

# **Estimate of numbers of fishes used for reduction to fishmeal and fish oil, and other non-food purposes, each year**

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## **1. Overview**

We have estimated the numbers of wild-caught fishes used for reduction, and for other non-food purposes, each year using five sources of information:

- 1) Wild fish capture tonnages each year between 2007 and 2016 published by the FAO (FAO, 2018a).
- 2) The proportions of total fisheries capture used for reduction for each of the top 20 capture species in nine geographical regions for 2007-2011 (Newton, 2014).
- 3) Estimated mean capture weights for fish species obtained in our earlier study (Mood and Brooke, 2010).
- 4) Figures provided by the FAO on total fisheries capture used for reduction and for other non-food uses each year between 2007 and 2016 (FAO, 2018b).
- 5) Information on the use of Norway pout for reduction (Anon, 2019).

We have estimated the average number of wild fishes caught for reduction to fish meal and fish oil each year, for 2007 to 2016, to be between a half a trillion and one trillion (to the nearest significant figure). Most fish oil and fish meal are used to feed to farmed fish and other animals rather than for human consumption. We have also estimated that the average fisheries capture used for other non-food purposes each year, reportedly 4.7 million tonnes (FAO, 2018b), may comprise between 0.1 to 0.3 trillion fishes. Since fish capture is likely to cause slow and distressing deaths (Mood, 2010), the capture of feed fish therefore presents a major animal welfare issue both in scale and in terms of proportionate use of sentient animals.

## **2. Estimated of numbers of fishes used for reduction each year 2007-2011**

### **2.1 Total fish capture tonnage used for reduction**

The first part of this analysis was to obtain the total fish capture weight used for reduction to fish meal and fish oil. The total fisheries capture tonnage used for reduction each year between 2007 and 2011 is provided by the FAO (FAO, 2018b) and equals 17.7184 million tonnes, as shown in Table 1.

We assume this capture is all fish species with the single exception of Antarctic krill. Antarctic krill is a small crustacean and is the only non-fish species that is used for reduction within the capture of the top 20 capture species categories of all nine geographical regions analysed by Newton (2014). It is a top capture species in Europe, where it is entirely used for reduction. Deducting the 155,985 tonnes average annual capture of Antarctic Krill for the period (FAO, 2018a) gives an average annual total fish capture for reduction (2007-2011) of 17,562,415, or 17.6 million, tonnes.

The total wild fish capture tonnage, on average each year between 2007 and 2011, was 76.4 million (76,461,534) tonnes, according to the FAO (FAO, 2018a). The amount used for reduction therefore

represents 23% of total fish capture by weight. The rest of this analysis for the period 2007 to 2011 serves to estimate the numbers of fishes represented by this capture for reduction.

Table 1 also shows fishery capture for other non-food purposes besides reduction to fish oil and fish meal. This includes, according to the FAO (2018b), feed and bait, for ornamental purposes, withdrawals from markets and any other non-food use of fish production (e.g. fertilizers, medical uses).

Table 1 Fisheries capture used for reduction and other non-food purposes

Year	World fishery capture used for reduction (million tonnes)	Other non-food use (million tonnes)
2007	18.897	4.631
2008	18.082	3.927
2009	17.484	4.105
2010	15.041	4.604
2011	19.088	4.874
2012	15.118	4.461
2013	15.663	4.957
2014	14.921	5.105
2015	15.120	5.150
2016	14.600	5.100
Average 2007-11	17.7184	4.4282
Average 2007-16	16.4014	4.6914

Source: FAO Yearbook 2016 (FAO, 2018b)

## 2.2 Calculation of capture for reduction from species regional reduction percentages

The second part of this analysis was to calculate the capture weight used for reduction for fish species by groups of countries where information was obtained on the proportion of capture used for reduction, as follows.

Data obtained from Newton (2014) details the top 20 wild-caught species categories in each of nine geographical regions for 2007-2011, together with the proportion of their capture tonnage used for reduction to fish meal and fish oil. Note that a fish species category can be a single species, such as 'Peruvian anchovy', or an identifiable group of species such as 'sardinellas nei' (unspecified sardinella species) or an unidentifiable group of species such as 'marine fishes nei' (unspecified marine fish species).

Among the top 20 species categories in each of the nine regions, there are 96 fish species categories out of which 43 are wholly or partly used for reduction and 53 are not used for reduction (this excludes non fish species, of which the only one in these regional top species that is used for reduction is Antarctic krill). In addition to these 43 species categories, we have assumed that Norway pout is used entirely for reduction in Europe, based on information on the Fishsource website (Anon, 2019), giving regional reduction percentages for 97 fish species categories in total. In combination with fish capture tonnages reported (by species category and country) by the FAO (2018a), this data was used to calculate total capture used for reduction for those 97 species categories in those regions, which is summarised in Table 2. For those species categories for which we have previously estimated a mean capture weight (Mood and Brooke, 2010), we also estimated the corresponding numbers of fishes.

Table 2 Annual capture of fishes used for reduction 2007-2011 based on regional reduction percentages.

	Fish capture (million t <sup>i</sup> )	Fish capture used for reduction <sup>ii</sup> (million t)	Percent of total capture used for reduction	Estimated numbers of fish used for reduction <sup>ii</sup> (millions)
Capture for which amount used for reduction has been calculated:				
For which fish numbers estimated	23,096,900	12,263,454	70	364,070 - 891,581
For which fish numbers not estimated	8,704,191	1,477,648	8	Not directly estimated
Species not used for reduction	25,742,524	0		0
Total of above <sup>iii</sup>	57,543,615	13,741,102	78	
Out of total capture	76,461,534	17,562,415	100	

i t = tonnes

ii For method of calculation, see main text. See full details of this estimate at:

<http://fishcount.org.uk/studydatascreens/2016/numbers-of-fish-caught-for-fishmeal2011.php>

### 2.3 Estimation of capture tonnage used for reduction from extrapolated regional reduction percentages

Table 3 Estimated annual capture of fishes used for reduction 2007-2011 based on extrapolated regional reduction percentages.

	Fish capture (million t <sup>i</sup> )	Fish capture used for reduction <sup>ii</sup> (million t)	Percent of total capture used for reduction	Estimated numbers of fish used for reduction <sup>ii</sup> (millions)
Capture for which amount used for reduction has been estimated (based on extrapolated reduction percentages):				
For which fish numbers estimated	920,566	231,174	1	2,339 - 7,546
For which fish numbers not estimated	568,133	91,039	1	Not directly estimated
Species not used for reduction	3,493,901	0	0	0
Total of above	4,982,599	322,213	2	
Out of total capture	76,461,534	17,562,415	100	

i t = tonnes

ii For method of calculation, see main text. See full details of this estimate at:

<http://fishcount.org.uk/studydatascreens/2016/numbers-of-fish-caught-for-fishmeal2011.php>

The third part of this analysis was to extrapolate the regional reduction percentages for the 97 fish species categories to any regions in which they were not within the top 20 capture species. This was done by assuming that in such regions, the proportion used for reduction was the lowest proportion used for reduction in any region for that species category for which data was available (ie the lowest proportion used for reduction in any region in which the species appeared in the top 20 capture species). The reason for this assumption was to avoid overstating (overestimating) the tonnage used for reduction for any individual species and for a simpler calculation. (An alternative approach could have been to extrapolate the average, rather than minimum, proportion used for reduction for the species across all regions. This would have resulted in a very slightly increased estimate of 367 to 901 billion fishes for species for which reduction tonnage has been calculated and which have an estimated mean weight, as compared to 366

to 899 billion (Table 4), and would not therefore have made a substantial difference to the final estimate.)

## 2.4 Estimation of total fish numbers used for reduction

The fourth part of this analysis was to estimate the total numbers of fishes used for reduction by extrapolating the average number of fishes per tonne of reduction capture for species categories with estimated mean weights to the reduction capture for species categories without an estimated mean weight and to the reduction capture of unknown species.

The data in Tables 2 and 3 are combined in Table 4 to give the total estimated capture tonnages used for reduction for species categories where regional reduction percentages were obtained or extrapolated, together with estimated numbers for species where an estimated mean weight was available (the figure in the last column not in italics). It has been estimated that for 63 million tonnes of fish capture, 14 million tonnes were used for reduction out of which 12 million tonnes comprised between 366 and 899 billion individual fishes.

The total capture for all fish species for which the reduction tonnage has not been estimated from regional reduction percentages (extrapolated or otherwise) is calculated by subtracting (a) the capture for species for which the reduction tonnage has been estimated from (b) the total capture, and similarly for the reduction capture. This gives a further 13 million tonnes of fish capture of which 3 million tonnes were used for reduction (2nd from bottom row in Table 4).

Table 4 Estimated annual capture of fishes used for reduction 2007-2011.

	Fish capture (million t <sup>i</sup> )	Fish capture used for reduction <sup>ii</sup> (million t)	Percent of total capture used for reduction	Estimated numbers of fish used for reduction <sup>ii</sup> (millions)
Capture for which amount used for reduction has been estimated:				
For which fish numbers estimated	26,255,649	12,494,628	71	366,409 - 899,127
For which fish numbers not estimated	10,798,769	1,568,687	9	<i>46,002 - 112,884</i>
Species not used for reduction	25,471,796	0	0	0
Total of above	62,526,214	14,063,315	80	
Species for which reduction tonnage not estimated from regional reduction percentages	13,395,319	3,499,100	20	<i>102,612 - 251,799</i>
Out of total capture for reduction	76,461,534	17,562,415	100	<i>515,024 - 1,263,810</i>

i t = tonnes

ii For method of calculation, see main text. Fish numbers in italics are extrapolated from estimated numbers for species whose numbers have been estimated. See full details of this estimate at:

<http://fishcount.org.uk/studydatascreens/2016/numbers-of-fish-caught-for-fishmeal2011.php>

By extrapolation, it is estimated that the total numbers of fishes used for reduction are between 515 and 1,264 billion, assuming the average fish size is similar to that of the 366-899 billion fishes. These extrapolated numbers are shown in italics.

### 3. Update for 2007-2016.

For 2007-2016, the average annual fish capture was 76,631,067, or 76.6 million, tonnes. According to the FAO (2018b), 16.4014 million tonnes of fisheries capture on average were used for reduction each year for 2007-2016 (Table 1). Deducting the 204,924 tonnes average annual capture of Antarctic Krill for the period (FAO, 2018a) gives an average annual total fish capture for reduction (2007-2016) of 16,196,476, or 16.2 million, tonnes, representing 21% of total fish capture.

Using a similar method as for 2007-2011, as shown in Table 5 we have estimated that for 24 million tonnes, 11 million tonnes were used for reduction and have further estimated that this comprised 316-766 billion individuals. This estimate assumes the proportions of each species used for reduction is similar in 2007-2016 to 2007-2011. For the remainder of the 16.2 million tonnes used for reduction, if we were to assume the overall average fish size is similar to that of the 316-766 billion fishes we calculated, then the total estimated numbers of fishes used for reduction would be between 462 and 1,120 billion.

Table 5 Estimated annual capture of fishes used for reduction 2007-2016.

	Fish capture (million t <sup>i</sup> )	Fish capture used for reduction <sup>ii</sup> (million t)	Percent of total capture used for reduction	Estimated numbers of fish used for reduction <sup>ii</sup> (millions)
Capture for which amount used for reduction has been estimated:				
For which fish numbers estimated	24,235,806	11,076,805	68	316,163 - 765,715
For which fish numbers not estimated	11,403,166	1,619,320	10	<i>46,220 - 111,940</i>
Species not used for reduction	26,510,159	0	0	0
Total of above	62,149,131	12,696,125	78	
Species for which reduction tonnage not estimated from regional reduction percentages	14,481,936	3,500,351	22	<i>99,910 - 241,971</i>
Out of total capture for reduction	76,631,067	16,196,476 <sup>ii</sup>	100	<i>462,293 - 1,119,626<sup>iii</sup></i>

i t = tonnes

ii For method of calculation, see main text. Fish numbers in italics are extrapolated from estimated numbers for species whose numbers have been estimated. See full details of this estimate at:

<http://fishcount.org.uk/studydatascreens/2016/numbers-of-fish-caught-for-fishmeal2016.php>

### 4. Conclusion

We estimate that the number of wild fishes caught for reduction to fish meal and fish oil each year, between 2007 and 2011 was between 515 and 1,264 billion fishes, and for between 2007 and 2016, was between 462 and 1,120 billion fishes. We conclude that for 2007 to 2016, the number of fishes caught from the wild and used for reduction is likely to be between a half a trillion and one trillion (to the nearest significant figure).

As shown in Table 1, a further 4.69 million tonnes (FAO, 2018b) of fisheries capture (29% of capture tonnage for reduction) were used for other non-food purposes each year between 2007 and 2016. Assuming these are all fish species, then if these fishes are of a similar size then this would suggest a further 134 to 324 billion fishes were used for other non-food purposes each year between 2007 and 2016.

## 5. References

1. FAO, 2018a FishStat 'Capture Production 1950-2016 (Release Date: 15th March 2018).'
2. Newton, R.W., 2014. Assessing environmental sustainability and value addition opportunities for by-products from aquaculture. Appendix 1.
3. Mood, A. and Brooke, P., 2010. Study to estimate the global annual numbers of fish caught.
4. FAO 2018b. FAO yearbook. Fishery and Aquaculture Statistics 2016.
5. Anon 2019. Fishsource Norway pout: North Sea, Skagerrak and Kattegat. Accessed at [https://www.fishsource.org/stock\\_page/1851](https://www.fishsource.org/stock_page/1851) on 24.05.2019.
6. Mood, A., 2010. Worse things happen at sea: the welfare of wild-caught fish. Available: <http://www.fishcount.org.uk>.