

Reconstructed marine fisheries catches of the Philippines, 1950-2010¹

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Abstract

This contribution synthesizes the results of the other contributions in this report, and estimates additional time series such that the total reconstructed catch of the Philippines marine fisheries covering the period 1950-2010 can be presented. Overall, the annual reconstructed catches in the Philippine EEZ were about 0.24 million t-year⁻¹ in the early 1950s, which increased and then plateaued in the late 1970s at around 0.9 million t-year⁻¹. Expansion into more offshore, pelagic stocks in the late 1980s then enabled a new growth phase, which led to about 2.4 million t-year⁻¹ being reached in 2010. Overall, this is 0.96 times the catch reported by FAO on behalf of the Philippines; while the adjusted reported FAO catch estimated from the reconstructed catch is 0.86 times that of the reported FAO catch. The industrial sector (including so-called ‘baby trawlers’ and unreported catch) contributed 66 % of the catch, the rest consisting of artisanal fisheries (23 %) and subsistence (11 %), recreational fisheries and industrial discards being minimal (0.6 %). Overfishing is ubiquitous, as is ‘fishing down’, but efforts are made to counter these, notably through a multitude of marine protected areas, a tool pioneered in the Philippines.

While our reconstructed estimates do not differ strongly from the official estimates, they are based on completely different assumptions about the balance between the industrial and artisanal catch (the latter being re-estimated from the bottom up). Therefore, if the new catch estimates are considered realistic, they should imply a serious re-examination of the Philippine fisheries statistics system.

Introduction

The Philippine fisheries statistics are extremely complex, in terms of their geography, the many species that are exploited, the different gears that are used and even in terms of the literature devoted to this subject. Thus, there are hundreds of papers discussing one of their many aspects or detailing the species caught or the gears used at certain locations, many more than cited in this report. However, there are extremely few, if any reliable accounts, that cover comprehensively the country’s fishing industry. Moreover, while usually extremely detailed and available in multiple forms, the fisheries statistics of the Philippines leave much to be desired with regards to their reliability, notwithstanding their apparent precision (e.g., millions of tonnes are routinely reported with a precision to the fraction of a kilogram).

The fundamental unreliability of the catch statistics of the Philippines is due to the catches of one sector, the ill-named “commercial” fisheries being linked through fixed ratios to the equally ill-named “municipal” catch such that if the former increase, so does the latter. While our attempt at re-evaluating the fisheries catches of the Philippines cannot reliably estimate how much has historically been caught since 1950, we have attempted to overcome the worst consequences of the linkage between the industrial (‘commercial’) and artisanal (‘municipal’) catches in the Philippines, by estimating artisanal catches independently from the industrial catch (see Parducho and Palomares, this vol.; Palomares and Parducho,

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this vol.; Cabanban *et al.* this vol.; Parducho and Palomares, this vol.). Also, we have taken this opportunity to partly correct the officially reported industrial catches by accounting for:

1. Unreported domestic industrial catch;
2. Industrial catches reported from Philippine waters, but likely taken in Indonesian, Papua New Guinean or Malaysian waters;
3. Non-marketable part of the industrial catch that is better counted as subsistence catch;
4. A small fraction of discards, for demersal and tuna fisheries; and
5. Industrial catches taken by so-called baby trawlers and considered as ‘municipal’ (i.e., artisanal) catch under current regulations².

After these corrections, we added estimates of artisanal catch based on separate analyses of 4 ‘subzones’ of the Philippines (Figure 1), of subsistence catch based on studies of gleaning (e.g., Palomares *et al.* Cabanban *et al.* this vol.) and estimates of ‘home fish’ taken by artisanal and industrial fishers (i.e., catch retained for self and family consumption), and a first estimate of recreational catches. Jointly, these estimates generated a total catch which, as we shall see, is 4% less than that reported by the FAO.

We present the component time series, and the total catch of the Philippines after briefly outlining the methods used to estimate artisanal and subsistence catches detailed elsewhere in this report and after presenting the method used to adjust the industrial catch, as mentioned above.

Material and Methods

Regarding item (1) above, we downloaded the nominal marine catch for the Philippines (1950-2010) from the Bureau of Agricultural Statistics (BAS) and the Bureau of Fisheries and Aquatic Resources (BFAR) and from the Food and Agriculture Organization of the United Nations (FAO) websites (FAO FishStat; see <http://www.fao.org/fishery/statistics/software/fishstat/en>). We eliminated non-fish vertebrates (marine mammals, seabirds, sea turtles), corals and algae from the Philippines and FAO data sets and compared them to evaluate the effectiveness of the transfer from the Philippine authorities to the FAO.

To accommodate item (2) above, we added 30 % to all Philippines reported ‘commercial’ (industrial) catches to account for underreported catches (Davies *et al.* 2009; Palomares and Pauly, this vol.). The industrial catch landed in Subzone D (i.e., bordering Sabah, East Kalimantan, Sulawesi and the Maluku) is known to include tuna caught outside of the Philippine EEZ (see Barut and Garvilles 2006; Palma and Tsamenyi 2008). Given estimates of foreign tuna catch (by Philippine flagged vessels fishing with or without access agreements; see BFAR/WCPFC 2012) at 27,408 t (2006), 49 876 t (2008) and 68,000 t (2009; see BFAR 2012), we ‘shaved off’ 24-33% of skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacores*) and bigeye tuna (*Thunnus obesus*) landed in Subzone D for the period 1980-1990, i.e., the period when Filipino fishers from this subzone most likely expanded to waters outside of the Philippine EEZ (see Vera and Hipolito 2006; BFAR/WCPFC 2012). The shaved-off catch was allocated to Indonesia (70 %), Papua New Guinea (20 %) and Malaysia (10 %), and was assumed to consist of 50 % skipjack, 40 % yellowfin, and 10 % bigeye tuna (Table 1; see also Aprieto 1995).

To avoid the double counting of non-marketable fish implied in (3), the small amount of such fish was subtracted from the national reported ‘commercial’ (industrial) catch. Regarding (4), discards as unreported catch were estimated as 1 % of the unreported tuna catch (Bailey *et al.* 1996) and 3% of the unreported demersal catch (Selorio *et al.* 2008).

² In line with Martín (2012), we consider all gear dragged across the bottom or through the water as ‘industrial’ (i.e., large-scale) rather than ‘artisanal’.

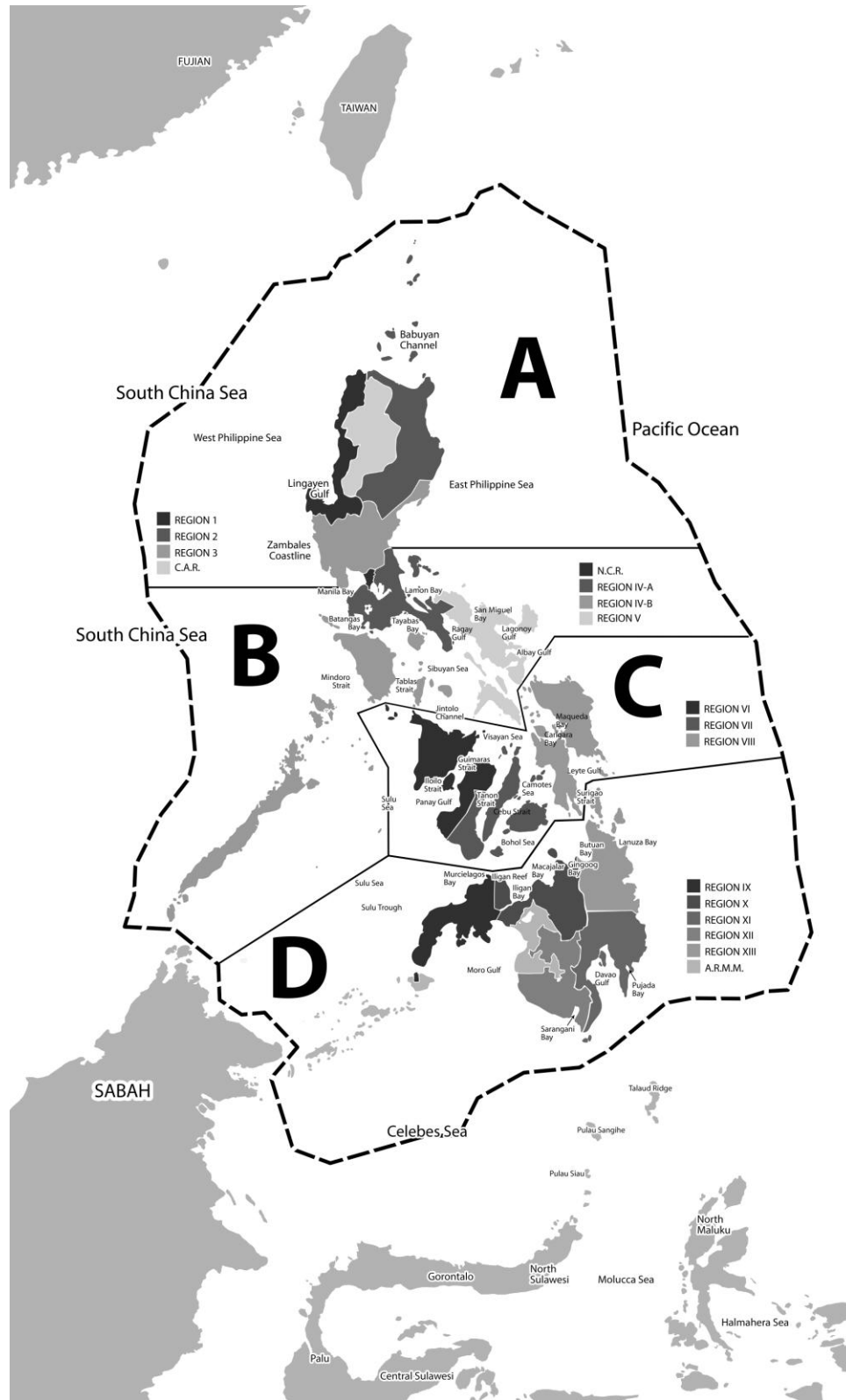


Figure 1. The Philippines, its Exclusive Economic Zone (EEZ) and the 4 subzones into which the EEZ was subdivided to obtain 4 independent and subsequently pooled estimates of artisanal catch of the Philippines (see text; redrawn by Mr. Mike Yap from a composite of several open source maps).

Table 1. Subset of the officially reported commercial (industrial) tuna catch (in $t \cdot 10^3$) of the Philippines that are here assumed to have been taken outside of the Philippine EEZ, in Sabah (Malaysia), Eastern Indonesia and Western Papua New Guinea, but landed in Subzone D (see Figure 1).

Year	Skipjack			Yellowfin			Bigeye			Total
	PNG	Indonesia	Sabah	PNG	Indonesia	Sabah	PNG	Indonesia	Sabah	
1980	0.57	1.99	0.28	0.45	1.59	0.23	0.11	0.40	0.06	5.69
1981	0.50	1.75	0.25	0.40	1.40	0.20	0.10	0.35	0.05	4.99
1982	0.81	2.82	0.40	0.65	2.26	0.32	0.16	0.56	0.08	8.06
1983	1.03	3.61	0.52	0.83	2.89	0.41	0.21	0.72	0.10	10.32
1984	1.26	4.40	0.63	1.01	3.52	0.50	0.25	0.88	0.13	12.57
1985	1.17	4.08	0.58	0.93	3.26	0.47	0.23	0.82	0.12	11.66
1986	1.07	3.76	0.54	0.86	3.01	0.43	0.21	0.75	0.11	10.74
1987	0.98	3.44	0.49	0.79	2.75	0.39	0.20	0.69	0.10	9.83
1988	0.89	3.12	0.45	0.71	2.50	0.36	0.18	0.62	0.09	8.92
1989	1.48	5.19	0.74	1.19	4.15	0.59	0.30	1.04	0.15	14.82
1990	1.78	6.25	0.89	1.43	5.00	0.71	0.36	1.25	0.18	17.84
1991	2.12	7.43	1.06	1.70	5.95	0.85	0.42	1.49	0.21	21.24
1992	1.55	5.42	0.77	1.24	4.33	0.62	0.31	1.08	0.15	15.48
1993	1.25	4.37	0.62	1.00	3.49	0.50	0.25	0.87	0.12	12.48
1994	1.80	6.31	0.90	1.44	5.05	0.72	0.36	1.26	0.18	18.03
1995	2.38	8.32	1.19	1.90	6.66	0.95	0.48	1.66	0.24	23.78
1996	2.67	9.33	1.33	2.13	7.46	1.07	0.53	1.87	0.27	26.65
1997	3.79	13.27	1.90	3.03	10.62	1.52	0.76	2.65	0.38	37.92
1998	2.09	7.32	1.05	1.67	5.86	0.84	0.42	1.46	0.21	20.93
1999	2.16	7.55	1.08	1.72	6.04	0.86	0.43	1.51	0.22	21.56
2000	2.22	7.76	1.11	1.77	6.21	0.89	0.44	1.55	0.22	22.18
2001	2.38	8.33	1.19	1.90	6.66	0.95	0.48	1.67	0.24	23.80
2002	3.92	13.72	1.96	3.14	10.98	1.57	0.78	2.74	0.39	39.20
2003	5.23	18.32	2.62	4.19	14.65	2.09	1.05	3.66	0.52	52.34
2004	5.85	20.49	2.93	4.68	16.39	2.34	1.17	4.10	0.59	58.54
2005	2.19	7.68	1.10	1.75	6.14	0.88	0.44	1.54	0.22	21.93
2006	5.28	18.49	2.64	4.23	14.79	2.11	1.06	3.70	0.53	52.82
2007	4.37	15.28	2.18	3.49	12.23	1.75	0.87	3.06	0.44	43.66
2008	3.97	13.91	1.99	3.18	11.13	1.59	0.79	2.78	0.40	39.74
2009	6.21	21.73	3.10	4.97	17.38	2.48	1.24	4.35	0.62	62.09
2010	4.62	16.17	2.31	3.70	12.93	1.85	0.92	3.23	0.46	46.19

Regarding item (5), i.e., correcting for 3 GT ‘baby trawlers’ being counted as ‘municipal’ (artisanal) gear which, because they drag a net, must be considered as an industrial gear (Martín 2012), we complemented the reported ‘municipal’ catch of baby trawlers by a linear increase from zero in 1950 (when dug out trawls were developed in Manila Bay; Caces-Borja 1966; see also Smith and Pauly 1983) to the 1978 reported catch (see Appendix A). Then, we assumed that the prohibition of active gears in ‘municipal’ waters in 1998 (Article II, Chapter 6, Section 90 of Republic Act 8550; see also Carandang *et al.* 2013), and the 5-year closures of the trawl and purse seine fisheries in 1981 in the waters of Bohol, Cebu and Negros Oriental (Fisheries Administrative Orders 130-132), in 1982 in Palawan (Fisheries Administrative Order 137), and in 1983 in Batangas (Fisheries Administrative Order 142), implied that baby trawl operations were also illegal. These prohibitions and closures imply an exponential decline in baby trawl annual catches (which we assume at 20%), because, if followed at all, would have been implemented only gradually.

The estimation of artisanal catch by subzone was discussed in Parducho and Palomares (this vol.) for subzones A and D, Palomares and Parducho (this vol.) for subzone B, and Cabanban *et al.* (this vol.) for subzone C and does not need reiterating here. Suffice to say that it is based on catch per fisher estimates

multiplied by the number of fishers per subzone and thus is completely independent of official fisheries statistics.

The subsistence catch consisting of reef gleaning estimates and a fraction of the take-home catch of artisanal and industrial fishers (see item (3) above) also did not depend on officially reported data. A description of how the take-home catch was estimated is available in Cabanban *et al.* (this vol.).

Finally, the marine recreational fisheries catches of the Philippines are described in Espedido *et al.* (this vol.) and the time series of catch estimated therein was simply added to the other time series described above.

Results and Discussion

Figure 2 shows the reconstructed total catches (in solid gray line), the officially reported marine catches on behalf of the Philippines by the FAO (broken gray line) and the EEZ-adjusted catches of the reported FAO catches superimposed on the area graph of the industrial, artisanal, subsistence and recreational sectors and the discards of the industrial sector. The reconstructed catches are lower than the FAO statistics by an average of 4% and with peak differences in the 1970s-1980s (-14%). We can hypothesize that the peak differences in the 1970s-1980s occur due to the raising factor (described in Palomares *et al.* this volume) adopted by BFAR in the 1970s and subsequently by BAS in the 1990s applied to a sample data that were probably not representative of the Philippine catches during that period. Note that this period was marked by government budget cuts which affected the fisheries statistics collection program. The reconstructed catches are higher in the late 1990s to the 2000s by 2%, which, as can be deduced from the EEZ-adjusted catch curve, is due to the addition of unreported and discarded catches. We list some facts from recent sources which might shed light on why our reconstructed catches have this behavior, i.e.:

- Palma (2007) outlines the problems of unreported, unregulated and illegal catches in the Philippines, which occurs in both the artisanal and industrial sectors;
- The industrial fishery (large purse seines) targets oceanic tuna, while the handline artisanal fishery targets both oceanic and neritic tunas (BFAR 2012);
- The artisanal fishing fleet (handlining pumpboats), on the other hand, is potentially composed of more than 2,500 unregistered vessels, i.e., traditional/local fishers (Palma 2007) either selling their catch directly to foreign vessels or likely infringing on international waters and landing their catch in the Mindanao ports;
- The Philippine distant water fleet, mostly based in the southern Philippines, targets tuna (yellowfin and skipjack), billfishes and other large pelagic species including sharks (as bycatch), reef fishes (for the live fish trade), corals and marine mammals, with illegal foreign catch estimates in Philippine waters reaching 80,000 t per year (Palma and Tsamenyi 2008);
- The Western Central Pacific Fisheries Commission lists 625 vessels fishing in the region, which does not include other industrial vessels fishing exclusively in Philippine waters (BFAR 2012), and whose catch may not be monitored by the WCPFC or by the BFAR;
- There are 150,370 registered fishing vessels in the Sulawesi Sea, 4% of which are large industrial vessels mostly flying the Philippine flag, whose catch are landed in Zamboanga, Davao and General Santos City (i.e., 3 of the 8 regional fish ports in the Philippines). The tuna canneries in General Santos City alone get 70% of their tuna from Philippine waters and the rest from Indonesian waters (Palma and Tsamenyi 2008), likely landed in General Santos City;
- Foreign vessels land their catches in the Davao Fish Port Complex, which is an alternative transshipment point in Asia (Palma and Tsamenyi 2008);

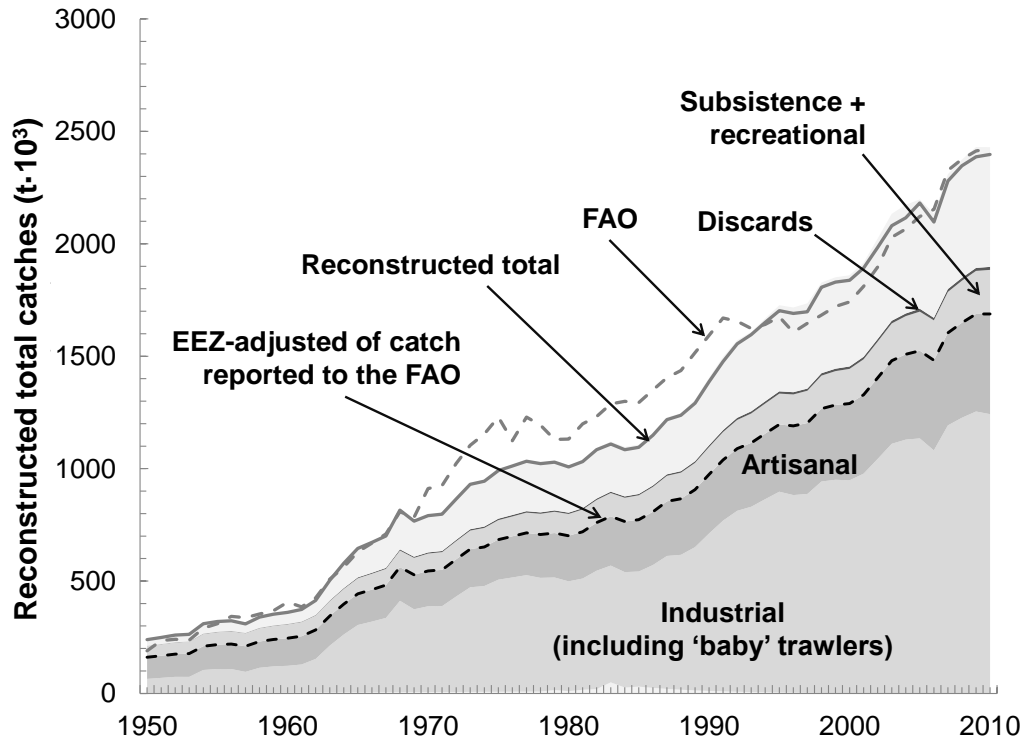


Figure 2. Reconstructed Philippine marine capture fisheries catches (1950-2010) compared with nominal marine catch for the Philippines reported by the Bureau of Fisheries and Aquatic Resources (BFAR; 1950-1979) and Bureau of Agricultural Statistics (BAS; 1980-2010) to the Food and Agriculture Organization of the United Nations and superimposed on area graphs of the component fisheries.

- BFAR/WCPFC (2012) reports that the differences in catch estimates after reconciliation of the different estimates from the national data sources are due to “*the diverse municipal fisheries [...] explained as possible bias in the probability surveys due to very low coverage. The workshop participants noted that while the industrial fleet estimates are now becoming more reliable, there is still a major problem in determining and validating the estimates of the small-scale municipal fisheries that needs to be resolved in the near future.*”
- Landings from the fish ports mentioned above figure into the national statistics, which are submitted as is to the FAO (BFAR/WCPFC 2012).

These various facts indicate that: (i) our estimation of tuna catches from international waters is justified, but might be a conservative estimate given that foreign vessels land tuna in Philippine fish ports monitored regularly by the Philippine government; and (ii) our estimation of the unreported catch might be lower than what happens in reality because we only accounted for unreported catches from the Philippine industrial fleet assuming a 30% markup and did not account for illegal catches by foreign vessels and unregulated catches by Filipino pumpboats. It may thus be that our reconstructed catch is a rather conservative estimate.

Note that the trends of the FAO and reconstructed catches resemble each other from the 1950s-1960s and the late 1990s onwards. This similarity is only fortuitous, as these time series are built based on completely different assumptions, i.e., the artisanal catches were not based on the ‘municipal’ catches reported by BFAR.

The industrial sector, which is composed of the BFAR/BAS reported industrial landings plus the reconstructed baby trawl catches based on BFAR/BAS reported ‘municipal landings’, dominates the total catches (66%). Discards, which are usually prominent in other countries, are virtually inexistent (0.54%) in Philippine fisheries. Recreational fisheries, though practiced, represent an even smaller sector (0.01%) and were thus added to the subsistence sector (11%) for ease of presentation.

Figure 3A presents the summary of the taxonomic composition of the catch. However, because the marine catch of the Philippines is extremely diverse – there are more than 100 species and species groups caught in the Philippines (which is, after all, at the global center of marine diversity; Carpenter and Springer 2005) – we have abstained from presenting a species-level taxonomic resolution, and used broader taxa instead. Pelagic fisheries dominate the total reconstructed catches, with large volumes of round scads consistently dominating from the 1950s onwards. Slipmouths (Family Leiognathidae) ranked 2nd until the 1970s and were increasingly replaced by Indian sardines from the 1990s onwards. The catch of tuna species (notably of skipjack) increased from the 1990s onwards, most likely a direct result of the increased use of fish aggregating devices (Aprieto 1995; Floyd and Pauly 1984) in conjunction with the increased ability of smaller outrigger boats to travel faster and farther into the open seas. Note that fish aggregating devices also had the effect of aggregating juvenile pelagic fishes, tuna and non-tuna alike (Babaran 2006), thus, enabling the catch of smaller pelagic species such as anchovies, sardines, mackerels and fusiliers at high levels. Detailed data on species composition of the catch will be available from the *Sea Around Us* database.

Figure 3B complements Figure 3A, with an analysis of the mean trophic level of the reconstructed industrial catch, i.e., for which landings data were disaggregated to the species-level. This analysis implies that the presence of the ‘fishing down the food web’ phenomenon (Pauly *et al.* 1998) is strong for tuna catches and clearly discernable in the non-tuna catches (see also Pauly and Palomares 2005; Pauly *et al.* 2000). Note the apparent cycles in increase and decline of the trophic level of the catch, which we tentatively attribute to successive phases of offshore expansion.

Tuna was considered a “second class” fish by Filipinos in the 1950s (Avery 1952) and was targeted mostly by hand liners (Aprieto 1995), probably to satisfy the American taste (Avery 1952). Species likely targeted in the 1950s would be inshore species like bigeye (*Thunnus obesus*; trophic level=TL=4.5, s.e.=0.8), eastern little (*Euthynnus affinis*; TL=4.5, s.e.=0.8), frigate (*Auxis thazard*; TL=4.3, s.e.=0.7) and bullet tuna (*Auxis rochei*; TL=4.1, s.e.=0.6; Barut 2007). Thus, the mean trophic level of the tuna industrial catch at this time was between 4.3 and 4.4. The 1960s were marked by the introduction of effective fishing gears (e.g., trawls and purse seines; see Lewis 2004) resulting from BFAR sanctioned research and surveys in the 1950s (Warfel and Manacop 1950; Ronquillo *et al.* 1960). In the 1970s, Presidential Decree No 704³ sanctioned the development of the fishing industry by increasing the number of trawling operations and improving the ‘fisheries loan and guarantee fund’, i.e., fisheries subsidies. The tuna fishery grew to about 245 vessels operated by 55 companies, using lights at night and employing fish aggregating devices harvesting not only tuna but also small pelagic fish species like sardines (see Lewis 2004), increasing the catch of yellowfin (*Thunnus albacares*; TL=4.3, s.e.=0.7) and skipjack tuna (*Katsuwonus pelamis*; TL=3.8, s.e.=0.6). Similar trends occurred in the demersal fisheries, which led to the overexploitation and growth overfishing of most nearshore stocks as recorded in Manila Bay (Silvestre *et al.* 1987; Muñoz 1991), San Miguel Bay (Smith and Pauly 1983; Lim *et al.* 1995; Soliman and Dioneda 1997), Pangul Bay (Dickson 1987), and Lagonoy Gulf (Soliman *et al.* 2009).

³ <http://www.bfar.da.gov.ph/pages/legislation/presdecree704.html>

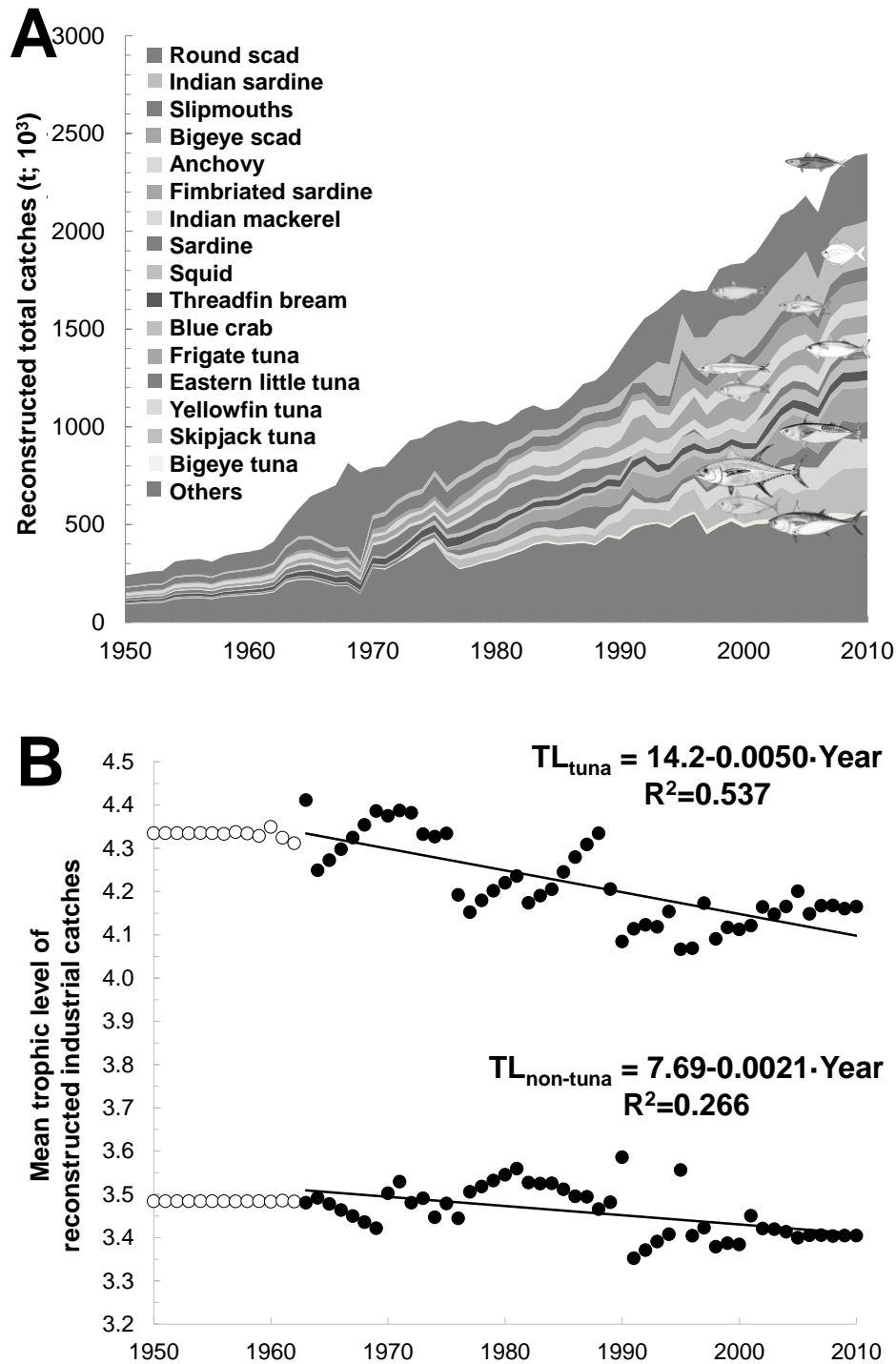


Figure 3. Two views of the reconstructed Philippine marine capture fisheries catches (1950-2010). A. Showing the top 12 species and species groups and the five tuna species, making 90% of the catch. Note the increasing contribution of pelagic fisheries. The same data, disaggregated by species may be found on www.seaaroundus.org. B. Mean trophic level of the reconstructed Philippine marine industrial fisheries catch (i.e., sum of reported landings, estimated underreported catches and discards and baby trawl catches reconstructed from nationally reported ‘municipal’ landings), and distinguishing between tuna and non-tuna catches, i.e., between offshore and inshore ecosystems, respectively.

The trend toward offshore expansion, which led to an increase of the contribution of pelagic fishes to the Philippine catch, also led to a blurring of the distinction between domestic and foreign catches by Philippine vessels. We have attempted here to correct for the latter effect, but we expect that our attempt to separate these catches remains imperfect. We have also not attempted to investigate the legal basis – if any – of foreign fishing by Philippine vessels in the EEZ of neighbouring countries. We note however, the bilateral access agreements between the Philippines and Indonesia, which permitted “255 fishing vessels and 300 Filipino lightboats” to fish in a defined area of the Indonesian EEZ was established in 2002 and, which, for all intents and purposes, is still honored in spite of its ending in 2007 (APEC 2008). Similarly, this account does not cover illegal fishing by other countries in the waters deemed to belong to the Philippine EEZ, although it is evident that at least one country not only has multiple vessels operating in the Western part of the Philippine EEZ (Pauly *et al.* 2013), but contests the Philippine claim of an EEZ in the South China Sea.

We conclude this by reiterating that the catch reconstruction presented in this report has not led to a definite account of the historic fisheries catches of the Philippines. Rather, we hope to have provided, along with clear definitions for describing the marine fisheries of the Philippines, an alternative methodology for estimating their catches. We hope that these definitions and methodology will be found useful, and contribute to a much-needed reform of the Philippine fisheries statistical system.

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