

Computing a Global Rate of non-Target Species Catch (Bycatch) in Tropical Tuna Purse Seine Fisheries

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I. Introduction

The incidental catch of non-target species is sometimes referred to as "bycatch", although the use of that term by some authors is strictly limited to the catch of non-target species that are discarded dead at sea (an ISSF blog¹ explains how the calculations of bycatch rates may differ depending on how the term is defined). In this document, I use the term "bycatch" to be the catch of anything that is not the main reason for which the skipper is fishing (see Dagorn and Restrepo, 2011). Note that many of these incidental catches are actually retained and they end up being utilized and marketed. Therefore, to say that they are not targeted may be too strict. Here, I assume that the main reason for which tropical tuna purse seine skippers are fishing is to catch skipjack, yellowfin and bigeye tunas.

Bycatch of non-target species is highly variable. It depends on the main fishing gears that are used, but can also vary due to other fishing factors such as the skipper's strategy at a given time, Ocean area, time of the year, market prices by species/size, etc. Nevertheless, there is currently an interest in characterizing "bycatch" with a single number that can be used to estimate the overall impact from all tuna purse seine fisheries. This document provides such an estimate at the global level.

II. Calculation of weighted bycatch rates

II.1. Weighted bycatch rate for the capture of non-target species

A weighted bycatch rate can be calculated taking into account regional and gear differences in bycatches and in the catch of target tunas. In this exercise, it is assumed that the target species of the tropical purse seine fisheries are yellowfin, skipjack and bigeye tunas. Tropical purse seine vessels may at times actively target other species such as bluefin or bonitos; these are not included in the calculations in this document.

Table 1 shows the 2005-2009 average catch of skipjack, yellowfin and bigeye made by purse seine vessels in the western and Central Pacific (WCPO), eastern Pacific (EPO), Indian (IO) and Atlantic (AO) Oceans. These average catches are separated into those made by setting on objects (anchored FADs, drifting FADs and natural logs) and those made setting on free (unassociated) schools of tuna. For the EPO, sets on tuna-dolphin associations are reported separately.

Table 1 also provides the catch rate of non-target species (all fish caught except skipjack, yellowfin and bigeye tunas), expressed as a percentage of the catches of

¹ See <http://iss-foundation.org/2011/08/30/defining-bycatch/>, and Dagorn and Restrepo (2011).

skipjack, yellowfin and bigeye combined. These percentages are also separated by set type in each region. These catch rates of non-target species include both retained and discarded fish.

The last column and row in the table provide a bycatch rate weighted by the amount of catch made in the different set types in each region, or weighted by the amount of catch made in the different regions for a given set type. The number at the bottom right hand side of the table is a global average bycatch rate of non-target species.

Table 1. Retained catch of target tunas and bycatch rate of non-target species by ocean region and set type. The last column and row show the average bycatch rates, weighted by the amounts of target tuna caught.

Region	Target tuna catch 2005-2009*				Non-target species catch (%)**			Weighted rate %
	Object	Dolphin	Free School	Sub-tot	Object	Dolphin	Free School	
WCPO	1,095,880		658,263	1,754,143	1.74		0.26	1.18
EPO	256,513	137,414	143,771	537,698	2.28	0.17	0.84	1.35
IO	207,621		102,673	310,294	3.58		0.83	2.67
AT	70,387		52,282	122,669	8.93		2.84	6.33
					2.37	0.17	0.55	1.62

* Retained catches of skipjack, yellowfin and bigeye tuna from WCPFC, IATTC, IOTC and ICCAT.

** Bycatch rates for species other than bigeye, yellowfin and skipjack tunas. These rates are calculated on the basis of tonnes (of a given species) caught relative to the amount of skipjack, yellowfin and bigeye landed. Sources:

WCPO: 2005-2010 observer data by P. Williams (SPC, pers. comm.).

EPO: 2000-2009 observer data by M. Hall (IATTC, pers. comm.)

IO: Amandé et al. (2008) using 2003-2007 observer data from EU vessels.

AO: Amandé et al. (2010) using 2003-2007 observer data from EU vessels.

The resulting calculation shows that, globally, tropical tuna purse seine fisheries have an overall bycatch rate of non-target fish of 1.62%. That is, for every 1,000 tonnes of skipjack, yellowfin and bigeye landed, 16.2 tonnes of non-target species (including minor tunas) are caught. It is worth noting that many of these fish are retained and commercialized. In West Africa (especially in Cote d'Ivoire) there is a market known as "faux poisson" where damaged or small target tunas are commercialized together with minor tunas, billfishes, sharks and other bony fishes (Romagny et al. 2000). In the eastern Pacific, the percentage of non-target catches that are retained has been increasing for several species, especially during the last decade. For example, the retention of dorado (mahi-mahi) went up from 51% in 2000 to 84% in 2010 (IATTC, 2011).

Regionally, the weighted averages show considerable differences, from a low of 1.18% in the WCPO, to a high of 6.33% in the AO. In terms of set type, the weighted bycatch rates range globally from as little as 0.17% for sets on tuna-dolphin associations, to a high of 2.37% for sets on objects.

II.2. Weighted bycatch rate for the capture of non-tuna species

Non-target fish caught in the tropical purse seine fisheries include "minor" tunas, many of which are retained. These include the *Auxis* group (bullet and frigate tunas) and the *Euthynnus* group (Pacific black skipjack and little tunny). This second calculation is made to show that much of the regional variability in the first calculation is due to the

capture of these minor tuna species. The bycatch rates in **Table 2** are as in Table 1, but exclude minor tunas.

Table 2. Retained catch of target tunas and bycatch rate of non-tuna species (excludes minor tunas and bonitos) by ocean region and set type. The last column and row show the average bycatch rates, weighted by the amounts of target tuna caught. Data sources are as in **Table 1**.

Region	Target tuna catch 2005-2009				Non-tuna species catch (%)			Weighted rate %
	Object	Dolphin	Free School	Sub-tot	Object	Dolphin	Free School	
WCPO	1,095,880		658,263	1,754,143	1.54		0.23	1.05
EPO	256,513	137,414	143,771	537,698	1.07	0.13	0.33	0.63
IO	207,621		102,673	310,294	2.66		0.24	1.86
AT	70,387		52,282	122,669	2.16		0.76	1.56
					1.64	0.13	0.28	1.08

The result shows that, globally, tropical tuna purse seine fisheries have an overall bycatch rate of non-tuna species of 1.08%. That is, for every 1,000 tonnes of skipjack, yellowfin and bigeye landed, 10.8 tonnes of non-tunas are caught. These include billfishes, sharks, rays, and other finfish such as dorados (mahi-mahi) and wahoo.

Regionally, the weighted averages in **Table 2** show considerably less variation than in Table 1, suggesting that "minor" tunas account for much of the regional differences in bycatch rates. Much of the difference appears to be due to catches of minor tunas on floating objects.

III. Concluding remarks

The calculations presented here indicate that, globally, the bycatch of non-target species in tropical purse seine fisheries represents less than 2% of the amount of target tunas produced. This is a somewhat simplistic calculation that responds to the current impetus to frame bycatch in tuna fisheries as if it could be characterized by a single number. In reality, there is great variation in bycatch, not only regionally and by gear type, but also likely through time. The rates will obviously vary depending on the relative population sizes and availability of target and non-target species. They will also vary as effective mitigation measures are implemented or due to market prices of retained species.

The weightings used to calculate an overall bycatch rate in this document are proportional to the retained catch of the target tropical tunas. Differences in discard rates of these target tunas between set types or between regions would be expected to affect the weighted averages. Similarly, the bycatch rates used as the basis for the calculations are relative to landed target tunas. If they were expressed relative to the catch of target tunas (i.e., including discards), the rates would be expected to be lower.

More importantly, the magnitude of a bycatch rate does not necessarily imply a given level of concern (or lack of it) for any particular species. For example, a bycatch rate of 10% may be of no concern for one species that is highly productive, while one of 1% may be of concern for another, less productive one. The impact of fishing on individual species, target and non-target, needs to be assessed through adequate monitoring and research.

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