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Post-release survival in tuna and tuna-like species in longline fisheries

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Summary

The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) has requested that the Extended Scientific Committee (ESC) conduct sensitivity analyses around all sources of unaccounted mortality of southern bluefin tuna (SBT) as part of the planned 2014 stock assessment. One potential source of unaccounted mortality not currently considered in the operating model is mortality from releases/discards.

This paper reviewed the literature available on at life status at the time of hauling and post-release survival rates in tuna and tuna-like (i.e. billfish) species to inform this discussion. The results from these studies were compared to the recent estimates of post-release survival obtained for southern bluefin tuna from the Japanese longline fishery using pop up satellite archival tags (PSATs). This comparison indicated that the results from the Japanese study are more optimistic than the other studies reviewed. This is likely due to the handling techniques the study used, which do not appear to be representative of day-to-day longline fishing operations. Thus, the real level of post-release survival is likely lower.

1 Introduction

The 2013 meeting of the CCSBT Extended Commission requested the ESC to conduct sensitivity analyses around all sources of unaccounted catch mortality and provide preliminary advice on the impact of any unaccounted catch mortalities on the stock assessment projections and the possible Management Procedure recommendation beyond the 2015–17 quota block. The Extended Commission noted that the sources of mortality should include:

- Unreported or uncertainty in retained catch by Members, for example surface fisheries, artisanal catch, non-compliance with existing measures (e.g. catch over-run)
- Mortality from releases and/or discards
- Recreational fisheries
- Catches by non-Members
- Research Mortality Allowance
- Any other sources of mortality that the ESC is able to provide advice on (including depredation)

The fifth meeting of the Operating Model and Management Procedure Working Group (OMMP5 2014) discussed the request from the Extended Commission and noted that the working group was not necessarily in possession of the information required to construct the full range of plausible scenarios for unaccounted mortalities. The working group discussed the required types and potential sources of information that could better inform unaccounted mortality scenarios and encouraged the ESC, Compliance Committee and Extended Commission to work towards filling the gaps in the information base.

This paper focus on mortality from releases and/or discards from pelagic longline fleets to further develop scenarios at the ESC. The OMMP5 working group noted that the critical information regarding releases and discards includes the life status of fish on capture and mortality rates (CCSBT 2014). The working group agreed that scenarios for releases and/or discards requires information on the amount of releases and/or discarding and then 1) the state of the fish at haul and then discard or release (e.g. dead/alive), and 2) post-release survival. The meeting agreed that Members should provide estimates on each category based on available data from their fisheries (CCSBT 2014).

In line with the Extended Commission's request and the OMMP5 discussions, this paper is provided to contribute to the ESC discussions about the implementation of scenarios for this unaccounted catch mortality. We briefly review the scientific studies that examined the state of tuna and tuna-like species (i.e. billfish) at hauling using commercial pelagic longlines and how this related to factors such as the soak time of hooks. This can contribute to the reported observer data on life status at hauling for released and/or discarded fish.

We also examined studies that provided information on the post-release survival of tuna and tuna-like species. However, acquiring estimates of post-release survival can be difficult. To date, studies that provide information on post-release survival have generally employed tagging methods, particularly acoustic or pop-up satellite archival tags (PSATs), to determine the fate of fish once released. Such methods are generally expensive to undertake, and as a result studies employing this technology to study tuna have been limited in number and have also been restricted to small sample sizes. In addition, tagging studies are often designed to examine fish movements, rather than post-release survival, although they often report mortalities. Due to the limited number of studies available, we have included those based on both commercial and recreational fishing methods.

2 Life status at hauling

Several studies have indicated low levels of survival, at the time of hauling, for tuna and tuna-like species caught using commercial pelagic longline after a moderate soak time. Poisson (2009) found that survival of a suite of tuna and billfish species at time of hauling ranged from 1.2–26.7 per cent after 8 hours of being hooked (using hook timers; Table 1). Poisson (2009) also provided information on the observed maximum survival time of these species, ranging from 2–14 hours (Table 1). The standard soak time used by distant water longline vessels is likely at the higher end of this range.

Table 1. The life status at time of hauling for tuna and tuna-like species caught on pelagic longline, including the number and percentage of fish alive at hauling, size range per species (lower jaw fork length for swordfish and fork length for other species), maximum survival time, percentage alive after 8 hours of the hooking and number of fish observed.

Species	n	Alive at hauling (number)	Alive at hauling (%)	Length (cm)	Maximum survival time (hrs)	Alive after 8 hrs (%)
Swordfish	389	76	19.5	93–242	14	8.4
Bigeye tuna	86	42	48.8	65–160	14	26.7
Albacore	79	2	3.8	105–113	8	1.2
Yellowfin tuna	66	23	34.8	99–150	14	13.6
Sailfish	7	3	42.8	Undefined–163	4	8.3
Black marlin	3	3	100	238-–40	2	-

Source: Modified from Table 1 Poisson 2009 and Table 4 Poisson et al. 2010

In contrast to these studies, Sakai & Itoh (2013a) reported that, based on 2012 observer data (coverage was 10.4 per cent in terms of the number of vessels, 7.9 per cent in terms of the number of hooks used and 6.9 per cent in terms of the number of SBT caught), 83 per cent of the fish caught on pelagic longline were in “vigorous condition” and therefore suggest that 83 per cent of the released fish can be considered “live-release”. The scientific observer data did not include the condition of small sized fish (≤ 5 years). In 2012, the rate of discarding reported by scientific observers, 4.7 per cent of total catch, was substantially lower than the level reported in the RTMP data, 16.5 per cent, with a discard rate of 44.4 per cent reported in Area 4.

Given the results of the other studies noted, the estimates of live-release in Sakai & Itoh (2013a) appear high and no information is provided on soak time or other factors that may influence survival. At the 2013 meeting of the CCSBT Extended Scientific Committee, it was noted that there would be value in considering the impact of soak time on survival at time of hauling (CCSBT 2013).

3 Post-release survival

Cryptic mortality may occur after fish have been released from the gear as they may die hours or even days later because of stress or injuries sustained by being caught. Quantifying these mortalities is challenging. We reviewed studies that provide information on post-release survival in tuna and tuna-like species from both commercial pelagic longline fisheries and recreational fisheries using tagging techniques, generally PSATs.

The Commission has previously considered this issue, when, in 1995 and 1996 releases of small fish were reported (CCSBT 1996). At that time the Scientific Committee agreed on a mortality rate (23.53 per cent of non-retained fish) so that these fish could be included in the catch-at-age and used in the assessment models (see Polacheck et al. 1997). However, it is not clear how this mortality rate was determined.

Table 2 provides a summary of tagging studies for tuna and tuna-like species that provide some information on post-release survival. Of the studies presented in Table 2, the stated objective of seven of the twelve studies was to examine post-release survival. Of these, three studies used commercial longline and four used recreational hook and line methods. The other studies were designed to track the movements of fish after release but also report the mortalities recorded.

Studies that had a specific objective of measuring post-release survival after fish are captured during commercial operations are likely to have a different experimental design from studies with the objective of tracking the movements of fish. To be representative of fish released from commercial longliners, research would require a representative and random selection of fish caught using the same methods employed by commercial pelagic longline vessels (e.g. soak times and handling protocols).

Studies designed to track the movements of fish after release are likely to have confounding factors that limit their applicability to estimating post-release survival from commercial pelagic longline fisheries. For example, studies aiming to track the movements of fish after release are unlikely to use a random selection process when choosing fish to tag; the preference would be for fish in good condition and unlikely to die shortly after release. In addition, studies aiming to track fish movements are also likely to use shorter soak times to capture the fish for tagging and/or different handling techniques than would normally be employed in commercial operations in order to improve the condition of the fish to be tracked. Similarly, studies using recreational methods may not be directly comparable to those using commercial methods because of the gear and the handling methods used. However, they do provide a useful comparison and thus have been included here.

From the studies with the objective of examining post-release survival, the estimates of post-release survival were 88.2–89.5 per cent for studies using commercial longlines and 73.8–96.6 per cent using recreational hook and line (Table 2). The highest level of survival from these studies was reported in Stokesbury et al. (2011). This study used recreational fishing methods and essentially was a 'best-case scenario' for survival that included using circle hooks so that the fish were jaw hooked, rather than gut hooked, and releasing the fish relatively quickly.

Sakai & Itoh (2013b) presented data derived from tagged southern bluefin tuna that had been captured using pelagic longline methods. This study appears to be an analysis of a subset of data from a larger tagging study. For example, the fact that some fish provided tagging information for over 100 days suggests that the primary objective of the study was to track fish movements, not estimate post-release survival. There is no information provided on how fish were selected for tagging, or the operational details of the sets that caught the fish (e.g. soak time, hook type etc). As noted above, if the objective of the study was tracking the fish after release, the method for selecting the fish to be tagged and their handling is unlikely to be representative of releases from normal commercial fishing operations. Therefore, these fish may not be representative of the overall condition of the fish captured during normal longline operations.

In addition to the selection process of which fish to be tagged, the study describes several handling or retrieval methods it used including “pulling up by the branch line”, “scooping by the spoon net” and “lifting electro-hydraulic basket”. Sakai & Itoh (2013b) note that one of the retrieval methods (i.e. pulling up by the branch line) was “*actually used on commercial longline vessels to release small sized SBT*”. This suggests that the other two methods described are not standard methods employed on day-to-day longline operations and therefore these results may not be applicable to post-release survival levels from commercial vessels undertaking normal fishing operations.

Sakai & Itoh (2013b) estimated a post-release survival level (~91 per cent) higher than some of the studies using recreational methods and the highest level of survival estimated among studies based on commercial pelagic longlining (Table 2). In 2013, the ESC noted confounding effects in the factors observed and the need for a larger sample size to address these.

Table 2. Summary of papers that provide information on post-release survival and survival at time of hauling for tuna and tuna-like species. Studies shaded in grey employed pelagic longline methods while unshaded studies employed recreational hook and line methods.

Species	Method *Stated objective*	Soak time	Tracking time	Survival Rate	Sample size (no. of fish)	Reference
Southern bluefin tuna	Pelagic longline *Unspecified*	Not provided	48 hrs (part of a longer tracking time period)	91%	45 (out of 61 tagged) 88-188cm FL	Sakai & Itoh 2013b
Striped marlin	Pelagic longline *Tracking fish movements*	4-8 hrs	4-51 hrs	83.4%	6	Brill et al. 1993
White marlin	Pelagic longline *Estimate post-release survival*	Not provided	5-43 days	89.5%	20	Kerstetter & Graves 2006
Blue marlin	Pelagic longline *Estimate post-release survival*	Not provided	5 & 30 days	77.7%	9	Kerstetter et al. 2003
Sailfish	Pelagic longline *Estimate post-release survival*	'Dusk-dawn'	10 days	88.2%	17	Kerstetter & Graves 2008
Striped marlin	Recreational hook & line *Estimate post-release survival*	N/A	5 days	73.8%	61	Domieir et al. 2003
Black marlin	Recreational hook & line *Examine post-release behaviour*	N/A	8-27 hrs	87.5%	8	Pepperall & David 1999
White marlin	Recreational hook & line *Estimate post-release survival*	N/A	5 & 10 days	82.5%	40	Horodysky & Graves 2005

Atlantic bluefin tuna	Recreational hook & line *Estimate post-release survival*	N/A	2-246 days	96.6%	59	Stokesbury et al. 2011
Blue marlin	Recreational hook & line *Track fish movements*	N/A	8 hrs	100%	6	Holland et al. 1990
Blue marlin	Recreational? *Unknown*	?	?	40%	5	Yeun et al. 1974 Information derived from other papers as unable to source the original.
Atlantic bluefin tuna	Recreational hook & line *Estimate post-release survival*	N/A	106 days	89.5%	20	Marcek 2013 MSc; source from AFS Abstract.
Suite of species (including bigeye, yellowfin and albacore tuna)	Pelagic longline *Survivorship of hooked fish*	8 hrs plus	N/A	Survival at time of haul, after 8 hrs of capture (hooking) ranged from 1.2–26.7%	801 (from 160 sets)	Poisson 2009; Poisson et al. 2010

4 Conclusions

This paper aims to contribute to the ESC discussions around scenarios for the unaccounted mortality from releases and/or discarding.

In future, scenarios could be improved through the collection of observer data on the life status at hauling and specially designed studies to estimate post-release survival in southern bluefin tuna from longline fisheries. Robust observer data may also provide information on the impact of differing fishing practices (such as soak time, hook type etc) on the post-release survival of discards. To address this issue, future studies and data reporting schemes should strive to examine the survival rate at haul in relation to these differing fishing practices.

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