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Tentative adjustments of China's marine fisheries catches (1950-2010)

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Abstract

The marine catch of China in its Exclusive Economic Zone (EEZ) has been officially overestimated for years, while the catches of China's distant-water fleets are officially underestimated. Given a recent reduction of the domestic catch figure published by the FAO, and a recent independent estimate of the catch of China's distant-water fleet, the overall, global marine catch of China from 2000 to 2010 appear to be in the 12-13 million t·year^{-1} range. Of this total, around 8.6 million t·year^{-1} are caught in the Chinese EEZ, and around 4 million t in the EEZs of other countries (especially in West Africa) and in the High Seas. Of the current domestic marine catch, slightly less than two-thirds is caught by large-scale, industrial vessels, and one third by artisanal gears. Estimates of recreational catches (around 50,000 t·year^{-1} in recent years), subsistence catches (1% of the artisanal catch) and discards (0.5 % of the artisanal and industrial catch) are also presented, but these are even more tentative than our artisanal and industrial landing figures.

Introduction

The People's Republic of China (here: China, excluding Hong Kong and Taiwan, but including Macau)[1] is rapidly growing to regain its historic role as one of the leading economies of the world. Its enormous consumption of resources of all kinds and output of a huge variety of manufactured and other products have huge impacts on the economies of other countries.

However, China, which is leading the world in a number of scientific and technological fields, remains saddled with an opaque statistical system which not only does not keep up with the country's development, but actively distorts production figures. Indeed, not a week passes without international news outlets picking up on this. For example, China is thought to massage its population statistics (Zhao and Zhang 2010) and its economic indicators (Worstall 2012; Oqvist 2013). With regards to marine fisheries, this statistical issue manifests itself in (i) an inflated 'domestic' catch (i.e., from the Exclusive Economic Zone [EEZ] claimed by China (see Figure 1), as demonstrated by Watson and Pauly (2001), and (ii) a huge unreported catch by

[1] Separate catch reconstructions exist for Hong Kong (Sumaila *et al.* 2007) and Taiwan (Kuo and Booth 2011), which are being updated.

China's distant-water fleet (Pauly *et al.* 2013). It is further suggested that China may also over-report its aquaculture production (FAO 2012b; Godfrey 2013).

Therefore, this contribution has three goals:

1. To update the contribution of Watson and Pauly (2001) in order to adjust the officially reported marine catches of China to a level where they become compatible with reconstructed (rather than official) catches from waters similar to those in China's EEZ;
2. To integrate, to the extent possible, the estimated distant-water fisheries catch of China into a coherent framework, harmonized to the extent possible with the landings database maintained by the Food and Agricultural Organization of the United Nations (FAO); and
3. To provide a basis for discussion with Chinese colleagues who might be interested in the medium- or long-term in a reform of China's fisheries statistical system.

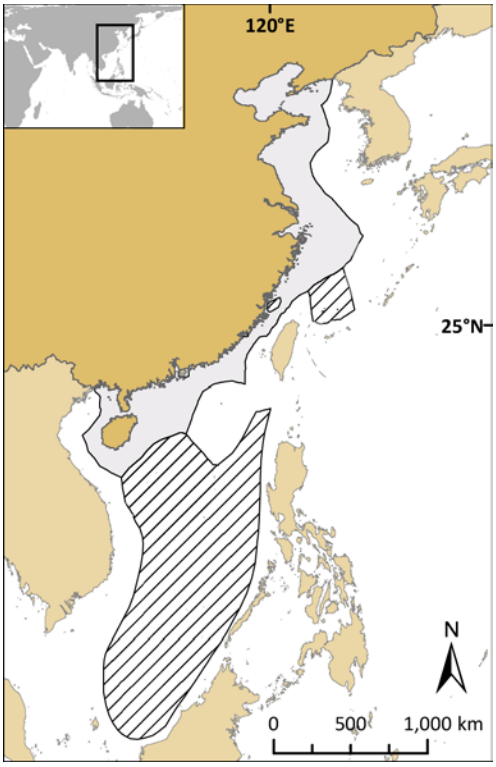

Figure 1. Map showing the extent of China's Exclusive Economic Zone (grey area), as well as the other areas it claims (stripped areas; either High Seas or claimed by other countries). The southern part is known as the 'Cow's Tongue'.

Materials and Methods

China's domestic catches

Watson and Pauly (2001) quantified the extent of over-reporting of China's reported domestic catch by comparing catch densities in China's EEZ with the catch density in the rest of the world, based mainly on FAO landings data spatialized over a cell grid of 0.5 degree latitude and longitude (Watson *et al.* 2004) and a general linear model (GAM) with dependent variables, one of which was a dummy variable stating whether a cell belonged to China's EEZ or not. The GAM's positive (and significant) partial slope associated with this dummy variable both confirmed that catch densities in the Chinese EEZ were significantly higher than in the rest of the world, and allowed estimation of what China's catches would be with this dummy variable set at zero (i.e., if Chinese catches were comparable to those of the rest of the world; see Figure 2 in Watson and Pauly 2001).

However, the *Sea Around Us* 'reconstructed' the catch of numerous countries in the last decade (Zeller *et al.* 2007; Zeller and Pauly 2007; Zeller and Harper 2009; Harper and Zeller 2012; Harper *et al.* 2012), and concluded that while China over-reports its domestic catch, other countries under-report the marine fisheries catch they report to the FAO by about 30-50% in developed countries, and often 100% in developing countries. Since it was such under-reported catch data that served as the baseline with which the official Chinese catches were compared, it is therefore likely that Watson and Pauly (2001) overestimated the extent to which China over-reported the catch of its domestic marine fisheries.

Extrapolating the trends in Watson and Pauly (2001; Figure 2A) into the 2000s would thus suggest that the EEZ (over-)corrected catch of China is about 6 million $t \cdot year^{-1}$ while the uncorrected catch would be about 10 million $t \cdot year^{-1}$, i.e., 1.67 times the uncorrected catch. As 67% is about halfway between the 30-50% underreporting for developed countries (see e.g., Zeller *et al.* 2011) and the 100% underreporting of many large developing countries (see e.g., Cisneros-Montemayor *et al.* 2013; Ulman *et al.* 2013), we can conclude that a catch of 10 million $t \cdot year^{-1}$ would be possible as a first estimate of the marine domestic catch of China that would have been obtained after comparison with globally reconstructed and spatialized catches (Figure 3).

Another way that China's catch could be re-evaluated is to spatialize the reconstructed catches of all countries and predict catch densities for the Chinese EEZ, by year, using the variables identified by Watson and Pauly (2001) as predictors for the Chinese catch by cell and year (primary production, depth, temperature, etc.). However, this cannot be done at present as reconstructions are lacking for numerous countries' EEZ and their catch have currently not been spatialized (as of September 2013).

A third approach was adopted here. Based on the data published by Watson and Pauly (2001; Figure 2A), we plotted the percentage of 'Total reported to FAO' included in the 'corrected EEZ catch', from 1970 to 2000 (Figure 2B). We then applied a linear regression to this time-series and extrapolated its trend to cover the entire 1950-2010 period (from 1950 to 1956, this ratio was higher than 100% and was therefore set to 100%; Figure 2B). Finally, we applied this time-series, representing the estimated percentage of the total catch caught within China's EEZ, to

the updated set of total catch extracted from FAO's FishStat (FAO 2012a), which resulted in an updated estimate of China's catch within its EEZ for the period 1970-2010 (Figure 2C; see final update from 1950 to 2010 in Figure 4). Note that three species not occurring in the Chinese EEZ (i.e., Alaska pollock, Japanese jack mackerel, and Pacific sandlance; www.fishbase.org), as well as seven taxa of large pelagics (i.e., *Thunnus alalunga*, *Thunnus obesus*, *Katsuwonus pelamis*, *Xiphias gladius*, *Thunnus albacares*, and various Istiophoridae) were automatically assigned to catches outside the Chinese EEZ. The rest of the taxa (i.e., those occurring in the Chinese EEZ) were reallocated proportionately to catches either within or outside the Chinese EEZ in order to match Figure 2C.

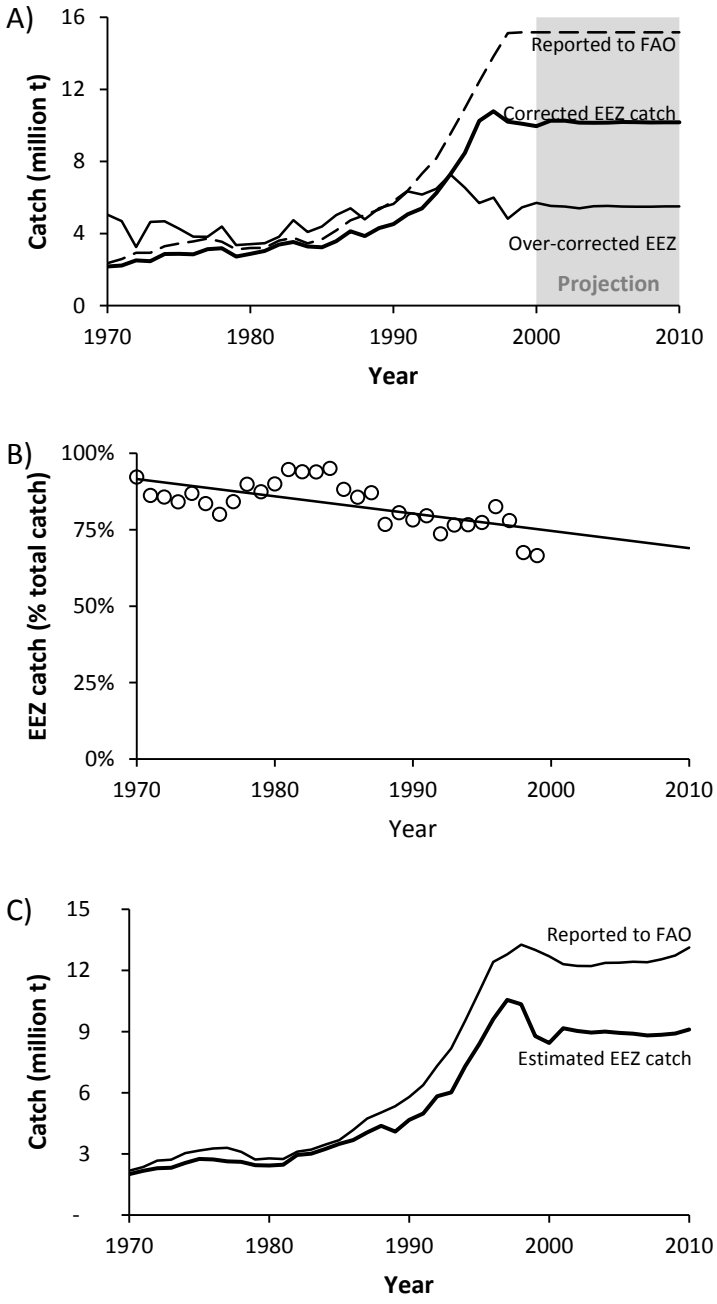

Figure 2. Time series data used to estimate China's current domestic marine fisheries catches: A) time series in Watson and Pauly (2001) showing the total catch reported to FAO at that time (dotted line), as well the estimated corrected (thick line) and over-corrected (thin line) EEZ catch (both time-series carried forward from 2000 to 2010); B) fraction of the total catch caught within the EEZ (from panel A), with the linear regression carried forward to 2010; and C) new total catch reported to FAO (thin line) and updated EEZ catch estimated by applying the trend in B to the new total catch reported to FAO. Catch from 1950 to 1970 are not shown (but see Figures 4 and 5).

China's distant-water catches

Pauly *et al.* (2013), based on a variety of conventional and unconventional sources, estimated the distant-water catch of China (i.e., its High Seas catch and the catches from EEZs other than its own) as 4.6 million t·year^{-1} in the period 2000 to 2010. Distant-water fishing was initiated by China in the mid-1980s (Pang and Pauly 2001) and hence the catches from such fishing can be viewed as increasing linearly from 1985 to 2000, after which they settled at the average of 4.6 million t·year^{-1}, as mentioned above. This figure is higher than the 1.15 million t·year^{-1} recently proposed by Chinese officials[2] and much higher than the 360,000 t·year^{-1} on average that are submitted by China to the FAO for all areas except Area 61 (Pauly and Froese 2012). It is, however, consistent with the suggestion by Pauly *et al.* (2013) that about one third of the catch of Chinese distant-water fisheries is being landed in China, because one third of 4.6 million t is equal to about 1.5 million t, which is near the 1.15 million t in question.

This estimate by Pauly *et al.* (2013) is close to the catch from Area 61 that was allocated to outside the EEZ (see above) added to the 300,000 t·year^{-1} reported to be caught in the other FAO areas, i.e., around 4 million t·year^{-1} in the late 2010s. For consistency reasons, we used the latter estimate in this report, rather than the one from Pauly *et al.* (2013).[3]

Taxonomic composition of China's marine catch

The marine catch in the Northwest Pacific (FAO Statistical Area 61; allocated to catches within and outside the EEZ, as explained above in the 'China's domestic catches' section) reported by China to the FAO comprised (for the years 2000 to 2010) an average of 40 identified taxa (species, genera, and families; excluding large pelagic species), with the remainder consisting of larger categories such as 'marine fishes nei' (i.e., 'not elsewhere included'; around 19.5% of reported catches for the years 2000 to 2010). As such a broad category cannot be properly spatialized, we used, following Watson (2001), the taxa reported by Taiwan and South Korea (but not reported by China)[4] to disaggregate these miscellaneous fish catches from the south and southern East China Seas, and the northern East China and Yellow Seas, respectively (each accounting for 50% of the 'marine fishes nei' catch). In addition, we assumed given reports of huge quantities of jellyfish being caught but always reported as 'others'[5], that the 'marine fishes nei' category also consisted of 10% and 50% of jellyfish in 1950 and 2010, respectively (percentages linearly interpolated in between).

This approximate taxonomic disaggregation applies only to China's domestic catches, i.e., the proportion we estimated to be caught within its EEZ. Its distant-water fleet will likely have a catch composition similar to that of other fleets operating in the EEZ of the countries where China's fleets operate, or in the adjacent High Seas areas, and thus need not be dealt with here.

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[2] Liu Xiaobing, Director of the Division of Inter-national Cooperation, Bureau of Fisheries, Ministry of Agriculture, China. Available at: http://webcast.ec.europa.eu/eutv/portal/archive.html?viewConference=15690.

[3] However, Pauly *et al.* (2013) should be used as the reference study with regards to the areas in which these catches occur.

[4] Excluding indian scad, Japanese scad, king crab, okhotsk atka mackerel, pacific cupped oyster, pacific ocean perch, and red-eye round herring, which are not occurring in the Chinese EEZ.

[5] This is reported by a colleague to remain anonymous.

Industrial vs. small-scale fisheries

Figure 3 illustrates the transition from small-scale fishing (predominant in 1950) to industrial fisheries (currently dominating) in South Korea (from data in Shon *et al.* in press). As China's economic development lagged behind that of South Korea, we assumed that a similar trend occurred in China as well, but with a 10 year lag.

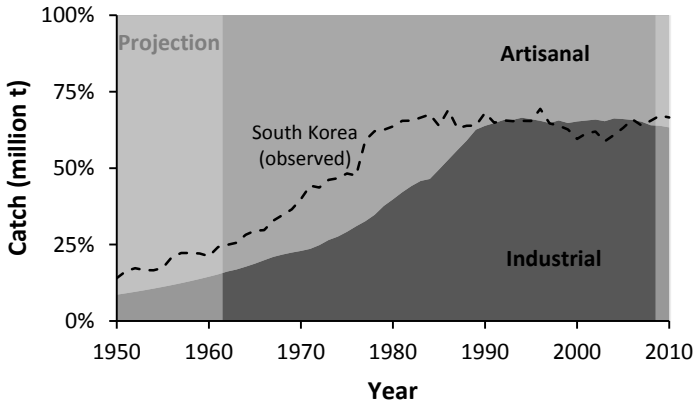

Figure 3. Relative catches by the small-scale and industrial sectors in South Korea (dotted line; data from Shon *et al.* in press), and the same time-series (smoothed with 5-year moving average), but shifted 10 years forward in order to estimate this proportion for China, which developed its industrial fisheries later (see text).

To disaggregate the updated EEZ catch (the non-EEZ catch being *de facto* labelled as 'industrial'), we assigned each taxon present in the catch to either 'artisanal', 'industrial',[6] or 'mixed' fisheries. We further considered that an 'artisanal species' was predominantly caught by the artisanal, small-scale fleet in 1950 (100%) and that this proportion linearly decreased to only 50% in 2010 (i.e., the industrial fleet also catches species targeted by the small-scale fleet). Similarly, we considered that only 5% of the 'industrial species' were caught by the industrial fleet in 1950 (this fleet was very small), and that this figure linearly increased to 90% by 2010. The remaining catch of 'mixed species' was then allocated to either the 'small-scale' or 'industrial' sector in order to match the overall ratio estimated in Figure 3.

Discarded catches

At least in their domestic fisheries, China does not seem to practice the widespread discarding of edible fish that occurs in other countries, notably because non-target and spoilt fish is used as feed in aquaculture. Thus, Kelleher (2005) gives a discarding rate of 0.5% in the spreadsheet that accompanies his review, communicated to him by "a member of the China delegation to COFI", i.e., FAO's Committee on Fisheries, its highest technical body. We applied this discarding rate throughout the time-period to catches in the EEZ (for both artisanal and industrial sectors).

[6] Only one species was included in this category, alfonsinos, given that it is a deepwater species (www.fishbase.org). Small molluscs and crustaceans were considered as 'artisanal', and other taxa were considered to be 'mixed'.

In terms of their taxonomic composition, the estimated discards were assumed to consist of 'marine fishes nei.'

Recreational and subsistence fisheries

Shen (2008) writes that, in the marine waters of China, "popular target species include large yellow croaker (*Pseudoscianea crocea*), small yellow croaker (*P. polyactis*), yellow drum (*Nibea albiflora*), genuine porgy (*Pagrosmus major*), red porgy (*Pagrus pagrus*), black porgy (*Sparus macrocephalus*), Japanese sea perch (*Lateolabrax japonicas*), rockfish (*Sebastes schlegeli*) and grouper (e.g., *Epinephelus maculatus*)". He also writes that "[w]ith rapid development of recreational fishing, many new fishing gear manufacturing plants have been built, and now China is the largest producer and exporter of fishing gear in the world. Furthermore, it is widely recognized that recreational fisheries development drives service businesses such as hotels, inns, cafés, restaurants etc. – but the latter point might more heavily apply to freshwater fisheries, which are indeed very developed in China (Gao 2001; Lin and Hong 2005; Shen 2008).

However, reliable numbers are not available, and thus the catch of marine recreational fishers was estimated as the average of two Fermi solutions (von Baeyer 1993; Pauly 2010). The first method was based on data published by Cisneros-Montemayor and Sumaila (2010), who estimated that the contribution of marine recreational fisheries to global GDP suggested a participation rate of 0.3067% for 'Eastern Asia'. Given the current population of China, the participation rate generates (1,338 million*0.003067 =) 4.1 million recreational fishers. Assuming that each recreational fisher catches 1 kg once a month gives ($12*0.001*(4.1*10^6)$) approximately 49,000 t as a first estimate of the recreational marine catch of China in 2010.

The second method was based on other reconstructions currently available. We collected estimates of recreational catches for 11 continental countries in 2010, and weighted these catches by each country's Inshore Fishing Area (www.seaaroundus.org; Table 1).[7] We then applied the average catch per IFA to China's IFA (i.e., 358,500 km^2), which resulted in a catch of around 52,000 t by recreational fishers in 2010.

Table 1. Data and sources used to estimate China's recreational catch in 2010.

Country	IFA (km^2)	Catch (t)	IFA catch (t/km^2)	Source
South Korea	97,000	52,800	0.54	Shon *et al.* (in press)
Lithuania	3,000	650	0.22	(Rossing *et al.* 2010; Zeller *et al.* 2011)
Finland	58,000	9,850	0.17	(Rossing *et al.* 2010; Zeller *et al.* 2011)
Denmark	58,000	6,100	0.11	(Rossing *et al.* 2010; Zeller *et al.* 2011)
Costa Rica	15,500	1,100	0.07	(Trujillo *et al.* 2012)
Sweden	101,000	6,600	0.07	(Rossing *et al.* 2010; Zeller *et al.* 2011)
Poland	19,500	1,050	0.05	(Rossing *et al.* 2010; Zeller *et al.* 2011)
Latvia	14,000	350	0.03	(Rossing *et al.* 2010; Zeller *et al.* 2011)
Russia (Baltic Sea)	18,500	450	0.02	(Rossing *et al.* 2010; Zeller *et al.* 2011)
China	358,500	50,850	Mean = 0.14	This study

[7] The Inshore Fishing Area is defined as the waters from coast to either 50 km offshore or 200 m depth, whichever comes first (Chuenpagdee *et al.* 2006).

Given that these two estimates are very close,[8] we accepted their average as the correct value; we also assumed that the recreational fishery only started in 1985 (i.e., we set recreational catch to zero in 1984), which corresponds to the time when the effects of economic reforms initiated by Deng Xiaoping started to be felt. We then fitted a logarithmic regression between the 1984 and 2010 anchor points in order to interpolate data for missing years.

In terms of their taxonomic composition, 50% of the recreational catch is assumed to consist in equal proportion of the 9 species listed above as "popular target species" by Shen (2008) plus a group of 'other groupers', while the other 50% was assigned to 'marine fishes nei'.

For the subsistence sector, which is very difficult to separate from the artisanal sector (Krumme *et al.* 2013), we simply considered than 1% of the artisanal domestic catch by China consisted of catches retained for subsistence purposes, in contrast with the remaining 99% that we deemed to be marketed. We also assume the same taxonomic composition.

Results and Discussion

Adding our estimate of the Chinese distant-water catch (outside the EEZ in Area 61, as well as catches in other FAO areas) to the Chinese domestic catch gives, for the years 2000 to 2010, an average total catch of 12.6 million t·year^{-1}. This is close to the total officially reported catch from China in those years, i.e., 12.5 million t·year^{-1} (Figure 4, Appendix Table 1).

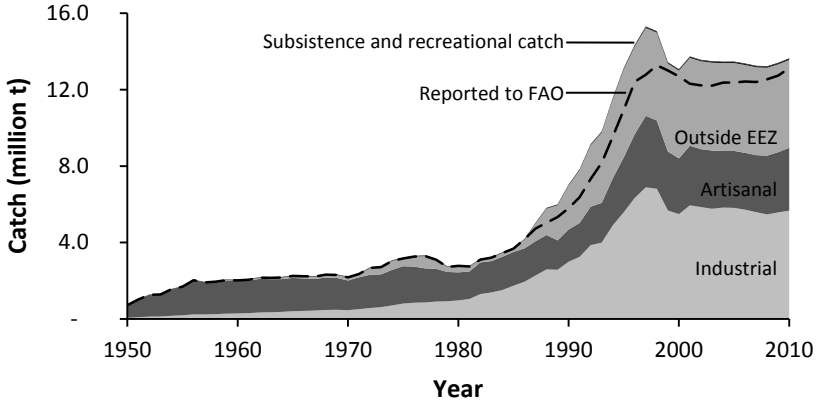

Figure 4. Total reconstructed catch for China, compared to the total catch reported to FAO (dashed line). The artisanal catch is shown in light grey, the industrial catch is shown in dark grey (both sectors operate within the EEZ), and the industrial catch outside the EEZ (distant-water fleets) is shown in medium grey. Subsistence and recreational catches, as well as industrial discards correspond to the thin, black area at the top.

[8] The match between our two estimates of recreational catch is a coincidence.

The relationship between artisanal and industrial catch (Figure 3) that we forced onto the estimated domestic catch of China, and which applied to South Korea (see Figure 3), yielded, for the period since 2000, an industrial catch of about 6 million t·year^{-1}, versus an artisanal catch of about 3 million t·year^{-1} (Figure 4). While this was not based on any official Chinese definition of artisanal fisheries (but rather on the definitions in South Korea), it appears more reasonable than the figure of 10.4 million t·year^{-1} (against 1.1 million for industrial fishing) suggested by FAO and World Fish Center (2008). That China's artisanal catch should be lower is confirmed by Govender (2013), who, on the basis of estimates of artisanal catches for over 100 other countries, established an empirical model for predicting countries' artisanal catch, given their inshore fishing area (Chuenpagdee *et al.* 2006) and other variables, and predicted, for China, an artisanal catch of 0.7 million t·year^{-1}.

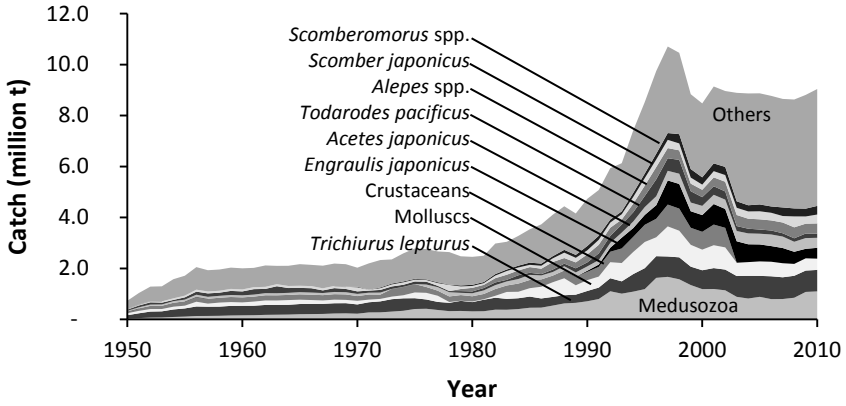

Figure 5. Taxonomic breakdown of the EEZ catch for China, 1950-2010, based primarily on the species (groups) reported by China to FAO, but with 'marine fish nei' disaggregated using catch composition data from South Korea and Taiwan (including a varying proportion of jellyfish; see text).

Figure 5 shows the species breakdown of China's domestic catches. Jellyfish (Medusozoa), Largehead hairtail (*Trichiurus lepturus*), various molluscs and crustaceans, Japanese anchovy (*Engraulis japonicus*), Akiami paste shrimp (*Acetes japonicus*), Japanese flying squid (*Todarodes pacificus*), scads (*Alepes* spp.), chub mackerel (*Scomber japonicus*), and seerfishes (*Scomberomorus* spp.) are the main taxa, and jointly represent 60% of the catch. For Figure 5 to remain understandable, all other taxa, each representing less than 2.5% of the catch, were pooled into 'others' (see Appendix Table 2 for more detailed breakdown).

However, the approximate correspondence between our estimate and official catches is not a confirmation that Chinese statistics are roughly correct after all, but a fortuitous coincidence. It is a coincidence because the overall catch levels in the years since 1998 are the result of a *political* decision taken in 1998, when China's central government decided that the ever increasing reported catch of the mid to late 1990s had become an embarrassment, and *decreed* that catches would not be allowed to grow beyond its 1998 value (see details in Pang and Pauly 2001; Chapter 3 in Pauly 2010). Had this decision been taken, say 2 years later, the official catch of China would have been around 18 million t·year^{-1}, given the rate at which reported catches were growing at the time.

While the first official corrections of the Chinese catch data that were made - after a face-saving interval of several years - were minimal (as noted in Pauly and Froese 2012), the last correction, presented in the 2012 FAO statistics (FAO 2012a) are substantial. It indeed reduced China's marine catch to little more than 13 million t·year^{-1}; about the same value that we obtain by adding the re-estimated domestic catch (as presented above) to the distant-water catch of Chinese fleet in Pauly *et al.* (2013). It is not clear whether the various corrections applied to FAO data come from FAO itself or from member countries. Some FAO officials argue that FAO never modifies the data contributed by member countries (Garibaldi 2012), while other senior officials publicly recognize that they commonly modify data if deemed necessary (Anon. 2013). Whatever the cause, the fact that the total catch now published by FAO and our estimate are similar is a coincidence, as we believe the Chinese domestic catch is still overestimated (by about 3.5 million t·year^{-1}),[9] while the distant-water catch of 4 million t·year^{-1} estimated by Pauly *et al.* (2013) is 3.5 times higher than the 1.15 million t·year^{-1} that Chinese officials admit to.

However, this coincidence is fortunate, because, as a result, we will not be required to use for China, in forthcoming global analyses, a total catch much different from the official statistics. Rather, it is the origin of these catches that will differ from what FAO presents.

Acknowledgments

This is a contribution of *Sea Around Us*, a scientific collaboration between the University of British Columbia and The Pew Charitable Trusts. We thank two Chinese colleagues for useful comments, but respect their wish to remain anonymous.

[9] Sampling surveys conducted in China from 2009-2012 suggest that its domestic marine catch is 8.5 - 10 million t·year^{-1} (pers. comm. from a Chinese expert who prefers to remain anonymous) and hence confirm our numbers.

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Appendix 1. FAO landings vs. reconstructed total catch (in tonnes), and catch by sector, for China, 1950-2010.

Year	Reported	Own EEZ Artisanal	Own EEZ Industrial	Own EEZ Recreational	Own EEZ Subsistence	Not in own EEZ Industrial
1950	716,000	658,000	61,900	0	6,550	0
1951	1,016,000	929,000	93,000	0	9,240	0
1952	1,264,000	1,148,000	122,000	0	11,430	0
1953	1,275,000	1,152,000	129,500	0	11,470	0
1954	1,550,000	1,393,000	165,100	0	13,860	0
1955	1,685,000	1,504,000	189,600	0	14,960	0
1956	2,018,000	1,789,000	239,300	0	17,800	0
1957	1,907,000	1,671,000	236,500	0	16,630	8,600
1958	1,945,000	1,681,000	253,400	0	16,730	19,800
1959	2,031,000	1,731,000	277,100	0	17,230	32,300
1960	2,015,000	1,694,000	287,300	0	16,850	43,500
1961	2,045,000	1,693,000	305,900	0	16,850	55,800
1962	2,154,000	1,754,000	339,100	0	17,460	71,100
1963	2,151,000	1,729,000	349,100	0	17,200	83,200
1964	2,166,000	1,710,000	370,300	0	17,020	96,200
1965	2,245,000	1,740,000	402,900	0	17,320	112,500
1966	2,229,000	1,694,000	421,000	0	16,860	124,400
1967	2,209,000	1,646,000	437,600	0	16,380	135,900
1968	2,311,000	1,697,000	470,200	0	16,880	155,300
1969	2,300,000	1,663,000	480,000	0	16,550	167,700
1970	2,168,000	1,548,000	459,800	0	15,400	170,400
1971	2,348,000	1,662,000	513,400	0	16,540	183,600
1972	2,662,000	1,735,000	572,000	0	17,260	367,400
1973	2,708,000	1,713,000	617,700	0	17,050	389,100
1974	3,037,000	1,858,000	708,400	0	18,490	482,900
1975	3,158,000	1,952,000	805,000	0	19,420	414,500
1976	3,257,000	1,887,000	847,600	0	18,770	536,600
1977	3,288,000	1,779,000	864,300	0	17,700	657,900
1978	3,093,000	1,708,000	907,500	0	16,990	490,300
1979	2,717,000	1,531,000	922,500	0	15,230	276,200
1980	2,772,000	1,465,000	968,800	0	14,580	350,400
1981	2,740,000	1,434,000	1,042,700	0	14,270	275,200
1982	3,105,000	1,651,000	1,302,600	0	16,430	165,600
1983	3,203,000	1,639,000	1,384,700	0	16,310	194,700
1984	3,445,000	1,739,000	1,511,100	0	17,300	211,900
1985	3,665,000	1,764,000	1,735,700	10,600	17,550	183,100
1986	4,165,000	1,744,000	1,943,300	16,900	17,360	496,400
1987	4,731,000	1,784,000	2,261,700	21,300	17,750	705,200
1988	5,028,000	1,793,000	2,580,900	24,700	17,850	675,400
1989	5,335,000	1,530,000	2,561,200	27,500	15,230	1,264,400
1990	5,790,000	1,683,000	2,979,300	29,900	16,750	1,151,100
1991	6,373,000	1,732,000	3,174,500	31,900	17,230	1,491,100
1992	7,325,000	1,958,000	3,751,100	33,700	19,490	1,643,500
1993	8,169,000	2,018,000	3,882,800	35,400	20,080	2,297,500
1994	9,539,000	2,408,000	4,779,800	36,800	23,960	2,387,200
1995	10,955,000	2,793,000	5,421,900	38,200	27,790	2,781,300
1996	12,419,000	3,261,000	6,191,000	39,400	32,450	3,014,300
1997	12,789,000	3,634,000	6,690,000	40,500	36,160	2,516,100
1998	13,270,000	3,514,000	6,701,900	41,600	34,970	3,104,500
1999	13,003,000	3,065,000	5,642,400	42,600	30,500	4,339,300
2000	12,695,000	2,898,000	5,453,500	43,500	28,840	4,385,600
2001	12,305,000	3,105,000	5,921,600	44,400	30,900	3,322,900
2002	12,222,000	3,025,000	5,846,900	45,200	30,100	3,393,700
2003	12,212,000	2,950,000	5,576,800	46,000	29,360	3,727,300
2004	12,368,000	2,891,000	5,688,300	46,700	28,770	3,830,800
2005	12,379,000	2,862,000	5,579,900	47,500	28,470	3,979,300
2006	12,428,000	2,873,000	5,528,500	48,100	28,590	4,067,500
2007	12,403,000	2,873,000	5,382,000	48,800	28,580	4,189,100
2008	12,543,000	3,011,000	5,352,300	49,400	29,960	4,221,700
2009	12,736,000	3,090,000	5,468,700	50,000	30,740	4,220,100
2010	13,128,000	3,222,000	5,557,200	50,600	32,060	4,392,300

Appendix 2. Reconstructed total catch (in tonnes) by major taxa for China, 1950-2010 as presented in Figure 5. Taxonomic categories composing less than 2.5% of total catch were grouped into "others".

Year	Medusozoa	*Trichiurus lepturus*	Miscellaneous marine molluscs	Miscellaneous marine crustaceans	*Engraulis japonicus*	*Acetes japonicus*	*Todarodes pacificus*	Alepes	*Scomber japonicus*	*Scomberomorus*	Others
1950	33,000	130,000	78,100	68,600	0	27,500	47,400	0	27,500	0	314,000
1951	50,700	188,000	96,600	98,900	0	39,600	73,500	0	39,600	0	444,000
1952	68,100	238,000	100,000	125,200	0	50,100	88,100	0	50,100	1	563,000
1953	73,300	242,000	92,300	127,200	0	50,900	71,200	0	50,900	0	586,000
1954	94,100	294,000	109,700	154,800	0	62,000	49,100	3	62,000	0	746,000
1955	108,400	322,000	109,100	169,400	0	67,700	89,000	0	67,700	0	775,000
1956	132,600	374,000	187,500	196,800	0	78,700	120,100	46	78,700	0	877,000
1957	134,400	363,000	121,800	190,900	0	76,400	134,100	0	76,400	0	827,000
1958	139,700	361,000	159,400	189,800	0	76,000	122,800	0	75,900	0	827,000
1959	152,800	377,000	150,300	198,600	0	79,500	159,700	0	79,500	0	828,000
1960	158,000	375,000	133,700	197,500	0	79,000	154,500	0	79,000	0	821,000
1961	163,400	373,000	162,700	196,300	0	78,500	213,100	0	78,500	0	750,000
1962	177,100	389,000	176,600	204,900	87	82,000	166,300	0	82,000	0	833,000
1963	182,500	387,000	172,500	203,800	0	81,500	274,100	0	81,500	0	712,000
1964	187,900	385,000	186,300	202,500	107	81,000	188,600	0	81,000	9	785,000
1965	202,400	401,000	170,300	210,800	0	84,300	168,100	0	84,400	5	839,000
1966	208,500	398,000	154,300	209,500	102	83,800	169,900	15	83,800	0	824,000
1967	213,400	396,000	134,600	208,300	0	83,300	102,500	0	83,300	0	879,000
1968	230,400	403,000	141,400	216,400	105	86,600	150,000	0	86,600	15	870,000
1969	236,200	400,000	129,800	215,000	0	86,000	127,700	20	86,100	4	878,000
1970	222,600	364,000	142,800	185,900	0	86,200	98,200	1	160,900	24,700	738,000
1971	272,600	399,000	103,400	201,200	0	71,700	81,600	0	34,000	0	1,028,000
1972	276,000	431,000	97,400	170,300	0	78,400	103,900	0	68,100	28,500	1,070,000
1973	305,700	487,000	101,600	301,900	0	4	97,000	31	80,400	31,500	942,000
1974	337,400	490,000	120,000	331,000	0	10	81,200	4	96,300	33,200	1,096,000
1975	407,500	424,000	227,000	328,500	0	5	102,400	0	74,000	29,400	1,184,000
1976	416,500	365,000	262,000	229,200	0	97,000	110,900	0	66,500	23,800	1,181,000
1977	369,300	317,000	242,400	199,800	0	138,600	51,500	0	108,800	30,900	1,203,000
1978	322,700	328,000	30,300	219,400	2	165,800	46,000	0	239,500	13,200	1,267,000
1979	331,100	396,000	6,200	221,700	0	88,800	67,400	82,700	101,700	38,400	1,135,000
1980	314,400	364,000	22,900	207,300	0	117,300	71,900	141,400	73,800	45,300	1,090,000
1981	319,700	452,000	18,700	208,200	0	140,600	91,600	125,400	66,600	43,700	1,024,000
1982	381,300	471,000	75,300	266,300	0	152,600	104,900	168,900	102,100	58,100	1,190,000
1983	378,400	428,000	273,600	254,800	4	158,900	62,800	201,100	145,700	58,800	1,078,000
1984	405,100	426,000	254,700	323,000	357	178,200	147,600	189,100	117,200	70,900	1,155,000
1985	457,000	439,000	331,200	323,500	0	200,200	82,100	223,900	88,600	86,700	1,295,000
1986	461,500	362,000	461,000	289,400	27	155,600	52,600	211,500	118,200	84,100	1,526,000
1987	540,500	339,000	575,200	261,100	995	140,000	95,400	297,100	143,600	85,300	1,606,000
1988	625,500	322,000	664,800	304,800	0	167,000	101,100	220,100	210,900	109,400	1,692,000
1989	647,700	322,000	366,800	335,300	0	167,800	162,500	231,700	178,800	114,300	1,607,000
1990	709,800	404,000	424,900	323,300	43,900	171,400	156,900	314,500	159,600	169,100	1,831,000
1991	782,000	441,000	422,800	373,500	89,000	170,800	259,100	330,400	190,900	157,900	1,738,000
1992	1,075,100	499,000	614,300	398,900	154,200	183,100	268,700	313,800	194,600	117,500	1,943,000
1993	984,700	471,000	700,600	558,600	414,100	194,500	307,400	193,200	202,000	107,800	1,823,000
1994	1,069,000	676,000	851,600	581,700	337,900	251,200	357,100	331,700	258,700	156,100	2,377,000
1995	1,158,500	801,000	1,001,000	657,000	377,100	300,700	423,600	397,200	286,800	174,900	2,703,000
1996	1,598,900	834,000	727,400	711,800	522,400	344,300	650,500	472,900	291,400	220,800	3,149,000
1997	1,628,500	779,000	1,150,500	834,100	922,800	368,600	481,400	388,500	313,900	261,300	3,272,000
1998	1,555,200	851,000	1,031,000	856,300	955,000	397,900	534,600	370,700	267,900	359,900	3,114,000
1999	1,344,900	720,000	853,600	666,900	646,400	341,400	442,900	296,200	237,300	334,700	2,896,000
2000	1,185,700	738,000	807,200	697,000	656,300	359,000	341,400	288,400	201,400	285,200	2,864,000
2001	1,192,900	820,000	897,000	809,000	806,200	361,900	334,500	348,400	244,000	305,700	2,982,000
2002	1,146,100	815,000	872,300	768,800	742,500	366,200	322,100	381,600	262,900	320,400	2,950,000
2003	858,100	795,000	506,500	0	816,800	391,300	189,000	421,500	273,700	247,000	4,104,000
2004	802,700	873,000	527,500	0	685,200	418,800	179,500	384,100	280,400	236,700	4,267,000
2005	853,300	793,000	546,800	7	641,300	405,700	157,800	386,000	304,200	259,000	4,171,000
2006	770,900	869,000	553,600	0	597,400	441,100	151,600	383,800	290,900	241,100	4,179,000
2007	773,000	824,000	532,500	2	576,800	434,900	124,300	408,200	245,900	325,500	4,086,000
2008	832,800	847,000	457,200	0	467,900	385,400	134,000	422,400	420,500	308,900	4,166,000
2009	1,060,700	825,000	471,800	222	367,800	414,300	175,800	380,000	279,400	302,000	4,362,000
2010	1,079,700	829,000	434,600	1,105	417,500	387,300	163,000	393,100	343,500	332,800	4,480,000