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Global Fisheries: Livelihood Impact of Overfishing

Technical Report: November 30 2022

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Director's Foreword

In 1497, John Cabot returned to England after a voyage along the coast of Newfoundland and reported that there was an unusually large concentration of fish, particularly cod, available, so many that he famously said that they could be caught with a basket lowered over the side of a boat. Just under 500 years later, in 1992, the Canadian government had to impose a moratorium on the Northern cod fishery along the country's east coast. Those fish stocks had been almost completely depleted.

This 'shifting baseline' has occurred around the globe as changes brought on by overfishing already depleted fish stocks have had devastating effects on both the availability of marine catches and the jobs that depend on them.

In this Fisheries Centre Research Report, members of the Fisheries Economics Research Unit (FERU) used data from the Global Fishing Index, a global assessment of the sustainability of over 1,400 fish stocks conducted by the Minderoo Foundation, to estimate the catch loss - the difference between the maximum sustainable yield of a fish stock and its catch in the most recent year - arising from overfished fish stocks, and the socio-economic impacts that are associated with this catch loss. They evaluated 482 fish stocks that the GFI had identified as 'overfished' in terms of catch loss, the landed value of the loss, and the number of jobs associated with marine fisheries that would be affected worldwide. The results are astounding: they estimated that we are losing around US$39 billion in potential lost landed value annually, and an estimated 668,479 associated full-time equivalent jobs. Moreover, most affected by those job losses are coastal communities, primarily in Latin America and the Caribbean, as closely thereafter in Europe and North America. No area of the world will be untouched by these losses.

This technical report supports what researchers have been saying for many years – we urgently need to rebuild overfished fish stocks in order to recoup the current economic and social benefits that are inescapable with current – and predicted - catch loss. In this way, we achieve Infinity Fish, i.e., the idea that if managed sustainability wild fish stocks can continue to give us these benefits forever.

I applaud the work of the Fisheries Economics Research Unit, and, indeed, the Global Fishing Index and Minderoo Foundation, for their continuing contributions to the zeitgeist of our need to rebuild fish stocks around the world, before they are but a distant memory, not able to be captured in a basket.

Prof. William Cheung
Director and Professor, Institute for the Oceans and Fisheries
The University of British Columbia

Executive Summary

This technical report estimates the catch loss arising from overfished fish stocks and the socio-economic impacts associated with this catch loss. In this analysis, catch loss is defined as the difference between the maximum sustainable yield of a fish stock and its catch in the most recent year. We focus on 482 fish stocks identified as 'overfished' in the Global Fishing Index, a global assessment of the sustainability of over 1,400 fish stocks conducted by the Minderoo Foundation. For these overfished stocks, we estimate (1) the potential catch loss (in tonnes) from overfished fish stocks; (2) the landed value (in USD) of catch loss; and (3) the number of jobs associated with marine fisheries catch loss worldwide.

Our results indicate that the annual estimated catch loss for 482 overfished fish stocks amounted to 15 million tonnes worldwide. This catch loss results in huge societal cost, translating to around US$39 billion in potential lost landed value annually, and an estimated 668,479 associated full time equivalent jobs. If all the overfished fish stocks were fished at MSY, all regions worldwide could potentially gain fishing jobs, with highest potential gains in Latin America and the Caribbean (24% above current jobs). Thus, our analysis emphasises the urgent need to immediately rebuild overfished fish stocks in order to recoup the current economic and social benefits that are forgone with catch loss.

1. Introduction

Fisheries play a crucial role in human and economic well-being (Teh and Sumaila 2013; Bene et al. 2015; Hicks et al. 2019; FAO 2022), but decades of overexploitation have led to unsustainable fisheries becoming a major worldwide problem (Pauly et al. 2002; Worm et al. 2009; McCauley et al. 2015). Global reconstructed marine capture fisheries peaked in the mid-1990s, reaching 124 million t in 1996 (Pauly et al. 2020), and since then, annual average global marine catches have been around 112 million t (Pauly et al. 2020). This catch supports employment for 37.9 million people and provides a valuable source of food for up to 3.1 billion people who obtain 20% of their protein source from fish (FAO 2016). Also, an estimated 260 million people earn some income along the value chain of marine fisheries (Teh and Sumaila, 2013). Nevertheless, major drivers of overfishing, such as excess fishing capacity (Watson et al., 2013), weak governance, and illegal, unreported, and unregulated (IUU) fishing (Sumaila et al. 2020), among others, have driven numerous fish stocks to collapse or depletion (Teh et al. 2017; Hilborn et al. 2021). Consequently, fish stocks with biomass within biologically sustainable levels have decreased considerably in the past few decades, from 90% of stocks in 1974 to 65% in 2019 (FAO 2022). At the same time, the percentage of stocks that are fished at biologically unsustainable levels (i.e., are presently subject to overfishing) has progressively increased from 10% in 1974 to 35% in 2019 (FAO 2022). The current state of overfished marine ecosystems compounds the effects of other major threats like habitat destruction, pollution (Abbott and Sumaila, 2019), and climate change (Cheung et al. 2021; Lam et al., 2020) putting the entire future of the world's oceans at risk (Brander 2007; Costello et al. 2010; Barange et al. 2014; Thiel et al. 2018).

The global problem of unsustainable fishing not only degrades marine habitats and biodiversity, but also leads to societal losses and threatens food and nutrition security, livelihoods, and employment of millions (Pauly et al. 2005; Crowder et al. 2007; Worm et al. 2009; Hicks et al. 2019). Indeed, if all depleted fish stocks were rebuilt to biologically sustainable levels, catches and hence social-economic benefits would increase relative to present levels (Sumaila et al. 2012; Costello et al. 2016; Teh and Sumaila 2020). For example, Srinivasan et al. (2010) highlighted the huge human and economic impact of unsustainable fishing as they estimated that it resulted in global annual catch losses that amounted to between 7 and 36% of actual fisheries landings in the year 2000 depending on Exclusive Economic Zone (EEZ). This catch loss was equivalent to between US$6.4 and 36 billion in landed value losses (in 2004 constant USD), and could help feed 20 million of the world's undernourished people. In a later study, Ding et al. (2017) estimated global catch losses of 333 million t over the period 1950-2010 (i.e., and average of 5.5 million t per year on average), using methods based on Srinivasan et al. (2010).

In their study, Srinivasan et al. (2010) calculated catch loss by estimating the difference between a species' catch and its Maximum Sustainable Yield (MSY). The MSY is the maximum catch that can be taken from a fish stock continuously without affecting the stock's long-term productivity (Tsikliras and Froese 2016). Due to the lack of actual fishery stock assessments, Srinivasan et al. derived an empirical relationship between MSY and the maximum catch for a subset of species, and then applied this to predict the MSY for 1,066 species in 300 EEZs.

The recent Global Fishing Index (GFI, Minderoo Foundation 2021a) assessed the status of over 1,400 fish stocks by determining the proportion of fish stocks whose abundance are at, or below the abundance level that can generate MSY. To overcome fishery stock assessment data limitations, the GFI used the CMSY++ method (Froese et al. 2021) to generate estimates of MSY for all assessed fish stocks. Having this dataset available provided the opportunity to estimate catch loss and update the analysis of the social and economic consequences from unsustainable fishing. Indeed, the GFI found that 45% of assessed fish stocks worldwide were overfished, while almost 10% had been driven to collapse. Considering the sustainability of stocks, the data available, and the governance in place to manage the fisheries, none of the countries assessed by the GFI are on track to meet the United Nation's Sustainable Development Goal (SDG) Target 14.4: to effectively regulate fishing, end overfishing, and restore fish stocks to sustainable levels. Estimating the lost catch and, consequently, lost revenue resulting from overfishing will help reinforce the urgency to meet SDG Target 14.4, which stipulates that overfishing should be ended, and already overfished stocks restored to sustainable levels of abundance.

Therefore, in this study we aim to assess the socio-economic impacts of the overexploitation of marine fish stocks. Specifically, our objective is to estimate: (1) the potential catch loss from overfished fish stocks; (2) the landed value of catch loss (in USD); and (3) the number of jobs associated with marine fisheries catch loss worldwide.

2. Method

We use an ecological-economic modeling framework based on Eco[2] in Sumaila et al. (2015) that allows us to compute and analyse the jobs and monetary consequences of the widespread overfishing of ocean fish stocks worldwide. Our analysis involves 3 components, i.e., estimating: 1) catch loss; 2) fishers' revenue loss (i.e., landed value of the catch); and 3) change in the number of marine fisheries jobs in terms of full-time equivalents (Figure 1).

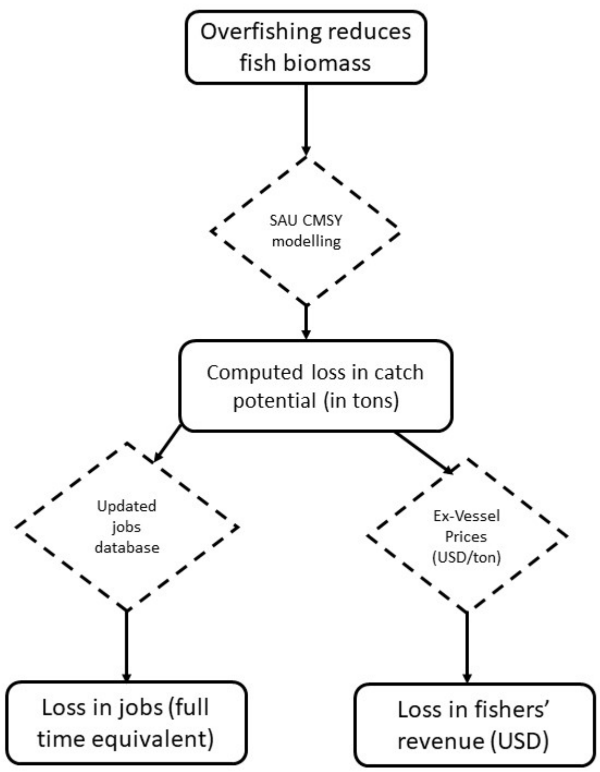


Figure 1. Framework for assessing the socio-economic impact of overexploiting marine fish stocks. Diamonds indicate data and analysis process, while rectangles indicate analysis inputs and outputs.

2.1. Quantifying catch loss

We calculate catch loss as the difference between the MSY of a stock and the most recent year's catch for that stock (i.e., Catch of last year, C). Note that catch data used in this analysis is reconstructed catches from the

Sea Around Us catch database (Pauly et al. 2020). Fish stock MSY and catch outputs are estimated using the CMSY++ method (Froese et al. 2021). Categorisation of the status of fish stocks is based on the stock abundance data included in the Global Fishing Index (Minderoo Foundation, 2021b). For this study, we focus only on catch losses when MSY is greater than the estimated catch for a stock. Additionally, we report to what extent stocks currently have catch exceeding MSY, which can be expected to lead to overexploitation of these stocks; these are presented in the report appendices.

The focus of this analysis is to identify the catch loss that occurs as a result of overexploitation of fish stocks, for e.g., when the biomass of a fish stock is too low to enable the MSY from being generated. Therefore, in this analysis we explore the catch loss for stocks that have been identified as 'overfished' in the GFI. Stock sustainability in the GFI is defined in line with the FAO classification using abundance-based reference points; thus, a stock is defined as overfished when its current biomass is less than 40 percent of its unfished biomass (Minderoo Foundation 2021b). In cases where stocks are assessed based on spawning stock biomass (SSB)[1], a stock is classified as 'sustainable' if SSB is equal or greater than 20% of the unfished level of SSB.

It is noted that a catch loss can also occur when, due to regulatory or other social or economic reasons, the stock is not being fished even though there is sufficient biomass. In the case of the 445 fish stocks identified as 'sustainable' in the Global Fishing Index, the catch of last year (C), was on average, 3-17%[2] below MSY (Appendix 1), thereby suggesting that some fish stocks may not be fully fished at MSY even when their populations are at sustainable levels. Thus, in order to determine whether catch losses for the 'overfished' stocks assessed here can be attributed to overexploitation of the stock, we also examine catch loss trends in terms of current fishing effort (F/F_{MSY}) and biomass relative to unfished biomass (B/B0). We expect high fishing mortality ($F/F_{MSY}>1$) to correspond with a smaller catch loss compared to low fishing mortality because more catch is being taken. We also expect a higher biomass relative to unfished biomass (B/B_0 range of 0.2-0.4) to correspond with a smaller catch loss compared to lower B/B_0 because all things being equal, there is more biomass to support higher catches.

Our analysis uses the following variables, which are taken from the GFI assessment and are all outputs of the CMSY++ model:

- MSY (Maximum Sustainable Yield): The annual maximum sustainable level of all catch (in tonnes) of the associated stock as determined by the CMSY assessment of the stock;
- C (Catch of last year): The total catch (in tonnes) of the stock in the latest year of the assessed time series (2018);
- B/B_0: Biomass at the time of assessment relative to that of the unfished biomass. Where available, official estimates from national fishery agencies are used instead of the CMSY++ output; and
- F/F_{MSY}: Fishing mortality relative to the fishing mortality at MSY to achieve sustainable catch.

Here we investigate catch loss as a result of overexploitation at a global, regional, and national level. The GFI database consisted of 1,439 stock assessments, of which 929 fish stocks (i.e., 453 unique species) had CMSY++ data available to run this analysis. Of these 929 stocks, 482 (52 %) were categorised as 'overfished' with a geographical coverage that spans 179 EEZs in 124 countries and territories. The regional groupings and

[1] Spawning stock biomass refers to the total weight of individuals in a stock that are old enough to reproduce.
[2] The range of 3-17% corresponds to an upper bound average Catch to MSY ratio of 0.97 (i.e., 3% below MSY) and lower bound average ratio of 0.83 (17% below MSY). The lower bound ratio excludes one outlier stock (the Sahelian stock of *Mustelus mustelus*) for which the Catch to MSY ratio was 65.9.

number of assessed stocks per region is summarised in Table 1, while the countries within each region is provided in Appendix 2.

Table 1. Regional summary of number of stocks and overfished stocks included in this analysis. Note that regional total and overfished stocks exceed 929 and 482 because some stocks occur in more than one region.

Region	No. of stocks		
	All stocks	Overfished stocks	C (Catch of last year) (in 10^3 t)
Central, Southern Eastern & Southeast Asia	264	114	8,234
Europe and North America	321	188	3,749
Latin America and the Caribbean	158	73	1,829
Northern Africa and Western Asia	169	96	3,438
Oceania	95	40	659
Sub-Saharan Africa	134	64	2,914

2.2. Estimating revenue loss

We estimated the revenue loss arising from catch loss by multiplying the amount of catch loss by the ex-vessel price of each stock to obtain the landed value of catch loss (landed value = ex-vessel price x catch loss quantity). Ex-vessel price refers to the price that fishers receive directly for their catch, or the price that is paid for the catch when it first enters the supply chain (Tai et al. 2017). Ex-vessel prices are extracted from the Fisheries Economics Research Unit's global ex-vessel price database (Sumaila et al. 2007; Swartz et al. 2013, Tai et al. 2017;), which contains over 60,000 reported prices spanning 1950-2010. These prices, which are sourced from government agencies, websites, published and grey literature, are applied to a country-product dummy model (Swartz et al. 2014) to estimate 'missing' prices in order to provide ex-vessel prices for unique taxon-country-year records of catch listed in the Sea Around Us catch database. In total, the price database contains estimated ex-vessel prices for over 1,031,000 unique taxon-country-year records of catch destined for human consumption, fishmeal, and fish oil production. As ex-vessel prices are reported by taxa and EEZ instead of by fish stock, a single fish stock can have multiple prices if it occurs in more than one EEZ; consequently, the landed value of catch loss per fish stock is equivalent to the summed up EEZ specific landed values of the fish stock.

$$LV_x = \sum_{n=1}^{n=n} G_n \times p_n$$

Where LV_x is the landed value of the MSY-Catch catch loss G of fish stock x
G_n is the EEZ adjusted catch loss (in tonnes) allocated to each EEZ n in which stock x occurs,
$G_n = \frac{C_n}{C_t}$, C_n is the average annual catch (1990-2018) of stock x in EEZ n, C_t is the total catch of stock x across n EEZs.
p_n is the ex-vessel price of stock (taxa) x in EEZ n.

2.3 Estimating number of jobs associated with catch loss

The number of jobs was calculated at a country level, as there was no employment data available by fish stock. This was a two-step process where first, we estimated marine employment globally, updating an existing dataset of fisher employment values (Teh and Sumaila 2011). Second, for each country we calculated a catch per fisher value by dividing the estimated number of fishers by total marine fisheries catch caught by the respective country. The estimated catch loss was then multiplied by catch per fisher to obtain the number of jobs associated with that amount of catch loss.

Marine employment

Marine employment is defined as the number of jobs in the direct and indirect fisheries sectors, whereby direct is the primary fishing sector inclusive of reported and unreported fishers in the artisanal, subsistence, and industrial sectors, and indirect is workers in the ancillary sector. While subsistence fishers are not part of the formal working force, we include them in this analysis because the reconstructed fish catch data, upon which our catch loss estimates are based, are inclusive of subsistence catch. The methods for updating the marine employment dataset followed the process as outlined in Teh and Sumaila (2013). Generally, estimates are based on reported values from the FAO, to which additions are made to account for unreported fishers, in particular the small-scale sector, based on evidence from the primary and grey literature. We then converted the final estimated number of fishing jobs to full-time equivalent (FTE) units to standardise across the different lengths of time spent fishing, for example the difference between a part-time artisanal fisher who has a second income source and a full-time industrial fisher. Figure 2 provides a step-by-step guide of this process.

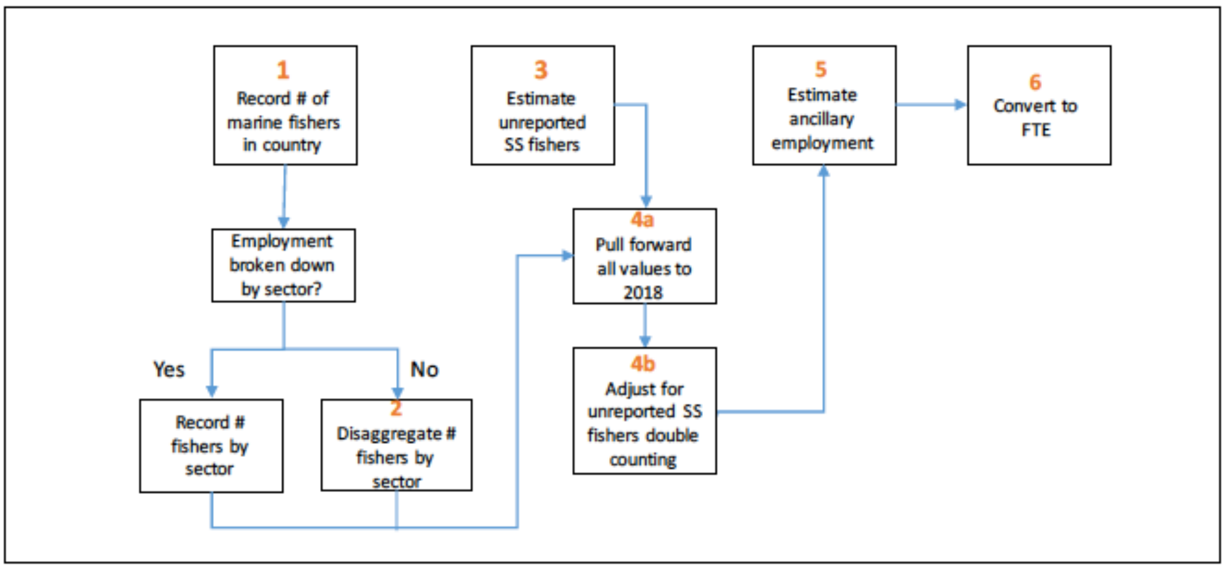


Figure 2. Schematic diagram of steps taken (starting at 1) to estimate marine fisheries employment in each country.

Step 1: Record number of reported marine fishers in the country, including citizens and foreign workers engaged in fisheries; fishers in artisanal, subsistence, and industrial sectors; full-time and part-time; licensed and unlicensed. Excluded are workers in aquaculture, inland fisheries, and recreational fishing for leisure.

Step 2: If fishing employment is not broken down by sector, estimate the proportional contribution of the artisanal, subsistence, and industrial fishing sectors using a benefit transfer method, whereby the sectoral breakdown of countries with data are applied to countries without data according to their geographical location and Human Development Index ranking.

Step 3: Account for unreported small-scale fishers (i.e., those not enumerated in national statistics or labour workforce surveys) using a percentage of a country's coastal population that fishes as a proxy. The coastal fishing population of countries grouped by geographical location and Human Development Index is extracted from Teh and Sumaila (2011).

Step 4a: Standardise all marine employment data points to the base year of 2018. Statistics from other years are pulled forward (if data are from years before 2018) or pushed back (if data are from years after 2018) using national population change percentages between 2018 and the year that the data was recorded.

Step 4b: Adjust for double counting small-scale fishers by subtracting the reported number of small-scale fishers from the estimated number of unreported fishers. We assume that all unreported fishers occur in the small-scale sector.

Step 5: Add employment from economic activities in the ancillary sector, including secondary activities such as fish processing and tertiary services such as marketing, using indirect to direct employment ratios from Teh and Sumaila (2011).

Step 6: Convert number of jobs to their Full-time Equivalent (FTE) units based on approximate time equivalencies from the literature. The conversion factors (# of jobs equivalent to 1 FTE) are:
a) Artisanal 0.3; Subsistence 0.13; Industrial full-time 1; Industrial part-time 0.5.

Catch rate

Total marine fisheries catch by fishing country in 2018 were extracted from the *Sea Around Us* database. Catch by fishing country includes catch taken from a country's own EEZ, as well as foreign EEZs if the country's fishing fleet fishes in international waters. Total catch is inclusive of those by the artisanal, subsistence, and industrial sectors; landed at port and discarded at sea; reported and unreported; and intended for direct human consumption, processing into fishmeal and fish oil and other end uses. Total marine fisheries catch was divided by the number of full-time equivalent fishers in the primary sector to obtain catch rate (t/FTE) in each country.

Jobs associated with catch loss

The number of jobs associated with catch loss in a given country was calculated by dividing the catch loss (section 2.1) by the catch rate to obtain number of FTE fishers. A catch loss implies the potential for increased fishing employment, assuming that once fish stocks recover, new fishers will enter the fishery to catch the rebuilt biomass. To account for this, we divided the number of FTE fishers lost by the number of FTE fishers in 2018 to yield a ratio of potential new fishing jobs to existing fishing jobs. On the flip side, cases where a stock's catch currently exceeds MSY indicates active overfishing and the need to remove excess fishing effort. This was calculated using the same method as job gain, i.e., by dividing the current catch from overfishing (MSY – Catch) by the catch rate to obtain number of FTE fishers, and then dividing the 'excess' FTE fishers by the number of FTE fishers in 2018 to get a ratio of potential future lost jobs to existing fishing jobs.

3. Results

3.1 Catch loss

Global

We found that catch loss occurred, to some degree, in 83% (i.e., 399 of the 482) of overfished fish stocks. For the remaining 17% of overfished stocks, catches exceed MSY, indicating active overfishing (Appendix 3). Total catch loss summed across all overfished stocks was 15 million t. MSY across all overfished stocks was 28.7 million t, meaning that around 51% of MSY was caught.

The top 10 stocks with largest losses consist mainly of smaller forage species, with four stocks of *Sardinops sagax* (South American pilchard) among the top 10 (Table 2). Most stocks in Table 2 have very low relative biomass, with some at levels considered to be collapsed (i.e., below 20 percent of B/B_0). The large losses for forage species such as *Sardinops sagax* and *Sardinops melanostictus* may be due to the cyclical fluctuations in stock biomass that is characteristic of small pelagic fishes (Alheit and Peck 2019). To address this, we also estimated catch loss using an annual average catch for the period 1990-2018. For stocks with the largest catch loss (Table 2), calculating catch loss using the annual average catch (1990-2018) and Catch of last year (C) resulted in generally comparable quantities. In order to remove the effect of total stock size on the quantity of catch loss (i.e., larger stocks may have higher MSY and/or catches), we calculated catch loss as a percentage of MSY. The catch loss of the top 2 stocks (South American pilchard and capelin) was 100% of MSY. In contrast, the percentage was less than half (41% and 45%) for Japanese flying squid and Japanese anchovy (Table 2).

Table 2. Top 10 stocks with largest catch loss (MSY>C)

Stock name	Scientific name	Common name	B/Bo	Catch loss (000 t)		Catch loss/ MSY
				MSY-C	MSY-Ann avg*	
sard_sag_panamaguayaquilc peru	*Sardinops sagax*	South American pilchard	0.05	2,013	1,447	100
mall_vil_northseanorwaybare nts	*Mallotus villosus*	Capelin	0.10	1,874	1,696	100
sard_mel_east coast of Japan	*Sardinops melanostictus*	Japanese pilchard	0.16	1,547	1,646	77
sard_sag_chile	*Sardinops sagax*	South American pilchard	0.07	934	873	100
sard_sag_namaquaagulhasna taldelagoa	*Sardinops sagax*	South American pilchard	0.23	782	692	91
ther_cha_japansea	*Theragra chalcogramma*	Alaska pollock	0.11	634	209	56
toda_pac_nwpacific	*Todarodes pacificus*	Japanese flying squid	0.31	325	781	41
sard_sag_scaliforniawmexico	*Sardinops sagax*	South American pilchard	0.16	306	53	74
engr_jap_echinayellow	*Engraulis japonicus*	Japanese anchovy	0.36	283	434	45
Cras_vit_virginian	*Crassostrea virginica*	Eastern oyster	0.08	257	258	86

*Ann avg = annual average EEZ catch from 1990-2018

Regionally focused results

Europe and North America had the largest estimated catch loss, followed by Latin America and the Caribbean. In contrast, the estimated catch loss in Northern Africa and Western Asia and Oceania was an order of magnitude lower, at less than 100,000 t (Table 3). The large catch loss for Latin America and the Caribbean is driven mainly by *Sardinops sagax* caught in Chile, Peru, and Ecuador (Table 4). Forage species – Japanese pilchard (*Sardinops melanostictus*), North Sea capelin (*Mallotus villosus*), and sardine (*sardinops sagax*), are the main stocks driving the large losses for Eastern Asia, Northern Europe, and Sub-Saharan Africa, respectively. In Southeastern Asia, other pelagics such as frigate tuna (*Auxis thazard*) have the largest catch loss. At the EEZ level, the largest potential catch losses are also driven by small pelagics (Table 4).

Table 3. Catch loss by region, ranked from largest to smallest catch loss.

Region	**Catch loss (000 t)**
Europe and North America	4,480
Latin America and the Caribbean	4,164
Central, Southern, Eastern and Southeast Asia	3,791
Sub-Saharan Africa	1,564
Northern Africa and Western Asia	61
Oceania	39

Table 4. Top catch loss by EEZ showing the stocks with the largest losses and the B/B_0 for each stock

EEZ	**Catch loss (000 t)**	**Stock with the largest catch loss**	**B/B_0**
Japan (main islands)	2,388	engr_jap_echinayellow (*Engraulis japonicus*)	0.36
Peru	1,795	sard_sag_panamaguayaquilcperu (*Sardinops sagax*)	0.05
Norway	1,695	mall_vil_northseanorwaybarents (*Mallotus villosus*)	0.10
Chile (mainland)	1,524	sard_sag_chile (*Sardinops sagax*)	0.07
Russia (Far East)	751	ther_cha_japansea (*Theragra chalcogramma*)	0.11
Namibia	623	loph_vom_namib (*Lophius vomerinus*)	0.16
Canada (East Coast)	452	cory_rup_canadaeastcoast (*Crassostrea virginica*)	0.04
Philippines	382	auxis_philippines (*Auxis* spp.)	0.31

FMSY and B/B_0 indicators

Overfishing occurred in 65% of the 482 assessed stocks ($F/F_{MSY}>1$). There was a significant difference in the average catch loss for stocks with high fishing mortality ($F/F_{MSY}>1$) vs. low fishing mortality ($F/F_{MSY}<1$) (Table 5). A smaller catch loss corresponds with high fishing mortality, which makes sense because it indicates that more catch is being taken relative to low fishing mortality. Stocks with a smaller biomass relative to unfished biomass (B/B_0 range of 0-0.2) had a significantly larger catch loss than stocks with a B/B_0 range of 0.2-0.4 (Table 5).

Table 5. Average catch loss (MSY – C) of fish stocks under different levels of fishing indicators.

	F/F_{MSY}		**B/B_0**	
Indicator level	>1	<1	0.2-0.4	0-0.2
Avg catch loss	17.0	52.8	12.9	50.1
t-stat	-2.32		-2.53	
Df	479		479	
P value	0.02		0.01	

Note that B/B_0 levels are 0-0.2 and 0.2-0.4. The t-test compares means of the catch loss between levels of each indicator.

3.2 Revenue loss: Landed value of catch loss

Globally focused results

The landed value (LV) associated with the catch loss of all overfished stocks assessed was estimated at US$15.4 billion, which is equivalent to 10% of global fisheries catch landed value of US$155 billion in 2018 (Sea Around Us 2022). This suggests that worldwide, US$15.4 billion is lost annually due to fish stocks not being managed at MSY level. The top 10 stocks with the highest loss in LV are summarised in Table 6. Together, these top 10 stocks accounted for 41% of total LV loss for all stocks.

Table 6. Top 10 stocks with highest catch loss landed value (USD), overfished stocks only.

Stock name	Scientific name	LV of catch loss (million USD)
mall_vil_northseanorwaybarents	*Mallotus villosus*	1,054
loph_vom_namib	*Lophius vomerinus*	1,052
sard_sag_panamaguayaquilcperu	*Sardinops sagax*	1,022
sard_mel_east coast of Japan	*Sardinops melanostictus*	687
sard_sag_chile	*Sardinops sagax*	569
sard_sag_namaquaagulhasnataldelagoa	*Sardinops sagax*	448
ther_cha_japansea	*Theragra chalcogramma*	411
cras_vir_virginian	*Crassostrea virginica*	401
engr_jap_echinayellow	*Engraulis japonicus*	377
loph_vom_namaqua	*Lophius vomerinus*	338

Regionally focused results

Europe and North America had the largest catch loss LV, driven mainly by the LV for capelin (*Mallotus villosus*) and Alaska pollock (*Theragra chalcogramma*). The regional trend in catch loss LV generally follows that of catch loss quantity (Table 7). At the EEZ level, Japan, Namibia, and Chile have the highest catch loss landed values (Table 8). The top 10 EEZs in terms of catch loss LV accounted for 62% of total LV.

Table 7. Landed value of catch loss by region (overfished stocks only) and main contributing fish species to total landed value.

Region	Sum of LV of catch loss (Billion USD)	Main taxa/species
Europe and North America	4.7	*Mallotus villosus, Theragra chalcogramma, Crassostrea virginica*
Central, Southern, Eastern and Southeast Asia	3.9	*Engraulis japonicus, Sardinops melanostictus, Todarodes pacificus*
Latin America and the Caribbean	3.2	*Sardinops sagax*
Sub-Saharan Africa	2.9	*Lophius vomerinus*
Northern Africa and Western Asia	0.5	*Trachurus mediterraneus*
Oceania	0.2	*Hoplostethus atlanticus, Jasus edwardsii*

Table 8. Landed value of catch loss by EEZ (overfished stocks only).

EEZ	LV of catch loss (Billion USD)
Japan (main islands)	1.81
Namibia	1.80
Chile (mainland)	1.05
Norway	1.01
Peru	0.96
Canada (East Coast)	0.63
Italy (mainland)	0.58
USA (East Coast)	0.57
Russia (Far East)	0.57
China	0.56

3.3 Marine employment associated with catch loss

Marine employment

Global[3] marine employment totalled 13 million full-time equivalent (FTE) fishers in 2018 (see Appendix 4 for complete list), with the vast majority (87%) concentrated in Central, Southern, Eastern and Southeast Asia, and least in Europe, North America (2%), and Oceania (<1%) (Table 9). Where they occurred, unreported fishers on average accounted for 54% of the total estimated number of fishers.

Table 9. Average marine employment in 2018 in full-time equivalent (FTE) units by region.

Region	FTE
Central, Southern, Eastern and Southeast Asia	737,147
Sub-Saharan Africa	33,048
Latin America and the Caribbean	29,294
Northern Africa and Western Asia	26,219
Europe and North America	16,118
Oceania	5,367

Catch rate per FTE fisher

The global total average catch rate is 44 t/FTE, with sector specific average catch rates of 7.1 t/FTE, 9.2 t/FTE, and 216 t/FTE for the subsistence, artisanal, and industrial sectors respectively. One third of all countries had catch rates of 5 t/FTE or less and 20% had catch rates higher than 50 t/FTE (Figure 2). Regionally, the lowest catch rates per FTE were in Asia and the Pacific Islands while highest catch rates per FTE were found in Northern Europe and North America (Table 10). Nordic countries (and Greenland) accounted for 4 of the top 10 countries with highest catch rates per FTE.

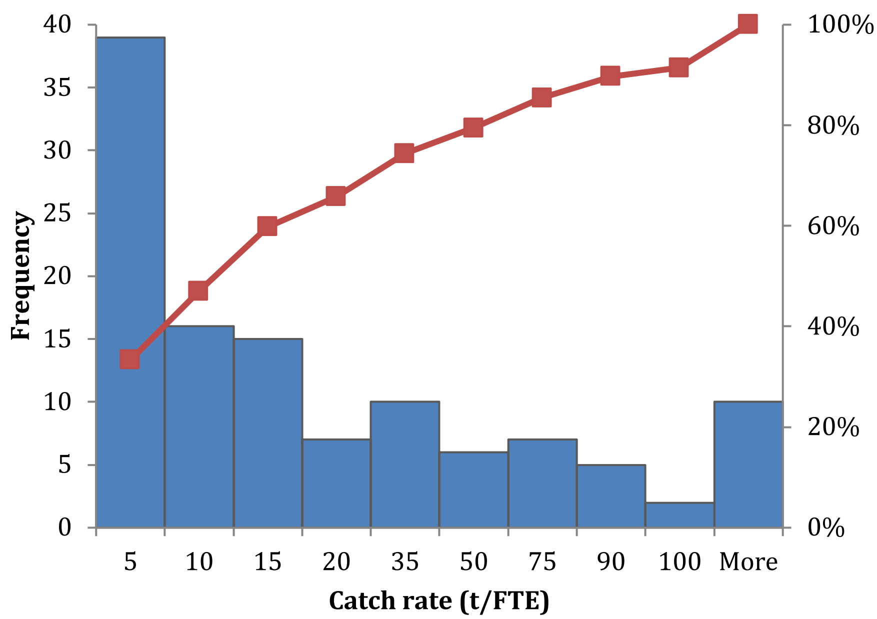


Figure 3. Distribution of catch rates with country count on the primary axis and cumulative % tracked by the solid line on the secondary axis.

[3] Global = all countries included in this study

Table 10. Average total catch rate per FTE by region.

Region	Catch rate (t/FTE)
Europe and North America	122
Oceania	56
Latin America and the Caribbean	33
Sub-Saharan Africa	19
Northern Africa and Western Asia	14
Central, Southern, Eastern, and Southeast Asia	11

Marine employment gains and losses

A total of 668,479 FTE jobs worldwide were associated with the estimated catch loss of 15 million t (Appendix 5). This indicates that all regions could potentially gain fishing jobs from fishing at MSY, with highest potential gains of 24% (relative to current employment) in Latin America and the Caribbean and lowest overall gains in Northern Africa and Western Asia (7%). We removed the highest value (Slovenia in Southern Europe, 418%) from the analysis as it was more than 10 times above the upper outlier fence; its inclusion would increase the overall average of Europe and North America from 17% to 32%.

Fishing above MSY (i.e., actively overfishing) was associated with an estimated 49,157 FTE jobs (Appendix 5). These current jobs could translate to potential future job losses if overfished fish stocks were fished to MSY only. These potential job losses were expected to occur in all regions, except Europe and North America, with highest job loss (relative to current 2018 jobs) estimated to occur in Africa (Sub-Saharan Africa 8%; Northern Africa and Western Asia 7%) (Table 11). Relative job gains tended to outnumber relative job losses in regions where both job gains and losses occurred. The countries with highest relative job loss (56%; Guinea-Bissau) and highest job gain (113%; Namibia) are both in Sub-Saharan Africa.

Table 11. Estimated future job gains and losses associated with catch loss and fishing above MSY, respectively. Gains and losses (brackets) are expressed as the ratio of jobs gained/lost relative to total number of jobs in 2018.

Region	Job gain	Job loss
Latin America and the Caribbean	0.24	0.01
Sub-Saharan Africa	0.17	0.08
Europe and North America	0.17	
Oceania	0.14	0.06
Central, Southern, Eastern and Southeast Asia	0.09	0.01
Northern Africa and Western Asia	0.07	0.07

4. Discussion and Conclusion

The objective of this study was to estimate the amount of catch, revenue, and job loss due to overfishing fish stocks. A recent study found that across assessed stocks globally, about 5% of potential catch is currently being forgone due to overfishing, whereas about 20% is being forgone due to 'underfishing' (i.e., fishing effort is below the level needed to catch MSY) (Melynchyk et al. 2020). The premise of our analysis is that the MSY is not being caught due to overfishing, which results in a low stock biomass that cannot support the MSY level. As such, we focus our analysis on fish stocks that are assessed as 'overfished' in the GFI because it increases the likelihood that a low catch is driven by low stock biomass.

The MSY is a globally used indicator for measuring fisheries sustainability (e.g., by the United Nations Sustainable Development Goals); within this context, our estimate indicates that up to 15 million t of fish catch is potentially lost annually due to the MSY not being caught. The estimated 15 million t of catch loss represents about 14% of reconstructed marine fish catch of 109.3 million t in 2018 (Pauly et al. 2020), and is within the 7 to 36% range that Srinivasan et al. (2010) found. As there is a lack of fisheries monitoring and stock assessments in many countries, the catch loss estimated here is likely conservative. At the same time, we are cautious that forgone catch can result from 'underfishing' instead of overfishing (Melnychuk et al. 2020). To address this, we calculated the ratio of the most recent year catch (C) to MSY for stocks assessed as sustainable in the GFI. Across sustainable stocks, the average C to MSY ratio ranged from 0.83 to 0.97, indicating that the MSY is not always caught even for sustainable stocks. While we do not pursue the reason for why the MSY level is not caught, this fishing below MSY suggests the possibility that our estimated catch loss of 15 million t may not be fully caught, even if the overfished stocks are rebuilt to a biomass that can produce MSY.

Our analysis implies that the stocks with the biggest losses are those that are in worst shape; this rationale is supported by the top 10 fish stocks with largest losses, because these stocks have a history of being overfished, e.g., Peruvian sardine collapsed in the 1990s, and North Sea Barents capelin collapsed twice in 20 years during the 1980s and 1990s period. At the same time, stocks such as southern and western zone stocks of Australian orange roughy may not have a large catch loss, but are so depleted that the ratio of the catch loss to MSY is close to 1. Indeed, Australian orange roughy catches fell drastically in the 1990s (Branch 2001), and the southern and western zone stocks are still assessed as Depleted (Emery 2021) (see Box 1).

The top 10 stocks with largest estimated catch losses also have a low B/B0, which is an indication that the stocks have been overfished. However, we have to be careful with attributing the large losses for forage species such as *Sardinops sagax* and *Sardinops melanostictus* to overfishing as the low catch levels may be due to the cyclical fluctuations in stock biomass that is characteristic of small pelagics. To investigate whether the large catch losses for small pelagics were due to the population going through a cyclical dip, we also estimated catch loss (MSY – C) using annual average catch over the time period 1990-2018, thus taking into account historic catches, instead of the most recent year catch. In general, the catch losses estimated using annual average catch for the period 1990-2018 are larger than that estimated using the most recent year catch (C) (i.e., historic catches were lower than current catch), thus indicating that the large catch losses may not be due to the population currently going through a low point in the cyclical fluctuation. The large catch losses observed for forage species across different regions also has important food security and nutritional implications, as small pelagics are widely consumed in many developing countries (Tacon and Metian 2009) (see Box 2).

An important assumption of our analysis is that the catch loss can be attributed to the stock being overfished, or having been overfished in the past and not having recovered, hence resulting in a low current biomass. Examining the MSY – Catch loss in relation to F/F_{MSY} appears to support this assumption, as stocks experiencing overfishing ($F/F_{MSY}>1$) have a significantly smaller catch loss than those with $F/F_{MSY}<1$ *(higher fishing effort resulting in higher catch and therefore smaller catch loss*). In addition, the catch loss for stocks with a lower B/B_0 is significantly larger than a higher B/B_0. Again, this is consistent with our rationale that a large catch loss coincides with low stock biomass due to overfishing.

We estimated that catch losses had a landed value of US$15.4 billion, which implies that annually, overfishing potentially costs fishers US$15 billion in lost revenue. This has serious social, economic, and health consequences for fishers' households and coastal communities. Moreover, the total economic effect of this potential revenue loss is much larger than US$15 billion, given that the indirect and induced economic impact of fisheries (i.e., upstream and downstream economic activities such as boat building and fish processing) can amount to 3 times larger than the landed value of catch (Dyck and Sumaila 2010 and see estimated economic impact of catch loss in Appendix 5).

The collapse of fish stocks has severe impacts on jobs and livelihoods (Warren and Steenbergen 2021). Driven by a high regional catch loss (second after Europe and North America), our analysis indicates a 20% gain in jobs in Latin America and the Caribbean if fishing at MSY was possible. The primary stock driving the current large catch loss in Japan (the EEZ with highest catch loss) is the East China Sea and Yellow Sea stock of Japanese anchovy (*Engraulis japonicus*), which is primarily caught using purse seines, and is also one of the most commercially important species in Japan (Yatsu 2019). However, while the recovery of this stock shows large potential job gains, it is also important to recognise that small pelagic fisheries are highly cyclical and subject to sudden collapses (Muko et al. 2018). This uncertainty must be taken into account when considering the estimated job gains, given that the top 10 stocks with largest catch losses are predominantly small pelagics. It is particularly relevant to Japan, which is already struggling with a declining fishing population that is undermining the viability of Japanese fishing communities and culture (Li and Namikawa 2020; Teh et al. 2021;).

Due to the lack of employment data at the fish stock level, our job analysis was done at the country level and may not reflect the crucial livelihood role of certain stocks. For instance, the disastrous collapse of northern cod in Newfoundland, Canada during the 1990s alone resulted in around 19,000 fishers and plant workers losing their jobs, while another 20,000 jobs were either lost or affected in the ensuing economic turmoil (Mason 2002). Preventing fishery collapse in the first place is therefore critical to avoid job losses.

Around 16% of the assessed fish stocks have catches that exceed MSY; these stocks generally have higher B/B0 than those incurring a catch loss, which is consistent with the rationale that biomass levels of these stocks are sufficiently high to enable larger catches. However, catching above the MSY is not a good sign as it is likely that catches and hence jobs will decrease in the future once the stock falls below a given threshold. While the LV associated with catching in excess of the MSY is around US$1.3 billion, and is not interpreted as a current economic loss, it is questionable if these economic benefits can continue into the future if the LV is not invested in managing the fish stock since the current LV arises from catch that is over and above the sustainable yield.

Our results highlight the importance of rebuilding overfished fish stocks such that current catch losses can be turned to future benefits (Sumaila et al. 2012; Sumaila 2004). In particular, it emphasises the important role of co-operative regional fisheries management, as many of the assessed fish stocks occur across multiple EEZs. Removing excess fishing effort is crucial for reversing the prevailing trend of overfishing, and tools such as marine protected areas, gear restrictions, and the use of economic incentives have been widely used to reduce fishing effort, albeit with varied results. In addition, successful rebuilding strategies also have to incorporate human and social considerations in order to increase the legitimacy of management policies among resource users and stakeholders, e.g., through co-management and human rights-based governance arrangements (Armitage et al. 2009; Cohen et al. 2019; Gutierrez et al. 2011;).

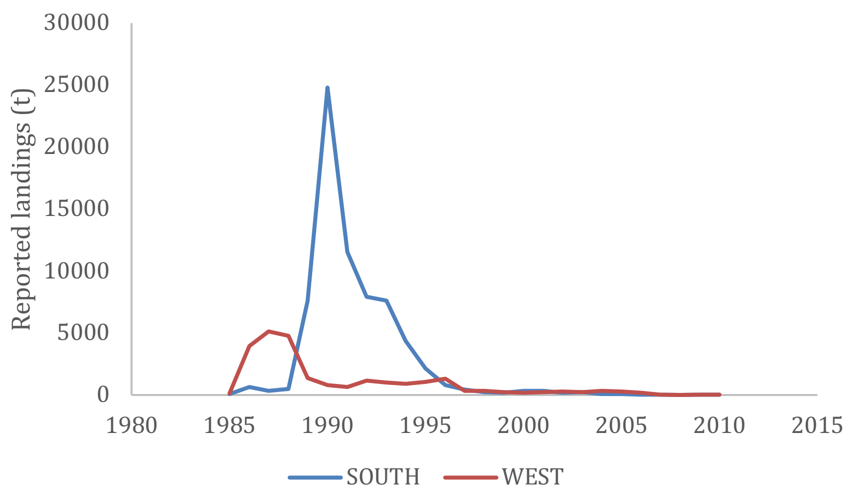
Nevertheless, there will be instances where fish stocks fail to recover despite being protected under conservation measures. Several rockfish species in British Columbia, Canada have not rebuilt even after being protected within fishing conservation areas for up to 7 years (Haggarty et al. 2016). As well, the western and southern zone stocks of Australian orange roughy are still considered to be depleted despite fishery closures resulted in the cessation of fishing since the mid-2000s (Emery 2021). Changes in climate conditions can have unexpected impacts on marine ecosystems and fish stocks, thereby also thwarting expected management outcomes (Grafton 2010). This re-emphasises the need to have strong precautionary polices in place to prevent overfishing, rather than reactionary management after fish stocks collapse (Mumby et al. 2017).

To conclude, this study shows that society may be losing up to an estimated 15 million t in potential marine fisheries catch per year due to overfished fish stocks. This catch loss potentially results in around US$39 billion in lost landed value globally, and is associated with an estimated 668,479 full time equivalent jobs. To recoup these economic benefits and thereby achieve Infinity Fish (Sumaila, 2021), steps should be taken to rebuild overfished fish stocks in order to secure livelihoods, income, and food security for coastal communities worldwide. In light of the poor progress countries are making towards achieving sustainable fish stocks (Teh et al. 2017; Minderoo Foundation 2021a), this study contributes an impetus for countries to act to improve fisheries management, or else face the risk of huge socio-economic losses.

Box 1. Australian Orange roughy case study

The south and western zone Australian stocks of orange roughy (*Hoplostethus atlanticus*) illustrate an all too familiar story of discovery followed by rapid overexploitation and subsequent collapse of a highly valuable but vulnerable fish. This has led to depleted stocks that have failed to rebuild, thereby resulting in ecological as well socio-economic loss.

Being a large, long-lived, slow maturing deep-sea species, which forms large spawning aggregations, the orange roughy has a vulnerable life history which makes it susceptible to overfishing. Orange roughy in Australia were first recorded in the early 1970s and commercial bottom trawl fishing started in the early 1980s, with catches increasing significantly in 1989 after the discovery of a large spawning aggregation off eastern Tasmania. Catches peaked to around 35,000 t in 1990, and decreased rapidly to less than 5,000 t in 1994. Figure 1 shows the trend in recorded landings for the south and western zone stocks. After peaking, annual catches of around 2,000 t were maintained until 2006, when orange roughy was listed as a conservation dependent species under the Australian Environment Protection and Biodiversity Conservation Act 1999. This resulted in the closure of most fishing areas in order to allow the stocks to rebuild, which at that time had decreased to around 16% of virgin biomass levels (Tuck 2007).



Box Figure 1. Reported landings for the south and western zone orange roughy. Source: data from Kloser et al. (2012).

Orange Roughy is now managed under a rebuilding strategy, and is assessed as six biological stocks. However, there have been no recent stock assessments for the southern and western zone stocks, and the last assessment was conducted in 2000 and 2002, respectively. Unlike orange roughy stocks in the eastern zone, which have shown signs of recovery (Kloser et al. 2015; Emery 2021) both the south and western stocks have not. As there is no evidence that both these stocks have rebuilt to above the limit reference point, they are classified as depleted in the most recent stock status report. Consequently, only incidental catch is allowed for both stocks. For the 2019-2020 fishing season, an incidental catch allowance of 31 t and 60 t was set for the southern and western stock, respectively.

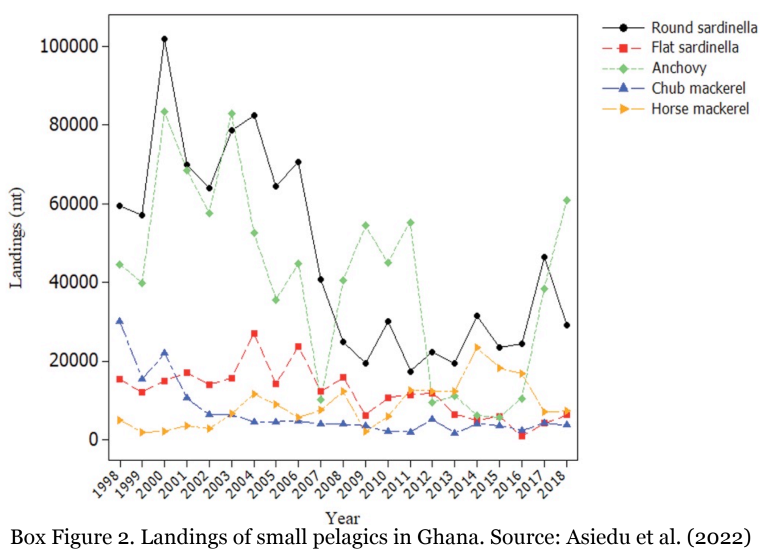
This study estimates that the catch loss for the southern and western zone stocks are 14,000 and 3,210 t, respectively. While the absolute value of the gap is not excessively large, the ratio of the gap to the MSY of both stocks is almost 1 – this reflects that almost no catch is taking place, and highlights that a lot of potential economic loss is occurring due to the failure of the stock to rebuild. Our analysis estimates this loss at US$65 million and US$14.7 million for the southern and western zone stocks, respectively.

Box 2. Northwest African *Sardinella aurita and S. maderensis* case study

Our analysis shows that five out of the top ten stocks with largest catch losses are forage species/small pelagics, which are immensely important for food and livelihoods in developing countries. A large catch loss raises concerns because although small pelagics have resilient life histories, their population levels are extremely influenced by changes in ocean climate, resulting in fluctuating distributions and abundance that are exacerbated by the impacts of fishing.

Using sardinella as an example, this case study illustrates how overexploitation of small pelagics threatens the social and economic well-being of millions along the coast of northwestern Africa. This is particularly serious given that these are some of the most vulnerable communities in the world in terms of dependence on fish for food, nutrition and livelihoods. The two sardinella stocks assessed in this study are flat (*S. maderensis*) and round (*S. aurita*) sardinella in the Sahara and Sahelian Upwelling marine ecoregions; both stocks are caught in the EEZs of the Gambia, Guinea-Bissau, Mauritania, Morocco, and Senegal. As sardinella migrate along the coastlines of these countries (Corten et al. 2017), the status of each stock will impact fisheries and associate socio-economic systems across northwest Africa.

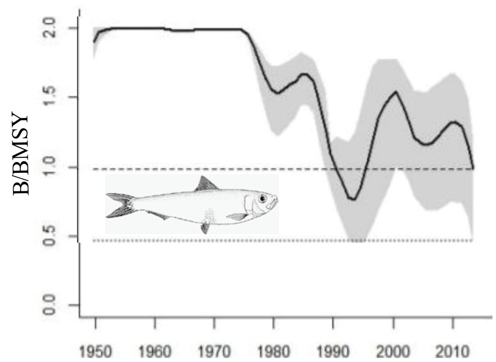
Sardinella have long been caught by both artisanal and industrial fisheries along the coast of northwest Africa; common gears include purse seine, gill nets, and beach seines (Arizi et al. 2022). These small pelagics have been extensively overexploited in northwest Africa (Arizi et al 2022, Palomares et al. 2020), and face numerous threats including destructive fishing practices, illegal, unreported and unregulated (IUU) fishing, and fishing fleet overcapacity (Asiedu et al. 2021). In the past decade, growing demand for small pelagics for use as raw material in fishmeal and fish oil production has intensified pressure on these stocks. Indeed, the number of fishmeal and fish oil factories in Mauritania grew from one in 2005 to 29 in 2015 and up to 39 in 2019 (Greenpeace 2019), while Morocco's production of fishmeal doubled between 2013-2015. This growth in the fishmeal and fish oil sector has occurred while small pelagic resources declined. For example, landings of small pelagics in Ghana steadily declined from 1998-2018 (Figure 2), with landings of *S.aurita* decreasing by 71% and *S. maderensis* decreasing by 57% due to fishing fleet overcapacity, particularly in the artisanal sector (Asiedu et al. 2022). Under this context of declining catches, the shift in usage of small pelagics for fishmeal and oil production instead of human consumption will only exacerbate food and nutrition concerns, which are already under threat from declining small pelagic stocks. For instance, in Senegal, where sardinella is a staple food, annual per capita consumption of small pelagics decreased from 18 kg in 2009 to 9 kg in 2018, with reductions in domestic fish consumption due to increased demand for exports and fishmeal processing (Deme et al. 2022).



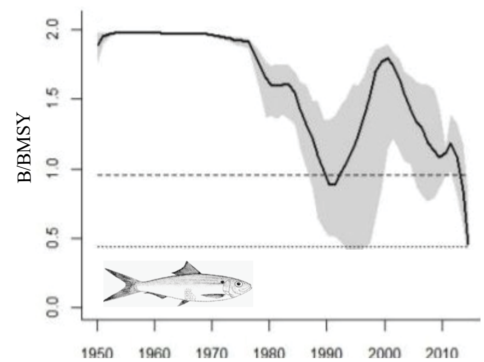
Box Figure 2. Landings of small pelagics in Ghana. Source: Asiedu et al. (2022)

Recent assessments of northwest African small pelagic stocks by the FAO found that *S. aurita* and *S. maderensis* were both overexploited (FAO 2020), while *S. maderensis* and *S. aurita* were considered overfished and grossly overfished, respectively, using the CMSY++ assessment method (Palomares et al.

2020). Our results largely confirm the depleted state of sardinella. We estimated a catch loss of 141,457 t for *S. aurita*, whereas *S. maderensis* catch was 12,552 t above MSY. Both stocks are subject to overfishing, with F/FMSY of 1.62 and 2.75 for *S. aurita* and *S. maderensis*, respectively. Taken together, these indicators reflect the current depleted state of sardinella. The higher F/F_{MSY} for *S. maderensis* indicates more intense fishing effort compared to *S. aurita*, and this is confirmed by its catch above MSY. In contrast, the catch loss for *S. aurtia* suggests that its current population size is insufficient for supporting higher catches. In fact, the biomass of both sardinella stocks have severely declined in the past two decades (Fig. 4a & b), and estimated B/BMSY using the CMSY++ method for both stocks are below 1, suggesting that both stocks are overfished and continued overfishing ($F/F_{MSY} > 1$) will only heighten the risk of pushing these stocks to the brink of depletion.



Box Figure 3a. B/BMSY of *S. aurita* as assessed using CMSY method. Source: Modified from Palomares et al. (2020).



Box Figure 3b. B/BMSY of *S. maderensis* as assessed using CMSY method. Source: Modified from Palomares et al. (2020).

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APPENDICES

Appendix 1: Ratio of Catch of last year (C) to Catch at Maximum Sustainable Yield (MSY) for each fish stock identified as 'sustainable' in the Global Fishing Index

Stock name	Scientific name	C:MSY Ratio
acan_mon_capeverde	*Acanthistius brasilianus*	1.09
acan_sol_indian	*Acanthocybium solandri*	1.04
acet_jap_sundajava	*Acanthocybium solandri*	0.69
alec_cil_persiangulf	*Acanthocardia tuberculata*	1.04
ank.27.78abd	*Aequipecten opercularis*	1.00
anod_cha_gulfoman	*Aetobatus narinari*	0.92
anod_cha_malacca	*Alopias superciliosus*	0.85
anod_cha_palawannborneo	*Alosa immaculata*	0.82
apha_car_seuroatlanticshelf	*Alosa pseudoharengus*	1.26
arct_isl_carolinianvirginianmaine	*Alosa sapidissima*	0.07
arct_jap_echinasea	*Amblyraja radiata*	0.21
argy_reg_sahelian	*Anchoa nasus*	0.80
aru.27.123a4	*Anguilla anguilla*	1.27
aru.27.5a14	*Anguilla rostrata*	0.40
auxi_roc_indian	*Anodontostoma chacunda*	1.56
auxi_tha_atlantic	*Anoplopoma fimbria*	0.80
bali_cap_usatlantic	*Archosargus probatocephalus*	1.19
bar7	*Arctoscopus japonicus*	0.98
bll.27.3a47de	*Arctoscopus japonicus*	0.99
brac_aur_gulfguineasangolan	*Argyrozona argyrozona*	1.62
brac_aur_gulfguineaupc	*Argyrosomus regius*	0.92
brot_cla_cocosislands	*Aristeus antennatus*	0.20
bucc_und_celtic	*Aristeus antennatus*	1.68
call_cap_namaqua	*Aristeus antennatus*	0.59
call_sap_virginian	*Arripis trutta*	0.63
cara_cry_bahamian	*Argentina silus*	0.56
cara_ign_ephilippines	*Argentina silus*	0.38
cara_rub_ecaribbean	*Atherina boyeri*	0.71
cent_str_ngomexfloridiancarolinian	*Atheresthes evermanni*	1.22
ceph_boe_arafura	*Aulacomya ater*	0.90
ceph_boe_nesulawesi	*Austroglossus pectoralis*	0.82
ceph_boe_papua	*Auxis thazard*	0.73
ceph_boe_sulawesimakassar	*Auxis thazard*	0.83
ceph_boe_sundajava	*Auxis genus and Auxis thazard*	0.99
cham_gal_blacksea	*Balistes capriscus*	0.87
chan_cha_yellowsea	*Thyrsites atun*	0.45
chei_nuf_delagoa	*Belone belone*	0.98
chel_kum_threekingsnenewzealand	*Molva dypterygia*	0.89
chio_opi_japansea	*Molva dypterygia*	1.29
chir_dor_arafura	*Boops boops*	0.61
chir_dor_gulfthailand	*Boops boops*	0.86
chir_dor_lessersunda	*Boops boops*	0.36
chir_dor_malacca	*Boops boops*	0.55
chir_dor_sundajava	*Boops boops*	0.83
chir_nud_persiangulf	*Bothus pantherinus*	0.96
clup_har_4sfall	*Branchiostegus japonicus*	0.79

Stock name	Scientific name	C:MSY Ratio
cod.2127.1f14	*Platichthys*	0.24
cong_con_alboran	*Callinectes sapidus*	1.16
cono_nob_brazil	*Carangoides malabaricus*	0.52
cory_hip_epacific	*Carangoides malabaricus*	0.84
cory_hip_indian	*Carangoides malabaricus*	0.95
cory_hip_mediterranean	*Caranx rhonchus*	0.33
cras_vir_floridian	*Carcharhinus falciformis*	0.82
cras_vir_ngomex	*Carcharhinus falciformis*	0.62
cyno_ana_cperu	*Carcharhinus limbatus*	1.09
cyno_ana_guayaquil	*Carcharhinus plumbeus*	0.92
cyno_gua_brazil	*Cetengraulis mysticetus*	0.91
cyno_gua_riodelaplata	*Cetengraulis mysticetus*	0.57
deca_mar_chinese waters	*Chaceon maritae*	0.01
deca_pun_gulfguineais	*Chamelea gallina*	0.55
deca_rus_philippines	*Chamelea gallina*	0.28
dent_den_tunisianpgsidra	*Chionoecetes opilio*	0.63
dent_hyp_japan, south korea and china	*Chionoecetes opilio*	1.34
dice_lab_alboran	*Cilus gilberti*	1.11
dory_gah_epatagoniansbrazil	*Clidoderma asperrimum*	0.31
dosi_gig_ecpacific	*Clupea harengus*	0.75
dosi_gig_sepacific	*Clupea harengus*	0.69
duss_acu_gulfomanpersiangulf	*Clupea pallasii pallasii*	0.83
duss_elo_sundajava	*Clupea pallasii pallasii*	1.03
elag_bip_wcpacific	*Clupea pallasii pallasii*	0.96
ele3	*Clupea pallasii pallasii*	1.26
eled_cir_adriatic	*Clupea pallasii pallasii*	0.53
eled_cir_ionian	*Clupea pallasii pallasii*	0.42
eleu_tet_arnhembonaparteexmouth	*Clupea pallasii pallasii*	0.60
eleu_tet_gbrcoralsea	*Clupanodon thrissa*	0.66
engr_anc_epatagoniasebrazil	*Gadus morhua*	0.20
engr_anc_uruguaybuenosaires	*Gadus morhua*	0.19
engr_cap_agulhasnatal	*Coilia mystus*	0.61
engr_enc_alboran	*Cololabis saira*	1.07
engr_enc_wmediterranean	*Conger conger*	0.46
engr_jap_chinese waters	*Coryphaena hippurus*	0.91
engr_jap_ephilippinespalawannborneoschina	*Coryphaenoides rupestris*	0.66
engr_jap_skuroshio	*Crassostrea virginica*	0.71
engr_rin_guayaquilcperu	*Cyclopterus lumpus*	0.75
engr_rin_humboldtian	*Cynoscion regalis*	0.68
epin_mul_arnhembonaparteexmouth	*Decapterus macarellus*	0.63
ethm_fim_gulfguineaw	*Decapterus macrosoma*	0.87
ethm_fim_sahelian	*Dentex dentex*	1.12
etru_mic_japan	*Dentex dentex*	0.72
etru_whi_namaqua	*Squalus acanthias*	0.73
euph_sup_antarctic	*Diagramma pictum*	0.99
euth_aff_indian	*Diagramma pictum*	1.30
euth_all_mediterranean	*Diapterus rhombeus*	0.93
euth_all_nwwcatlantic	*Dicentrarchus labrax*	0.67
euth_all_seuroatlanticshelfwmediterranean	*Dicentrarchus labrax*	0.84

Stock name	Scientific name	C:MSY Ratio
farf_azt_sgomex	*Dicentrarchus punctatus*	0.86
farf_cal_magdalena	*Diplodus annularis*	1.69
farf_pau_riogrande	*Diplodus annularis*	0.46
fenn_chi_echinayellow	*Diplodus sargus sargus*	1.29
fenn_ind_arafura	*Diplodus sargus sargus*	1.22
fenn_ind_banda	*Diplodus sargus sargus*	1.05
fenn_ind_halmahera	*Dissostichus eleginoides*	1.17
fenn_ind_nesulawesi	*Dissostichus eleginoides*	1.10
fenn_ind_papua	*Dissostichus eleginoides*	1.15
fenn_ind_sulawesimakassar	*Dissostichus eleginoides*	1.16
fenn_ind_sundajava	*Doryteuthis opalescens*	1.12
fenn_mer_gulfthailand	*Drepane punctata*	0.78
fist_cor_guayaquil	*Drepane punctata*	0.20
fist_cor_panamabight	*Dussumieria elopsoides*	0.19
fle.27.2223	*Anguilla anguilla*	0.41
fle.27.2425	*Eledone cirrhosa*	0.77
fle.27.3a4	*Elops lacerta*	0.51
gadu_cha_northeast japan sea	*Scomber australasicus*	0.41
gale_dec_gulfguineacis	*Scomber australasicus*	1.24
geny_bla_malvinasfalklands	*Engraulis capensis*	0.48
geny_cap_namaqua	*Engraulis capensis*	0.44
gerr_oye_eafricacoralcoast	*Engraulis encrasicolus*	1.04
gnat_spe_persiangulf	*Engraulis encrasicolus*	0.73
haem_plu_bahamian	*Engraulis encrasicolus*	0.20
haem_sci_bahamian	*Engraulis encrasicolus*	0.21
harp_neh_nbaybengal	*Engraulis encrasicolus*	1.22
harp_neh_windia	*Engraulis japonicus*	0.95
her.27.3031	*Engraulis japonicus*	1.09
hypo_mys_bahamian	*Engraulis japonicus*	0.38
isti_ind_indian	*Engraulis mordax*	0.73
isti_pla_iattc	*Engraulis ringens*	1.67
isti_pla_indian	*Epinephelus adscensionis*	0.88
isti_pla_wcpfc	*Epinephelus areolatus*	1.29
isur_oxy_satlantic	*Epinephelus coioides*	0.82
isur_oxy_spacific	*Epinephelus marginatus*	0.55
isur_oxy_swatlantic	*Epinephelus morio*	0.83
jasu_edw_cnewzealand	*Epinephelus striatus*	0.32
jma7	*Etelis coruscans*	1.26
kath_gig_cnewzealand	*Ethmalosa fimbriata*	0.87
kath_gig_snewzealand	*Ethmidium maculatum*	0.87
kats_pel_eatlantic	*Euthynnus affinis*	1.42
kats_pel_indian	*Euthynnus alletteratus*	1.50
kats_pel_philippines	*Euthynnus alletteratus*	0.92
lact_lac_gulfoman	*Euthynnus alletteratus*	0.31
lact_lac_nbaybengal	*Farfantepenaeus duorarum*	0.25
lact_lac_windia	*Fenneropenaeus merguiensis*	0.64
laem_lon_northeast japan sea	*Gadus macrocephalus*	0.40
lari_pol_chinese water	*Gadus macrocephalus*	0.92
late_cal_kg	*Gadus morhua*	0.97

Stock name	Scientific name	C:MSY Ratio
late_cal_nt	*Gadus morhua*	0.37
late_cal_palawannborneo	*Galeocerdo cuvier*	1.07
late_cal_schinaoceanic	*Galeoides decadactylus*	1.19
late_cal_sundajava	*Galeoides decadactylus*	1.20
late_jap_ckuroshio	*Galeorhinus galeus*	0.75
lepi_bil_goa	*Galeorhinus galeus*	0.34
lich_ami_sahelian	*Galeorhinus galeus*	0.73
lima_asp_aleutian	*Galeorhinus galeus*	0.81
lima_asp_ebering	*Galeorhinus galeus*	1.05
lin.27.1-2	*Galeorhinus galeus*	1.22
lin.27.3a4a6-91214	*Genypterus blacodes*	0.75
lin1	*Genypterus blacodes*	1.27
lith_mor_wmediterranean	*Glossanodon semifasciatus*	1.23
lithodes_epatagoniauruguaybuenosaires	*Haliotis midae*	0.86
lito_set_carolinian	*Heterololigo bleekeri*	0.71
lito_set_floridian	*Hippoglossus stenolepis*	0.68
lito_set_ngomex	*Hoplostethus atlanticus*	0.90
lito_sty_cortezian	*Hoplostethus atlanticus*	1.29
lito_sty_panama	*Trachurus trachurus*	0.49
lito_van_mexicantropicalpacific	*Hoplostethus atlanticus*	0.99
loba_gig_ecaribbean	*Hoplostethus atlanticus*	0.63
loph_cha_virginianmaine	*Ilisha elongata*	0.79
loph_gas_brazil	*Ilisha elongata*	0.93
loph_lit_east coast of japan	*Istiophorus albicans*	1.55
loph_vom_natal	*Istiompax indica*	0.99
lutj_ana_usatlantic	*Jasus edwardsii*	1.49
lutj_cam_carolinianvirginian	*Jasus lalandii*	0.51
lutj_joh_persiangulf	*Trachurus novaezelandiae and Trachurus declivis*	0.90
lutj_syn_nebrazil	*Kajikia audax*	1.04
macr_mag_patagoniauruguaybuenosaires	*Katsuwonus pelamis*	0.36
maka_nig_atlantic	*Konosirus punctatus*	1.06
mega_cor_arnhembonaparteexmouth	*Lachnolaimus maximus*	0.88
mega_cor_seasia	*Lactarius lactarius*	1.52
mela_aeg_5zjm	*Laemonema longipes*	1.05
meli_ker_tunisianpgsidra	*Lambis lambis*	0.34
meli_ple	*Lamna nasus*	1.25
meni_men_atlantic	*Larimichthys crocea*	0.39
merc_mer_carolinian	*Larimichthys crocea*	0.28
merc_mer_virginian	*Microstomus kitt*	0.28
merl_aus_epatagoniauruguaybuenosaires	*Lepidopus caudatus*	0.37
merl_aus_schile	*Lepidopus caudatus*	0.24
merl_cap_namaquaagulhasnatal	*Lethrinus lentjan*	0.62
merl_gayp_guayaquilcperu	*Lethrinus lentjan*	0.55
merl_hub_patagonianshelfnpatagoniangulfs	*Lethrinus miniatus*	0.70
merl_hub_uruguaybuenosairesriogrande	*Lethrinus miniatus*	0.38
merl_mer_adriatic	*Lethrinus miniatus*	0.45
merl_mer_saharan	*Lethrinus nebulosus*	0.73
meso_fra_pacific	*Lethrinus nebulosus*	0.27
micr_aus_epatagoniauruguaybuenosaires	*Lethrinus nebulosus*	0.97

Stock name	Scientific name	C:MSY Ratio
micr_fur_uruguaybuenosaires	*Lethrinus olivaceus*	0.81
micr_pou_neatlantic	*Lethrinus olivaceus*	0.87
moro_sax_atlantic	*Lichia amia*	0.36
mugi_cep_guayaquilcperuhumboldtian	*Lichia amia*	1.46
mugi_cep_schina	*Limanda aspera*	0.87
mugi_cep_sgomex	*Limanda ferruginea*	0.99
mugi_cep_wcaribbean	*Limanda ferruginea*	0.96
mull_bar_adriatic	*Limanda ferruginea*	0.69
mull_bar_aegean	*Genypterus blacodes*	0.44
mull_bar_ionian	*Lithognathus lithognathus*	0.47
mull_bar_wmediterranean	*Lithognathus mormyrus*	0.88
mull_sur_alboran	*Litopenaeus occidentalis*	1.22
mura_cin_malacca	*Litopenaeus vannamei*	0.77
must_mus_sahelian	*Lobatus gigas*	65.89
nemi_hex_arafura	*Lobatus gigas*	0.90
nemi_hex_sundajava	*Loligo vulgaris*	1.19
nemi_jap_windia	*Lophius americanus*	0.95
nep.fu.2829	*Lophius americanus*	0.69
neph_nor_celtic	*Lopholatilus chamaeleonticeps*	0.89
neph_nor_wmediterranean	*Lophius piscatorius*	0.32
netu_tha_sundajava	*Lophius piscatorius*	1.27
netu_tha_windia	*Lophius vomerinus*	1.12
obla_mel_tunisianpgsidra	*Lophius vomerinus*	1.17
obla_mel_wmediterranean	*Lutjanus analis*	0.98
octo_cya_eafricacoralcoast	*Lutjanus apodus*	1.30
octo_vul_greaterantilles	*Lutjanus argentiventris*	0.49
octo_vul_seuroatlanticshelf	*Lutjanus bohar*	0.73
octo_vul_seychelles	*Lutjanus campechanus*	1.18
octo_vul_wmediterranean	*Lutjanus campechanus*	0.61
ocyu_chr_usatlantic	*Lutjanus campechanus*	0.98
opis_ogl_brazil	*Lutjanus griseus*	0.40
orcy_uni_wmediterranean	*Lutjanus griseus*	1.27
otol_rub_gulfoman	*Lutjanus malabaricus*	0.89
otol_rub_persiangulf	*Lutjanus synagris*	0.91
page_aca_alboran	*Lutjanus vivanus*	0.92
page_aca_wmediterranean	*Macrourus berglax*	1.17
page_bel_gulfguineaupc	*Mactromeris polynyma*	0.80
page_bog_azorescanariesmadeira	*Mallotus villosus*	1.11
page_bog_wmediterranean	*Mallotus villosus*	1.11
page_ery_tunisianpgsidra	*Mallotus villosus*	1.06
pagr_aur_wv	*Marsupenaeus japonicus*	0.27
pagr_maj_ckuroshio	*Marsupenaeus japonicus*	0.16
pagr_pag_ngomexfloridian	*Melanogrammus aeglefinus*	1.44
pagr_pag_riodelaplata	*Melanogrammus aeglefinus*	0.74
pagr_pag_uruguaybuenosaires	*Melanogrammus aeglefinus*	0.65
pagr_pag_wmediterranean	*Melicertus kerathurus*	0.78
pamp_arg_gulfoman	*Mene maculata*	1.08
pamp_arg_nbaybengal	*Merluccius australis*	1.20
pamp_arg_sundajava	*Merluccius gayi gayi*	0.97

Stock name	Scientific name	C:MSY Ratio
pamp_chi_nbaybengal	*Merluccius gayi gayi*	0.98
pand_bor_iceland	*Merluccius hubbsi*	0.12
pand_mon_sfa4	*Merluccius merluccius*	1.04
panu_arg_amazonia	*Merluccius merluccius*	0.71
panu_arg_bahamian	*Merlangius merlangus*	0.75
panu_arg_ebrazil	*Merlangius merlangus*	0.79
panu_arg_ecaribbean	*Merlangius merlangus*	0.69
panu_arg_nebrazil	*Metapenaeus joyneri*	0.89
para_bra_brazil	*Metacarcinus magister*	0.88
para_col_cnewzealand	*Metapenaeus monoceros*	0.80
para_col_snewzealand	*Metanephrops mozambicus*	0.89
para_lon_adriatic	*Micropogonias furnieri*	0.53
para_lon_alboran	*Micromesistius poutassou*	0.83
para_lon_ionian	*Mugil cephalus*	1.06
para_nig_gulfoman	*Mugil cephalus*	1.45
para_nig_gulfthailand	*Mugil cephalus*	1.18
para_nig_malacca	*Mugil cephalus*	0.73
para_nig_persiangulf	*Mugil liza*	1.31
para_nig_sundajava	*Mullus barbatus barbatus*	1.24
para_oli_ckuroshio	*Mullus barbatus barbatus*	0.31
para_oli_east china sea	*Mullus barbatus barbatus*	0.75
para_oli_nehonshu	*Mulloidichthys flavolineatus*	0.73
para_oli_oyashio	*Mullus surmuletus*	0.84
para_oli_skuroshio	*Mullus surmuletus*	0.77
paro_vet_uscanadapacific	*Mullus surmuletus*	0.19
pell_har_sebrazil	*Mullus surmuletus*	0.87
pena_sem_gulfthailand	*Mullus surmuletus*	0.46
pena_sem_nbaybengalandaman	*Muraenesox cinereus*	0.55
perc_bra_sbrazil	*Muraenesox cinereus*	0.87
perc_bra_uruguaybuenosaires	*Muraenesox cinereus*	0.92
plec_leo_newcaledonia	*Muraenesox cinereus*	0.75
plec_med_saharan	*Muraenesox cinereus*	0.92
plec_med_sahelian	*Mustelus schmitti*	7.61
pleu_mon_oyashio	*Mustelus schmitti*	1.16
poly_ame_wmediterranean	*Mycteroperca bonaci*	0.92
poly_qua_gulfguineais	*Mycteroperca bonaci*	0.79
poma_jub_gulfguineas	*Mycteroperca venenosa*	0.22
poma_jub_gulfguineaupc	*Mytilus edulis*	0.53
poma_kaa_gulfoman	*Myxine glutinosa*	1.38
poma_kaa_persiangulf	*Naso unicornis*	1.07
poma_sal_ecaribbeanusatlantic	*Nemadactylus bergi*	0.32
port_pel_arnhembonaparteexmouth	*Nemipterus japonicus*	0.80
port_pel_capehowemanningtweed	*Nemipterus japonicus*	0.24
port_pel_gulfthailand	*Nemipterus virgatus*	0.79
port_pel_leeuwin	*Nephrops norvegicus*	0.78
port_pel_malacca	*Nephrops norvegicus*	0.51
port_pel_ningaloosharkbayhoutman	*Nephrops norvegicus*	0.60
port_pel_sundajava	*Nephrops norvegicus*	0.58
port_tri_skuroshio	*Netuma thalassina*	0.99

Stock name	Scientific name	C:MSY Ratio
prio_gla_indian	*Netuma thalassina*	0.37
prio_gla_ncatlantic	*Oblada melanura*	1.17
prio_gla_satlantic	*Octopus vulgaris*	0.91
prio_gla_spacific	*Octopus vulgaris*	0.90
prio_ste_cortezian	*Octopus vulgaris*	0.44
pris_fil_arnhembonaparteexmouth	*Octopus vulgaris*	0.43
pris_fil_hawaii	*Octopus vulgaris*	0.55
pris_fil_oman	*Ocyurus chrysurus*	0.96
psen_ano_echinayellow	*Opisthonema libertate*	0.18
pset_eru_nbaybengalandaman	*Orcynopsis unicolor*	0.74
pset_eru_windia	*Osmerus mordax mordax*	0.83
pseu_pra_gulfguineaup	*Osmerus mordax mordax*	0.99
pseu_pra_gulfguineaw	*Pagellus erythrinus*	1.27
rach_can_oman	*Pagellus erythrinus*	0.87
rast_bra_seasia	*Pagellus erythrinus*	1.12
rast_kan_eafricacoralcoast	*Pagellus erythrinus*	0.82
rast_kan_eindia	*Pagrus auratus*	0.92
rast_kan_ephilippines	*Pagrus auratus*	0.86
rast_kan_malacca	*Pagrus major*	0.37
rast_kan_nbaybengal	*Pagrus pagrus*	0.64
rein_hip_alaska	*Pagrus pagrus*	0.34
rein_hip_nwatlantic	*Palinurus delagoae*	1.39
ruve_pre_schinaoceanic	*Palinurus elephas*	0.79
sali_aus_channelsfjordsschile	*Palinurus gilchristi*	0.25
salv_alp_nlabrador	*Palinurus mauritanicus*	1.18
sard_aur_angolan	*Pampus argenteus*	1.02
sard_aur_gulfguineac	*Pampus argenteus*	0.43
sard_aur_gulfguineaup	*Pampus argenteus*	0.50
sard_fim_wcpfc	*Pampus argenteus*	0.36
sard_gib_windia	*Panulirus argus*	0.56
sard_lem	*Panulirus homarus*	0.68
sard_lem_sjava	*Paracentrotus lividus*	1.06
sard_lem_sundajava	*Parapenaeus longirostris*	0.97
sard_mad_gulfguineac	*Parapenaeus longirostris*	1.39
sard_mad_gulfguineas	*Parapenaeus longirostris*	0.36
sard_mad_gulfguineaw	*Parapenaeus longirostris*	1.34
sard_pil_celtic	*Parapenaeus longirostris*	0.77
sard_sag_se	*Parapenaeus longirostris*	0.07
sard_sar_mediterranean	*Paralichthys olivaceus*	0.95
sard_sar_neecatlantic	*Parupeneus indicus*	0.83
sard_sar_wcatlantic	*Parupeneus indicus*	0.80
sarp_sal_wmediterranean	*Patagonotothen ramsayi*	1.09
saur_tum_gulfoman	*Penaeus monodon*	1.25
saur_tum_sundajava	*Penaeus semisulcatus*	1.14
scia_umb_tunisianpgsidra	*Perna viridis*	1.27
scom_cav_gomexfloridian	*Phycis phycis*	1.24
scom_cav_secaribbeanbahamiangreaterantilles	*Placopecten magellanicus*	0.37
scom_com_indian	*Planiliza haematocheila*	1.01
scom_com_wcpfc	*Platichthys flesus*	1.17

Stock name	Scientific name	C:MSY Ratio
scom_comm_persiangulf	*Platycephalus indicus*	1.23
scom_gut_indian	*Platycephalus indicus*	0.99
scom_jap_wcnwpacific	*Platichthys stellatus*	1.00
scom_lys_gulfoman	*Pollachius virens*	0.53
scom_mac_gomexusatlantic	*Pomadasys incisus*	0.97
scom_sco_neatlantic	*Pomatomus saltatrix*	1.29
scom_tri_wafrica	*Pomatomus saltatrix*	0.92
scor_por_wmediterranean	*Pomatomus saltatrix*	1.14
scyl_ser_eafricacoralcoast	*Pomatomus saltatrix*	0.55
scyl_ser_samoa	*Pomatomus saltatrix*	0.44
seba_ala_oyashiokamchatka	*Pomadasys stridens*	1.16
seba_fla_pacific	*Portunus pelagicus*	0.78
seba_mac_northeast japan sea	*Portunus pelagicus*	0.69
sela_cru_society	*Portunus pelagicus*	0.56
sela_cru_tuamotus	*Psettodes belcheri*	0.55
sela_lep_malacca	*Pseudopleuronectes americanus*	0.85
sele_dor_gulfguineaup	*Pseudopleuronectes americanus*	1.19
sepi_off_seuroatlanticshelf	*Pseudupeneus prayensis*	0.79
sepi_off_tunisianpgsidra	*Pseudotolithus senegalensis*	1.05
sepi_pha_gulfoman	*Rachycentron canadum*	0.72
sepi_pha_warabian	*Ranina ranina*	0.98
seri_bra_cnewzealand	*Rastrelliger kanagurta*	0.33
seri_bra_threekingsnenewzealand	*Rastrelliger kanagurta*	0.33
seri_dum_floridiancarolinianvirginian	*Rastrelliger kanagurta*	1.18
seri_dum_tunisianpgsidra	*Rastrelliger kanagurta*	0.45
seri_dum_wmediterranean	*Rastrelliger kanagurta*	0.94
seri_nig_malacca	*Rastrelliger kanagurta*	0.76
serr_cab_wmediterranean	*Rastrelliger kanagurta*	0.94
seti_tat_nbaybengal	*Rastrelliger kanagurta*	1.04
sna1	*Rastrelliger kanagurta*	0.55
sole_sol_adriatic	*Pseudophycis bachus*	0.19
sole_sol_tunisianpgsidra	*Sebastes mentella*	1.15
spar_aura_aegean	*Reinhardtius hippoglossoides*	0.81
spar_aura_tunisianpgsidra	*Rexea solandri*	1.57
spar_aura_wmediterranean	*Rhabdosargus globiceps*	0.93
spar_cre_azorescanariesmadeira	*Rhynchobatus djiddensis*	0.41
sphy_bar_wcaribbean	*Salvelinus alpinus alpinus*	0.35
sphy_zyg_atlantic	*Sardinella aurita*	1.11
spis_sol_quebec	*Sardinella aurita*	0.93
spis_sol_useast	*Sardinella aurita*	0.68
spo1	*Sardinella aurita*	0.41
spo3	*Sarda chiliensis*	0.67
spon_can_wmediterranean	*Sardinella gibbosa*	0.30
spra_spr_blacksea	*Sardinella longiceps*	1.10
squa_aca_newzealand	*Sardinella maderensis*	0.79
squatinidae_riodelaplata	*Sardinella maderensis*	0.81
squi_man_adriatic	*Sardinops melanostictus*	0.59
squi_man_wmediterranean	*Sardina pilchardus*	0.54
stro_dro_quebec	*Sardina pilchardus*	0.75

Stock name	Scientific name	C:MSY Ratio
swa3	*Sardina pilchardus*	0.75
syac_ova_cortezian	*Sardina pilchardus*	0.44
tana_kit_east coast of japan	*Sardina pilchardus*	1.15
tegi_gra_andamancoral	*Sardina pilchardus*	0.00
tegi_gra_lessersunda	*Sardina pilchardus*	0.27
tegi_gra_malacca	*Sardinops sagax*	0.71
tegi_gra_sulawesimakassar	*Sardinops sagax*	0.89
tenu_ili_eindianbaybengal	*Sardinops sagax*	1.13
ther_cha_aleutian	*Sardinops sagax*	0.97
ther_cha_nehonshuoyashio	*Sardinella*	0.53
ther_cha_okhotsk	*Saurida tumbil*	0.93
thun_ala_indian	*Micromesistius australis*	0.92
thun_ala_ncatlantic	*Scarus rubroviolaceus*	0.64
thun_ala_satlantic	*Sciaenops ocellatus*	0.62
thun_alb_atlantic	*Sciaena umbra*	1.02
thun_alb_indian	*Scomber australasicus*	1.10
thun_alb_wpacific	*Scomber australasicus*	1.27
thun_atl_wcatlantic	*Scomber australasicus*	0.39
thun_obe_atlantic	*Scomber colias*	0.95
thun_obe_indian	*Scomberomorus guttatus*	0.56
thun_thy_eatlanticmediterranean	*Scomber japonicus*	0.75
thun_thy_watlantic	*Scomber japonicus*	0.56
thun_ton_eindianwpacific	*Scomber japonicus*	0.85
thun_ton_windian	*Scomberomorus niphonius*	1.09
thyr_atu_namaqua	*Scomber scombrus*	0.81
trac_cap_namaqua	*Scophthalmus aquosus*	0.78
trac_cap_namib	*Scophthalmus aquosus*	0.85
trac_cur_japansea	*Scophthalmus maximus*	0.68
trac_dec_e	*Sebastolobus alascanus*	0.30
trac_jap_echinajapansea	*Sebastes aleutianus*	0.72
trac_jap_sea of japan and east china sea	*Sebastolobus altivelis*	0.51
trac_jap_tonkinschina	*Sebastes alutus*	1.05
trac_tre_wafrica	*Selar crumenophthalmus*	0.85
tric_lep_echinayellow	*Selaroides leptolepis*	0.68
tric_lep_ephilippines	*Sepia officinalis*	0.82
tric_lep_gulfguineaupc	*Sepia officinalis*	1.36
tric_lep_gulfomanpersiangulf	*Sepia officinalis*	1.10
tric_lep_gulfthailand	*Seriolella brama*	0.96
tric_lep_malacca	*Seriolella brama*	0.82
tric_lep_scaribbean	*Seriola dumerili*	0.71
tric_lep_sundajava	*Sillago sihama*	0.60
tric_lep_windia	*Solea solea*	0.79
tur.27.3a	*Solea solea*	0.73
turb_cor_ckuroshio	*Solea solea*	0.59
tylo_cro_philippines	*Sparus aurata*	1.21
upen_mol_philippines	*Sphyrna lewini*	0.97
upen_vit_windia	*Sphyrna lewini*	0.32
upen_vit_wsumatra	*Sphyraena obtusata*	0.86
urop_chu_4vw	*Spicara smaris*	1.06

Stock name	Scientific name	C:MSY Ratio
vari_lou_seychelles	*Spisula solidissima*	1.97
xiph_gla_epacific	*Spratelloides gracilis*	1.26
xiph_gla_indian	*Sprattus sprattus*	0.66
xiph_gla_mediterranean	*Squalus acanthias*	0.83
xiph_gla_ncatlantic	*Squalus acanthias*	0.50
xiph_kro_brazil	*Squalus acanthias*	0.41
zeus_fab_tunisianpgsidra	*Squilla mantis*	1.25

Appendix 2: List of countries and regions

Country Name	Region
Albania	Europe and North America
Algeria	Northern Africa and Western Asia
American Samoa	Oceania
Angola	Sub-Saharan Africa
Anguilla (UK)	Latin America and the Caribbean
Argentina	Latin America and the Caribbean
Aruba (Netherlands)	Latin America and the Caribbean
Australia	Oceania
Bahamas	Latin America and the Caribbean
Bangladesh	Central, Southern, Eastern and Southeast Asia
Barbados	Latin America and the Caribbean
Belgium	Europe and North America
Belize	Latin America and the Caribbean
Benin	Sub-Saharan Africa
Bermuda (UK)	Europe and North America
Bonaire, Sint Eustatius and Saba	Latin America and the Caribbean
Brazil	Latin America and the Caribbean
Bulgaria	Europe and North America
Cameroon	Sub-Saharan Africa
Canada	Europe and North America
Canada	Europe and North America
Cape Verde	Sub-Saharan Africa
Chile	Latin America and the Caribbean
China	Central, Southern, Eastern and Southeast Asia
Colombia	Latin America and the Caribbean
Comoros	Sub-Saharan Africa
Congo (ex-Zaire)	Sub-Saharan Africa
Congo, R. of	Sub-Saharan Africa
Cook Islands	Oceania
Costa Rica	Latin America and the Caribbean
Côte d'Ivoire	Sub-Saharan Africa
Croatia	Europe and North America
Cuba	Latin America and the Caribbean
Cyprus	Europe and North America
Denmark	Europe and North America
Dominican Republic	Latin America and the Caribbean
Ecuador	Latin America and the Caribbean
Egypt	Northern Africa and Western Asia
El Salvador	Latin America and the Caribbean
Equatorial Guinea	Sub-Saharan Africa
Falkland Isl. (UK)	Latin America and the Caribbean

Country Name	Region
Fiji	Oceania
France	Europe and North America
French Polynesia	Oceania
Gabon	Sub-Saharan Africa
Gambia	Sub-Saharan Africa
Georgia	Northern Africa and Western Asia
Germany	Europe and North America
Ghana	Sub-Saharan Africa
Greece	Europe and North America
Greenland	Europe and North America
Grenada	Latin America and the Caribbean
Guatemala	Latin America and the Caribbean
Guinea	Sub-Saharan Africa
Guinea-Bissau	Sub-Saharan Africa
Haiti	Latin America and the Caribbean
Honduras	Latin America and the Caribbean
Iceland	Europe and North America
India	Central, Southern, Eastern and Southeast Asia
Indonesia	Central, Southern, Eastern and Southeast Asia
Iran	Central, Southern, Eastern and Southeast Asia
Ireland	Europe and North America
Israel	Northern Africa and Western Asia
Italy	Europe and North America
Japan	Central, Southern, Eastern and Southeast Asia
Kenya	Sub-Saharan Africa
Korea (South)	Central, Southern, Eastern and Southeast Asia
Kuwait	Northern Africa and Western Asia
Latvia	Europe and North America
Lebanon	Northern Africa and Western Asia
Liberia	Sub-Saharan Africa
Lithuania	Europe and North America
Madagascar	Sub-Saharan Africa
Malaysia	Central, Southern, Eastern and Southeast Asia
Maldives	Central, Southern, Eastern and Southeast Asia
Malta	Europe and North America
Marshall Isl.	Oceania
Mauritania	Sub-Saharan Africa
Mexico	Latin America and the Caribbean
Micronesia	Oceania
Montserrat (UK)	Latin America and the Caribbean
Morocco	Northern Africa and Western Asia
Mozambique	Sub-Saharan Africa

Country Name	Region
Myanmar	Central, Southern, Eastern and Southeast Asia
Namibia	Sub-Saharan Africa
Netherlands	Europe and North America
New Zealand	Oceania
Nigeria	Sub-Saharan Africa
Northern Mariana Islands	Oceania
Norway	Europe and North America
Oman	Northern Africa and Western Asia
Pakistan	Central, Southern, Eastern and Southeast Asia
Palau	Oceania
Panama	Latin America and the Caribbean
Papua New Guinea	Oceania
Peru	Latin America and the Caribbean
Philippines	Central, Southern, Eastern and Southeast Asia
Portugal	Europe and North America
Russian Federation	Europe and North America
Saint Vincent & the Grenadines	Latin America and the Caribbean
Samoa	Oceania
Sao Tome & Principe	Sub-Saharan Africa
Saudi Arabia	Northern Africa and Western Asia
Senegal	Sub-Saharan Africa
Seychelles	Sub-Saharan Africa
Sierra Leone	Sub-Saharan Africa
Slovenia	Europe and North America
Solomon Isl.	Oceania
Somalia	Sub-Saharan Africa
South Africa	Sub-Saharan Africa
Spain	Europe and North America
Sweden	Europe and North America
Tanzania	Sub-Saharan Africa
Thailand	Central, Southern, Eastern and Southeast Asia
Timor Leste	Central, Southern, Eastern and Southeast Asia
Tonga	Oceania
Tunisia	Northern Africa and Western Asia
Turkey	Northern Africa and Western Asia
Turks & Caicos Isl. (UK)	Latin America and the Caribbean
Ukraine	Europe and North America
United Arab Emirates	Northern Africa and Western Asia
United Kingdom	Europe and North America
Uruguay	Latin America and the Caribbean
USA	Europe and North America
Viet Nam	Central, Southern, Eastern and Southeast Asia

Appendix 3a: Table: Fish stocks where active overfishing is occurring (Catch>MSY)

Stock name	Scientific name	MSY - Catch (000 t)
pagr_aur_sc	*Pagrus auratus*	-0.0048
mull_bar_tunisianpgsidra	*Mullus barbatus barbatus*	-0.01
cara_mal_sundajava	*Carangoides malabaricus*	-0.01
dipl_sar_levantine	*Diplodus sargus sargus*	-0.02
epin_are_nmonsooncc	*Epinephelus areolatus*	-0.03
mull_fla_sredsea	*Mulloidichthys flavolineatus*	-0.03
nemi_jap_malacca	*Nemipterus japonicus*	-0.03
leth_neb_nmonsooncc	*Lethrinus nebulosus*	-0.04
drep_pun_persiangulf	*Drepane punctata*	-0.04
leth_len_nmonsooncc	*Lethrinus lentjan*	-0.04
scia_umb_wmediterranean	*Sciaena umbra*	-0.04
leth_oli_nmonsooncc	*Lethrinus olivaceus*	-0.04
ema7	*Scomber australasicus*	-0.05
scia_oce_ecaribbeanusatlantic	*Sciaenops ocellatus*	-0.07
netu_tha_nredsea	*Netuma thalassina*	-0.07
netu_tha_sredsea	*Netuma thalassina*	-0.09
naso_uni_tonga	*Naso unicornis*	-0.09
argy_arg_agulhas	*Argyrozona argyrozona*	-0.16
lutj_cam_wcaribbean	*Lutjanus campechanus*	-0.16
leth_len_csomali	*Lethrinus lentjan*	-0.16
leth_oli_csomali	*Lethrinus olivaceus*	-0.17
xiph_gla_wcpno	*Xiphias gladius*	-0.22
scom_col_mediterranean	*Scomber colias*	-0.23
rast_kan_svietnam	*Rastrelliger kanagurta*	-0.26
lin2	*Genypterus blacodes*	-0.33
nemi_jap_sundajava	*Nemipterus japonicus*	-0.33
leth_neb_csomali	*Lethrinus nebulosus*	-0.37
pamp_arg_sjava	*Pampus argenteus*	-0.39
lito_occ_panamabight	*Litopenaeus occidentalis*	-0.39
poma_sal_levantine	*Pomatomus saltatrix*	-0.46
colo_sai_nwneecpacific	*Cololabis saira*	-0.49
isti_ind_schinasea	*Istiompax indica*	-0.58
swa4	*Seriolella punctata*	-0.62
pamp_arg_windia	*Pampus argenteus*	-0.66
meta_mag_ncalifornia	*Metacarcinus magister*	-0.67
xiph_gla_wcpfc	*Xiphias gladius*	-0.70
lutj_mal_arnhembonaparteexmouth	*Lutjanus malabaricus*	-0.76
drep_pun_philippines	*Drepane punctata*	-0.80

Stock name	Scientific name	MSY - Catch (000 t)
chac_mar_namib	*Chaceon maritae*	-0.84
para_lon_wmediterranean	*Parapenaeus longirostris*	-0.88
pset_bel_sahelian	*Psettodes belcheri*	-1.31
ema1	*Scomber australasicus*	-1.47
lutj_cam_sgomex	*Lutjanus campechanus*	-1.50
gadu_mac_southern east/japan sea	*Gadus macrocephalus*	-2.27
para_lon_sahelian	*Parapenaeus longirostris*	-2.37
rach_can_persiangulf	*Rachycentron canadum*	-2.46
scom_nip_japan, south korea and china	*Scomberomorus niphonius*	-2.63
plan_hae_chinese waters	*Planiliza haematocheila*	-2.80
pamp_arg_lessersundabonapartearafurabandanesulawesi	*Pampus argenteus*	-2.93
epin_coi_persiangulf	*Epinephelus coioides*	-3.14
squa_aca_carolinianvirginianmaine	*Squalus acanthias*	-3.23
pseu_pra_sahelian	*Pseudupeneus prayensis*	-3.45
lima_asp_goa	*Limanda aspera*	-3.61
engr_enc_adriatic	*Engraulis encrasicolus*	-3.65
poma_inc_sahelian	*Pomadasys incisus*	-3.90
mugi_cep_sahelian	*Mugil cephalus*	-4.30
urot_edu_japan, china and taiwan	*Uroteuthis edulis*	-4.46
auxi_tha_windian	*Auxis thazard*	-4.48
acan_sol_atlantic	*Acanthocybium solandri*	-4.91
alop_sup_indian	*Alopias superciliosus*	-5.21
hipp_ste_uscanadapacific	*Hippoglossus stenolepis*	-6.16
trac_tra_nwafrica	*Trachurus trachurus*	-6.30
sard_aur_mediterranean	*Sardinella aurita*	-7.24
engr_enc_aegean	*Engraulis encrasicolus*	-7.61
rast_kan_gulfoman	*Rastrelliger kanagurta*	-7.89
dice_pun_sahelian	*Dicentrarchus punctatus*	-8.6
mura_cin_east china sea	*Muraenesox cinereus*	-9.25
sela_cru_philippines	*Selar crumenophthalmus*	-10.39
sela_lep_sundajava	*Selaroides leptolepis*	-12.02
sard_mad_saharansahelian	*Sardinella maderensis*	-12.55
sardinella_philippines	*Sardinella*	-18.51
loli_vulg_yellow sea-east china sea/japan sea	*Loligo vulgaris*	-24.36
kats_pel_epacific	*Katsuwonus pelamis*	-28.35
gale_dec_gulfguineaw	*Galeoides decadactylus*	-28.95
scom_jap_ecpacific	*Scomber japonicus*	-37.78
mura_cin_chn&tw	*Muraenesox cinereus*	-45.19
scom_jap_chinese waters	*Scomber japonicus*	-65.84

Stock name	Scientific name	MSY - Catch (000 t)
rast_kan_windia	*Rastrelliger kanagurta*	-68.97
umbr_can_sbrazil	*Umbrina canosai*	-83.98
sard_pil_saharansahelian	*Sardina pilchardus*	-293.94

Appendix 3b: Table: Top 10 stocks for which C>MSY

Stock name	Scientific name	Common name	B/Bo	GAP (000 t)	
				MSY-CMSY	MSY-Ann avg*
sard_pil_saharansahelian	*Sardina pilchardus*	European sardine	0.38	-294	482
umbr_can_sbrazil	*Umbrina canosai*	Argentine croaker	0.24	-84	84
rast_kan_windia	*Rastrelliger kanagurta*	Indian mackerel	0.21	-69	-81
scom_jap_chinese waters	*Scomber japonicus*	Chub mackerel	0.35	-66	97
mura_cin_chn&tw	*Muraenesox cinereus*	Daggertooth pike conger	0.24	-45	127
scom_jap_ecpacific	*Scomber japonicus*	Chub mackerel	0.26	-38	15
gale_dec_gulfguineaw	*Galeoides decadactylus*	Lesser African threadfin	0.37	-29	115
kats_pel_epacific	*Katsuwonus pelamis*	Skipjack tuna	0.37	-28	190
loli_vulg_yellow sea-east china sea/japan sea	*Loligo vulgaris*	Common squid	0.20	-24	116
sardinella_philippines	*Sardinella*	Sardine	0.31	-19	41

*Ann avg = annual average EEZ catch from 1990-2018

Appendix 4: **Table**: Number of people engaged in marine fisheries globally, 2018.

	Primary (reported)				Primary total	Ancillary		
Country	**Artisanal**	**Subsistence**	**Industrial**	**Unreported**	**(Reported + unreported)**		**Primary + Ancillary**	**FTE**
Albania	1,429	-	804	3,639	5,872	5,107	10,979	6,692
Algeria	42,217	-	8,911	-	51,127	122,978	174,105	128,068
American Samoa	-	4,992	-	-	4,992	2,108	7,100	2,496
Angola	61,355	-	38,653	-	100,008	295,816	395,824	311,067
Anguilla	199	-	-	148	347	97	444	189
Antigua and Barbuda	1,785	-	145	-	1,929	5,682	7,611	5,634
Argentina	15,823	-	4,795	15,305	35,923	18,513	54,436	29,733
Australia	1,948	-	1,479	43,465	46,892	39,511	86,404	49,490
Bahamas	11,459	-	929	-	12,387	27,000	39,387	27,875
Bahrain	13,012	-	-	17,469	30,481	47,459	77,940	50,671
Bangladesh	945,664	-	38,643	4,693,929	5,678,237	26,940,764	32,619,001	25,298,859
Barbados	2,133	-	173	-	2,306	6,600	8,906	6,566
Belgium	-	-	215	2,293	2,508	5,714	8,222	8,222
Belize	2,064	-	167	7,084	9,315	6,015	15,330	8,154
Benin	7,665	-	189	70,126	77,980	413,795	491,775	385,573
Brazil	580,725	-	175,977	-	756,703	3,468,525	4,225,228	3,363,157
Brunei Darsm	2,138	-	143	228	2,509	4,066	6,575	4,393
Bulgaria	486	-	224	-	711	1,632	2,343	2,343
Cambodia	3,845	-	157	472,212	476,214	2,274,207	2,750,422	2,132,886
Cameroon	28,078	-	3,815	-	31,893	9,325	41,218	19,921
Canada	37,586	-	8,321	-	45,907	26,429	72,336	41,682
Cape Verde	5,491	-	1,277	-	6,768	4,206	10,974	6,445
Chile	68,837	-	20,860	-	89,697	108,495	198,192	133,836
China	1,715,522	-	142,445	4,936,650	6,794,617	20,423,335	27,217,952	19,990,709
Colombia	52,324	-	15,856	-	68,180	476,549	544,729	446,551
Comoros	4,675	-	146	-	4,820	22,106	26,927	20,873
Congo (DemRep)	4,002	-	-	480	4,482	2,592	7,074	3,613
Congo (Rep.)	5,803	-	2,032	-	7,835	9,148	16,983	11,524
Cook Islands	1,767	590	-	-	2,357	7	2,364	613
Costa Rica	1,386	-	112	17,396	18,894	14,771	33,665	18,657
Cote d'Ivoire	9,814	-	550	30,585	40,948	165,228	206,176	157,175
Croatia	215	-	1,436	-	1,651	3,797	5,448	5,448
Cuba	6,981	-	566	61,130	68,676	58,254	126,931	71,901
Cyprus	521	-	173	139	833	1,341	2,175	2,175
Denmark	1,516	-	336	5,193	7,044	16,032	23,076	23,076
Djibouti	1,640	-	-	224	1,864	1,212	3,077	1,620
Dominica	1,254	-	102	-	1,356	4,032	5,388	3,993
Dominican Rp	9,008	-	730	33,686	43,423	28,602	72,025	38,473
Ecuador	65,045	-	19,711	-	84,756	321,903	406,658	318,425

	Primary (reported)				Primary total	Ancillary		
Country	Artisanal	Subsistence	Industrial	Unreported	(Reported + unreported)		Primary + Ancillary	FTE
Egypt	61,869	-	57,465	190,088	309,423	486,002	795,425	551,121
El Salvador	23,785	-	4,624	-	28,409	28,982	57,390	36,540
Eq Guinea	1,977	-	942	-	2,920	8,348	11,268	8,722
Eritrea	5,477	-	171	19,476	25,123	121,423	146,546	113,880
Estonia	334	-	129	-	462	792	1,254	1,254
Faroe Island	1,221	-	270	-	1,491	3,387	4,878	3,566
Fiji	9,177	3,059	1,700	-	13,936	2,000	15,936	6,389
Finland	154	-	117	32	303	690	992	992
France	2,057	-	4,576	4,370	11,003	40,641	51,644	51,644
French Polynesia	2,803	6,447	1,595	-	10,845	8,655	19,501	10,651
Gabon	25,254	-	5,330	-	30,584	7,570	38,154	18,864
Gambia	38,071	-	93	16,172	54,336	87,364	141,700	92,798
Georgia	5,418	-	450	3,563	9,430	39,023	48,453	37,233
Germany	536	-	675	19,601	20,812	47,421	68,232	68,232
Ghana	183,745	-	87,561	-	271,306	921,299	1,192,605	937,876
Greece	9,590	-	4,064	-	13,653	898	14,551	14,551
Greenland	3,240	-	263	-	3,503	3,370	6,873	4,151
Grenada	2,584	-	209	-	2,793	8,187	10,980	8,122
Guatemala	10,983	-	2,135	8,275	21,394	8,690	30,083	15,249
Guam	171	66,143	-	-	66,314	55,932	122,246	57,619
Guinea	20,250	-	1,668	16,916	38,834	91,385	130,220	92,571
Guinea-Bissau	5,859	-	183	54,052	60,094	322,260	382,354	300,111
Guyana	4,842	-	1,467	18,875	25,185	94,375	119,560	90,977
Haiti	65,000	-	1,200	-	66,200	68,091	134,291	80,130
Honduras	23,579	-	4,833	-	28,412	8,060	36,472	18,355
Hong Kong	5,347	-	4,677	55,442	65,466	106,200	171,666	115,254
Iceland	1,616	-	358	-	1,973	1,289	3,262	1,925
India	7,428,637	-	303,561	-	7,732,198	3,371,136	11,103,334	5,443,951
Indonesia	2,429,568	-	201,735	1,034,185	3,665,487	4,278,510	7,943,998	4,959,340
Iran	139,840	-	11,611	-	151,451	617,940	769,391	592,809
Iraq	818	-	33	186,154	187,006	896,531	1,083,537	840,586
Ireland	1,858	-	411	953	3,222	2,172	5,394	5,394
Israel	681	-	323	5,916	6,919	10,854	17,774	11,759
Italy	8,583	-	11,647	8,558	28,788	65,695	94,483	94,483
Jamaica	22,044	-	1,786	-	23,830	70,794	94,624	70,121
Japan	81,714	-	71,465	84,140	237,319	385,039	622,358	449,197
Jordan	65	-	-	62	127	522	650	495
Kenya	10,423	-	86	22,522	33,031	81,747	114,778	81,488
Kiribati	3,252	-	275	194	3,720	46	3,767	1,314
Korea South	40,371	-	35,308	88,294	163,973	265,109	429,082	301,464
Korea DPRp	105,519	-	18,621	145,293	269,433	1,249,996	1,519,429	1,185,283

	Primary (reported)				Primary total	Ancillary		
Country	Artisanal	Subsistence	Industrial	Unreported	(Reported + unreported)		Primary + Ancillary	FTE
Kuwait	213	-	186	59,420	59,819	96,879	156,698	102,822
Latvia	119	-	204	171	494	389	883	883
Lebanon	6,860	-	288	17,237	24,386	93,775	118,161	89,535
Liberia	15,582	-	485	35,937	52,004	194,145	246,149	185,757
Libya	32,512	-	6,862	-	39,374	11,806	51,180	26,088
Lithuania	60	-	307	143	510	326	836	836
Madagascar	144,132	-	5,079	31,429	180,639	169,788	350,427	205,677
Malaysia	49,580	-	77,972	359,825	487,377	789,712	1,277,089	882,045
Maldives	16,872	-	1,401	26,749	45,021	110,662	155,683	111,141
Malta	475	-	269	-	745	1,639	2,383	2,383
Marshall Islands	2,688	3,763	-	-	6,451	678	7,129	1,890
Mauritania	50,834	-	1,583	61,141	113,558	524,786	638,344	494,165
Mauritius	3,601	-	2,891	-	6,492	66	6,558	3,668
Mexico	213,650	-	16,105	164,959	394,714	332,959	727,674	419,014
Micronesia	262	-	51	537	850	128	978	396
Montserrat	86	-	-	-	86	258	344	252
Morocco	76,181	-	36,303	-	112,484	403,203	515,687	407,422
Mozambique	199,064	-	1,976	82,401	283,441	445,159	728,600	475,682
Myanmar	1,040,358	-	42,513	-	1,082,871	5,150,788	6,233,659	4,856,246
Namibia	23,539	-	11,217	-	34,756	123,800	158,556	125,202
Nauru	5,701	-	-	-	5,701	1,157	6,858	2,723
Netherlands	70	-	1,663	7,614	9,347	17,352	26,699	26,699
New Caledonia	660	96,702	129	-	97,492	110	97,602	13,021
New Zealand	1,435	-	1,089	11,755	14,280	9,916	24,195	13,587
Nicaragua	13,545	-	2,403	-	15,948	5,637	21,585	11,099
Nigeria	549,462	-	17,116	387,799	954,377	5,000,924	5,955,301	4,671,963
Niue	575	-	-	-	575	147	722	301
Northern Mariana Islands	30	7,056	23	-	7,109	42	7,151	986
Norway	9,319	-	2,063	-	11,382	25,768	37,150	27,148
Oman	30,043	-	26,274	-	56,317	88,162	144,479	109,145
Pakistan	423,776	-	17,317	-	441,093	2,081,106	2,522,199	1,963,253
Palau	84	841	-	-	925	36	961	166
Panama	35,130	-	4,105	-	39,234	31,651	70,886	41,825
Papua New. Guinea	50,232	75,348	1,776	-	127,356	7,536	134,892	33,046
Peru	68,681	-	20,812	-	89,494	374,446	463,939	366,455
Philippines	1,980,464	-	164,444	-	2,144,908	8,226,323	10,371,231	7,936,060
Pitcairn	6	11	-	-	17	-	17	3
Poland	1,263	-	1,022	3,146	5,431	7,169	12,600	12,600
Portugal	2,520	-	5,292	-	7,811	17,831	25,642	25,642
Qatar	3,406	-	-	11,734	15,139	23,891	39,031	25,447

	Primary (reported)				Primary total	Ancillary		
Country	**Artisanal**	**Subsistence**	**Industrial**	**Unreported**	**(Reported + unreported)**		**Primary + Ancillary**	**FTE**
Romania	22	-	38	435	495	1,129	1,624	1,624
Russian Fed	73,277	-	64,085	40,569	177,931	287,720	465,651	341,984
Saint Kitts and Nevis	1,072	-	87	-	1,159	3,423	4,582	3,393
Samoa	4,347	8,660	228	-	13,235	33	13,268	2,662
Sao Tome Prn	4,163	-	-	-	4,163	13,212	17,375	12,809
Saudi Arabia	19,012	-	16,628	25,425	61,065	88,186	149,251	105,043
Senegal	70,248	-	1,814	156,099	228,162	843,299	1,071,460	807,378
Seychelles	1,289	-	-	-	1,289	2,150	3,439	2,268
Sierra Leone	74,840	-	2,331	-	77,172	382,409	459,580	359,099
Singapore	54	1,759	-	87,354	89,167	141,542	230,709	150,301
Slovenia	53	-	10	-	63	144	207	207
Solomon Islands	7,281	187,227	319	-	194,827	1,918	196,745	28,563
Somalia	125,390	-	3,906	14,638	143,934	565,290	709,224	540,055
South Africa	-	31,460	-	-	31,460	43,533	74,993	42,195
Spain	6,216	-	23,114	-	29,330	66,551	95,881	95,881
Sri Lanka	259,558	-	21,552	-	281,110	1,150,846	1,431,955	1,103,715
St Vincent and the Grenadines	1,064	-	86	-	1,150	3,426	4,576	3,392
St. Lucia	2,709	-	219	-	2,928	8,694	11,622	8,612
Sudan	6,110	-	190	4,397	10,697	57,787	68,483	53,882
Suriname	6,260	-	1,897	-	8,157	24,000	32,157	24,538
Sweden	278	-	523	2,240	3,041	6,909	9,951	9,951
Syria	3,522	-	622	2,032	6,176	30,862	37,037	29,214
Taiwan	142,398	-	10,210	-	152,608	246,734	399,342	267,546
Tanzania	46,429	-	-	54,590	101,019	294,915	395,934	288,356
Thailand	149,268	-	12,394	658,698	820,361	2,725,089	3,545,449	2,637,688
Togo	6,746	-	18	51	6,815	277	7,092	2,297
Tokelau	-	461	-	-	461	378	839	391
Tonga	856	435	34	183	1,508	47	1,555	439
Trinidad and Tobago	3,222	-	261	857	4,340	728	5,068	2,089
Turks and Caicos	257	-	21	2,677	2,955	1,749	4,704	2,429
Tunisia	40,365	-	6,386	-	46,751	40,110	86,861	52,793
Turkey	19,852	-	17,362	89,828	127,043	204,960	332,002	227,436
Tuvalu	114	2,717	391	-	3,221	2	3,223	732
Ukraine	14,672	-	8,253	-	22,925	2,000	24,925	13,373
United Kingdom	6,421	-	1,421	1,522	9,365	21,234	30,599	30,599
United Arab Em	20,647	-	-	-	20,647	29,701	50,348	32,182
Uruguay	3,098	-	1,549	-	4,647	4,500	9,147	6,222
USA	136,848	-	30,295	187,097	354,240	229,340	583,580	324,364
Vanuatu	11,227	79,882	50	-	91,158	46	91,204	13,871

	Primary (reported)				Primary total	Ancillary		
Country	**Artisanal**	**Subsistence**	**Industrial**	**Unreported**	**(Reported + unreported)**		**Primary + Ancillary**	**FTE**
Venezuela	46,730	-	14,161	-	60,891	270,062	330,953	262,714
Vietnam	1,764,453	-	72,850	830,115	2,667,419	3,997,895	6,665,314	4,340,273
Wallis and Futuna	22	3,455	16	-	3,493	34	3,527	501
Yemen	71,587	-	12,633	10,210	94,430	277,923	372,353	278,776
Zanzibar	48,216	-	-	4,087	52,303	22,081	74,385	35,012
TOTAL	22,756,982	581,008	2,130,866	15,829,616	41,298,472	105,714,392	147,012,864	106,134,364

Appendix 5: **Table:** Estimated catch loss and associated landed value (USD), economic impact (USD), and job loss by country.

Country	Catch loss (000t)[1]	Landed value of catch loss (USD)	Economic impact (USD)	Job loss[2]
Albania	0.48	539,422	878,072	-137
Algeria	32.67	25,969,992	30,854,653	-2,946
American Samoa	0.09	271,963	909,344	-613
Angola	10.71	129,775,133	459,324,203	-978
Anguilla (UK)	0.00	0	0	-
Argentina	34.68	73,809,382	219,452,539	-389
Aruba (Netherlands)	-0.12	0	0	-
Australia	27.31	127,219,158	469,434,013	-1,927
Bahamas	1.24	12,073,151	14,669,683	-426
Bangladesh	0.00	0	0	-0
Barbados	-0.01	0	0	2
Belgium	0.02	88,115	547,998	-1
Belize	0.23	599,221	2,074,690	-2
Benin	0.25	181,347	276,429	-68
Bermuda (UK)	-0.15	0	0	-
Bonaire, Saint Eustatius and Saba	-0.02	0	-	-
Brazil	34.04	334,162,905	800,239,267	-12,964
Bulgaria	0.60	916,678	16,808,721	-32
Cameroon	0.00	3,194	9,444	0
Canada	452.66	634,829,316	2,096,766,428	-9,333
Cape Verde	0.23	963,004	1,468,393	-6
Chile	1523.82	1,045,056,692	2,550,164,399	-26,147
China	176.25	562,166,137	1,876,055,049	-77,411
Colombia	11.51	10,834,529	34,007,643	-18,822
Comoros	0.00	0	0	0
Congo (ex-Zaire)	0.20	685,907	2,420,221	-23
Congo, R. of	0.24	573,003	1,694,095	-12
Cook Islands	-0.53	1,738,404	5,813,242	100
Costa Rica	-0.70	337,589	729,318	120
Côte d'Ivoire	24.77	15,283,481	23,285,535	-3,335
Croatia	23.22	23,592,240	77,203,640	-405
Cuba	5.80	31,684,987	38,498,999	-4,668
Cyprus	1.77	16,226,811	9,877,189	-700
Denmark	65.54	63,636,974	236,691,746	-655
Dominican Republic	0.01	688,305	836,271	-3
Ecuador	205.74	145,688,321	473,864,691	-22,640
Egypt	2.21	12,014,815	29,033,417	-1,804
El Salvador	0.25	184,981	640,395	-87
Equatorial Guinea	0.01	16,977	50,338	-1
Falkland Isl. (UK)	61.49	243,971,359	517,601,514	-
Fiji	0.08	294,484	984,739	-10
France	19.79	95,027,372	390,789,710	-367
French Polynesia	4.99	20,418,389	68,279,092	-703
Gabon	1.62	2,860,526	8,457,994	-500
Gambia	0.93	2,306,193	3,513,764	-170
Georgia	10.05	7,969,962	16,263,031	-117
Germany	10.19	7,849,129	25,710,657	-784
Ghana	75.12	80,013,786	121,905,019	-18,874
Greece	16.82	52,114,999	172,713,114	-1,978
Greenland	3.86	13,233,099	97,672,469	-87
Grenada	-0.01	0	0	2
Guatemala	-0.01	4,091	7,656	1
Guinea	-3.20	2,125,904	3,238,781	120
Guinea-Bissau	-18.74	2,585,902	3,938,114	10,239
Haiti	-0.22	120,895	146,913	181

Country	Catch loss (000t)[1]	Landed value of catch loss (USD)	Economic impact (USD)	Job loss[2]
Honduras	0.24	409,488	1,417,722	-114
Iceland	7.58	20,526,945	51,087,997	-27
India	-64.75	2,302,307	3,140,962	40,678
Indonesia	253.32	234,752,395	390,764,721	-48,292
Iran	20.29	54,286,855	105,194,978	-1,733
Ireland	6.47	24,416,699	52,526,060	-86
Israel	0.04	420,741	431,740	-53
Italy	137.52	680,279,254	1,189,283,469	-11,842
Japan	2387.53	1,805,883,384	4,974,043,419	-70,016
Kenya	0.13	831,123	2,453,930	-54
Korea (South)	99.46	198,529,602	576,807,987	-3,885
Kuwait	0.00	103,914	106,375	-3
Latvia	0.32	514,462	2,215,063	-2
Lebanon	0.05	421,270	430,910	-68
Liberia	23.15	14,870,550	22,631,118	-13,236
Lithuania	0.15	251,925	954,820	-1
Madagascar	-0.02	61,572	144,144	8
Malaysia	-2.23	4,759,029	12,257,388	181
Maldives	0.39	2,125,771	6,322,707	-138
Malta	1.78	7,209,874	18,308,220	-33
Marshall Isl.	0.01	12,757	42,656	-2
Mauritania	110.22	134,287,666	204,572,789	-3,569
Mexico	386.29	281,159,181	171,070,535	-19,320
Micronesia	0.00	27,585	92,240	-1
Montserrat (UK)	0.00	0	-	-
Morocco	-194.97	115,498,118	324,527,854	6,480
Mozambique	0.04	22,752	41,702	-14
Myanmar	0.06	63,727	54,117	-17
Namibia	623.33	1,795,265,585	8,659,780,596	-19,138
Netherlands	3.98	7,462,450	22,008,204	-101
New Zealand	6.71	55,267,723	142,771,150	-71
Nigeria	0.01	30,607	8,688	-8
Northern Mariana Islands	0.00	10,112	33,833	-40
Norway	1891.94	1,122,326,554	3,774,500,227	-3,698
Oman	3.68	8,034,313	8,226,733	-196
Pakistan	9.10	6,908,298	14,930,653	-1,438
Palau	0.02	86,198	287,979	-8
Panama	99.61	70,733,369	180,743,173	-9,261
Papua New Guinea	0.01	30,949	103,487	-30
Peru	1794.96	958,492,220	2,823,882,328	-8,898
Philippines	382.25	426,293,581	507,435,389	-144,192
Portugal	123.01	101,182,086	484,010,566	-3,982
Russian Federation	754.26	569,061,563	1,424,545,798	-8,303
Saint Vincent & the Grenadines	-0.03	0	0	-
Samoa	-0.01	331,993	1,110,136	2
Sao Tome & Principe	0.12	899,474	2,665,628	-12
Saudi Arabia	3.00	29,790,620	30,504,255	-878
Senegal	49.30	67,106,827	148,283,229	-3,029
Seychelles	-0.01	79,157	233,637	0
Sierra Leone	-2.28	193,613	294,997	204
Slovenia	0.80	2,240,974	13,968,176	-264
Solomon Isl.	0.00	1,690	5,650	0
Somalia	-1.34	1,024,935	3,024,380	1,073
South Africa	668.74	663,321,936	2,076,957,845	-4,528
Spain	93.88	215,071,247	830,986,738	-2,202
Sweden	44.67	65,590,139	174,410,048	-557
Taiwan	339.32	435,541,395	1,428,457,312	-22,365

Country	Catch loss (000t)[1]	Landed value of catch loss (USD)	Economic impact (USD)	Job loss[2]
Tanzania	0.56	560,145	1,525,932	-119
Thailand	175.66	170,151,313	360,454,675	-9,475
Timor Leste	2.80	2,814,602	5,941,938	-3,500
Tonga	-0.07	97,681	326,614	4
Tunisia	13.11	33,645,840	49,027,454	-1,694
Turkey	192.48	285,659,501	454,216,490	-16,334
Turks & Caicos	0.41	1,030,305	1,251,645	-39
Ukraine	46.96	60,081,523	333,969,631	-4,991
United Arab Emirates	-0.87	299,723	306,886	-
United Kingdom	237.19	175,883,071	748,590,531	-3,027
Uruguay	4.92	9,507,709	25,002,788	-144
USA	534.58	711,569,065	2,202,555,187	-10,815

[1] Countries with negative catch loss indicate that C > MSY across all stocks.

[2] Negative number of jobs indicate job loss associated with catch loss while positive number of jobs indicate the number of jobs associated with fishing about the MSY.