short report

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Introduction

Catch and release (C&R) is one of the many types of fishing that has recently become very popular in sports and recreational fishing practice. High percentage of fish survives after the catch and subsequent release (Cooke and Schramm, 2007). In regard to this, it is believed that C&R, unlike traditional fishing, lowers negative effect on natural resources. This C&R practice is lately present in sport fishing of Bluefin tuna (*Thunnus thynnus*), highly migratory pelagic fish that reaches weight of up to 650 kg, as a type of big game fishing.

There is little information on mortality rate of caught and released tuna, concerning her migratory nature and biologic sensitivity (Donaldson et al., 2008). Marked and released tuna in GBYP marking program showed high rate of survival (Tičina et al., 2014; Katavić et al., 2014). Conducted research indicate connection between survival and degree of physiological stress and physical trauma in C&R tuna (Michael et al., 2011). General opinion is that the type of the hook, i.e. circled or straight J-shaped, has crucial role on the place of hooking, and consequently, on the damage of mouth, pharynx or upper part of the intestine. Bearing this in mind, we decided to conduct comparative research between point of hooking and ensuing damage with the survival of C&R tuna.

Economic tuna fishing in Croatia is mostly done by purse seine, primarily for cage farming and in lesser part by hook and line. Traditional component of hook and line tuna fishing is sports and recreational fishing during the summer period. This is done in Big Game Fishing (BGF) competitions and from year 2011 until 2017 there were 50 BGF competitions with 1157 caught and released tuna specimens. Growing concern for sustainability of natural Bluefin tuna stocks seeks answers to numerous questions, and survival rate of released tuna is amongst them.

The goal of this study is to determine mortality rate, behaviour and sub-lethal wounds of juvenile tuna caught with different types of fishing tools and subsequently released in controlled cage conditions in order to observe their recovery and behaviour during 29 days of intensive feeding. Based on gathered, analysed and interpreted results of research, series of recommendations will be defined for sports and recreation fishermen and for organizers of BGF competitions so that the idea of C&R tuna fishing grants positive effect to the survival of released fish.

Material and methods

To carry out this project, sufficient quantity of biological material – live individuals of Bluefin tuna had to be secured. Prerequisite for project realisation and obtaining of live tuna was allocation of scientific quota from SCRS research committee within a framework of GBYP research programme of International commission for the conservation of Atlantic tunas (ICCAT), which recognized the importance of expected results. Research mortality allowances (RMA) is a quota for tunas that will be sacrificed for sampling or that will eventually die during the execution of experimental C&R fishing. Sampled tuna was caught in southern waters of island Jabuka basin during the second half of june 2017 with purse seine. This type of fishing

is the only one that allows the catch and manipulation of live pelagic fish and its transport via transport cages to fish farms. Using this method, 241 tuna specimens were transferred to stationary cage for the purposes of this project. To determine the number and size of the caught tuna by non-invasive method, AQ1 SYSTEMS stereoscopic camera was used during the transfer of tuna from the net to the transport cage and finally to the stationary cage.

Equipment used in the experimental fishing was selected so that its parameters, while counting in the size of the available fish, simulate characteristics of the equipment that is used in competitive sports fishing where the targeted fish size is above 50 kg. Big game fishing rods PENN VS 3080 ARD 56 International Stand Up 5'6'' 30-80 lbs with PENN 50V SW reel of 50 lbs nominal strength were used. Reel had monofilament string Normic Red Strike of 80 lbs nominal strength as a base and leader line connected with aluminium Jinkai stops (size grade K and J) and Olympus swivel with 85 kg nominal strength. In the place of connection, the line is protected by silicone cover Stonfo (1mm inner radius) to prevent line damage. Leader line is 150 cm long and made from fluorocarbon monofilament line M&W International with radius of 0,615 mm and line strength of 52 lbs.

Taking into account the goals of the research, 4 types of hooks were selected for tuna fishing: 1. straight J-shaped hook (J); 2. circle ringed hook (Cp); 3. barbless circle hook (Cbb) and 4. tournament legal circle hook (Cn). Japanese manufacturer OWNER was chosen for the hooks – Gorilla straight hooks size 6, Super Mutu circle ringed hooks size 5 and Tournament Mutu Light circle hooks size 5.

In order to observe tuna behaviour after the experimental C&R with each type of the hooks, different silicone baits, beads and, most often, polyamide fibres of different colours and combinations were attached on each leader line.

During the transport from the net to the towing cage to tuna farm, caught tuna gets agitated and doesn't accept food even for some time after the transfer to the stationary cage. This acclimatization period lasted for 15 days after which sampling has been performed to gain biometric parameters (length, weight and condition) for adjustment of fishing equipment, behaviour tracking methods after the release and the visibility of different markers.

Fishing was executed from the working platform in a way that is most often used in big game fishing – so called stand up fishing, where fisherman tries to tire the caught fish while standing on his feet with fishing rod attached to his battling belt around his thighs and reel secured to it with special fasteners. After the 15 minute period of fish tiring, the diver or the fisherman would note the position of hooking and cut the leader line behind the last mark. Hooking position was marked with symbols for: deep in mouth cavity (D), edge of upper or lower jaw (R) and the area of jaw joint (Z). During the experimental fishing 80 blue fin tuna individuals were caught and released, 20 individuals for each type of the hook. This lasted for 3 days, from 18th to 20th of july 2017. After this, video recording protocol with GO PRO 4 Black camera was set during the feeding and daily cage check-up to collect all potentially dead tuna.

Condition index value between treatment groups and size structure between control group and tunas in starvation were tested by variance analysis with 95% significance value (ANOVA-test).

Results and discussion

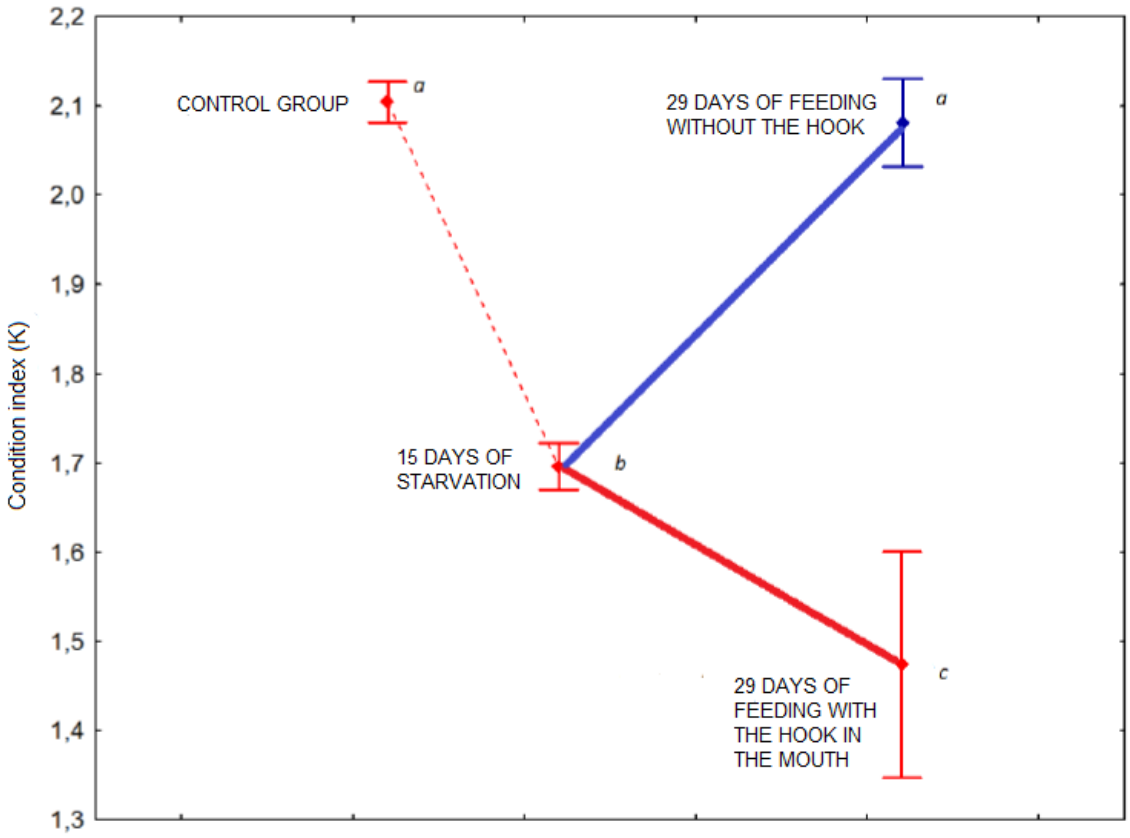
After the experimental fishing and the feeding trial, 152 tunas were released from the cage. Conducted research showed that hooking damages range from superficial injuries, most often on peripheral parts of jaw, skin and operculum to serious wounds. It is believed that the place of hooking is the primary factor that affects the mortality of the C&R fish (Aalbers et.al., 2004; Arlinghaus et.al. 2017).

Table – Point of hooking for the different type of hooks used in C&R experimental fishing

Place of hooking/Hook type	Straight J-shaped (J)	Circle ringed hook (Cp)	Barbless circle hook (Cbb)	Tournament legal circle hook (Cn)
Edge of upper and lower jaw (R)	1	5	4	4
Jaw joint (Z)	3	15	16	6
Palate	4			12
Pharynx	4			
Oesophagus	3			2
Gills	3			
Eye	2			
Total	20	20	20	20

Clear relationship has been established between the type and the characteristics of the tested hooks and the severity of the injury. Straight J-shaped hook, with point of hooking that is parallel to the arm of the hook, has higher caught fish mortality rate due to serious injury. Most of this injuries are deep within the mouth cavity. On the other hand, the results from the circle hooks, which have vertical hooking point in regard to the arm of the hook, show significantly shallower and lighter injuries with reduced risk of damaging important organs like oesophagus, heart and liver. In fact, use of circle hooks results in highest number of jaw hooking and superficial injuries to skin and operculum. This confirms earlier results which state that the circle hooks have important role in fish preservation. Despite our experiments not showing any significant difference in mortality or severity of injury between circle hooks with or without the barb, it is definite that barbless hooks cause less injury and fish tend to dispose of them easier. Having this in mind, barbless circle hooks have certain comparative advantages in fish protection during the C&R fishing. However, type of hook also affects the rate of tuna unhooking during the catch period. In the case of barbless circle hook, every fourth fish got off the hook (25%), while this rate was only 10% for the other types of hook.

Different sub-lethal injuries as a consequence of use of different hooks shows that not all tunas that survived had suffered the same. During the transport (1st week) and acclimatization to cage conditions (2nd week) condition index drops significantly, from K=2.1, which is value for freshly caught tuna, to K=1.7 after 15-day starvation. Most of the tuna caught and released with circle hook manages to get rid of the hook and regain good condition index (K>2) during the 29 days of feeding. Tuna with hook remaining on its body had drastically reduced condition index (K<1.5). Although they survived for the next 1.5 months, these starved individuals will most definitely have reduced growth and significantly reduced chances for completion of gametogenesis (reproduction).



Picture - Condition index (K) of recently caught tunas (control group) and tunas after 15 days of starvation in comparison with tuna fed for 29 days in the cage, red representing average condition index for tuna fed for 29 days but with hook still attached and blue representing average condition index for tuna without hook fed for 29 days. Average value range represents 0,95 confidence interval. Different letters (a,b,c) next to average values of condition index with the standard deviation (SD±) show statistically significant differences of condition index (Tukey HSD test, p<0,05).

Conclusions and recommendations

Catch and release practice in sports and recreational fishing in its basis is not wrong if it is done within the scope of scientifically determined regulation measures. With this research and available literature, it is already possible to upgrade C&R practice through this:

- juvenile individuals can be released back with great survival rate,

- reduce the tiring and catch time in C&R fishing by using adequate fishing gear,

- avoid or maximally reduce exposure of fish to air (out of water time),

- use of circle hooks,

- avoid fishing during the reproduction period,

- adjust size of the hook and the bait to desired fish size,

- fishermen education with special consideration on effects of “deep bite” followed with intensive bleeding (attracts predators) and vital organs damage (liver, heart) and momentary or imminent death.

Finally, it is our recommendation for the starting phase to make specific guides focused on certain targeted species and fishing areas. To overcome multiple conflicts within and around this fishing activity close cooperation is necessary between fishermen, their associations and fishing sector, including administrative and scientific segment.

Literature

Aalbers, S. A., Stutzer, G.M. and Drawbridge, M.A. 2004. The effects of catch-and-release angling on the growth and survival of juvenile white seabass captured on offset circle and J-type hooks. *N. Am. J. Fish. Manage*., 24:793-800.

Arlinghaus, R., Cooke, S.J., Lyman, J., Policansky, D., Schwab, A., Suski, C.D., Sutton, S.G. and Thorstad, E.B. 2017. Understanding the complexity of catch-and-release in recreational fishing: an integrative synthesis of global knowledge from historical, ethical, social, and biological perspectives. *Rev. Fish. Sci*., 15:75-167.

Cooke, S. J. and Schramm, H. L. 2007. Catch-and-release science and its application to conservation and management of recreational fisheries. *Fisheries Management and Ecology*, 14:73-79.

Donaldson, M.R., Arlinghaus, R., Hanson, K. and Cooke, S.J. 2008. Enhancing catch and release science with biotelemetry. *Fish. Fish*., 9:79-105.

Katavić, I., Cinoti, N., Grubišić, L. and Tičina V. 2014. Tagging of the tuna in the Adriatic (TAGAT) *Atlanitc-Wilde Research Program on Bluefin Tuna* (ICCAT/GBYP 01/2013 – Phase 4).

Stokesbury, M. J. W., Neilson, J. D., Susko, E. and Cooke, S. J. 2011. Estimating mortality of Atlantic Bluefin tuna (*Thunnus thynnus*) in an experimental recreational catch-and-release fishery. *Biological Conservation*, 144:2684-2691.

Tičina, V. Grubišić, L. and Katavić, I. 2004. Sampling and tagging of live Bluefin tuna in growth-out floating cages. *Aquaculture Research*, 35:307-310.