Fisheries Centre

The University of British Columbia

Working Paper Series

Working Paper #2015 - 10

Reconstruction of total marine catches for Aruba, southern Caribbean, 1950-2010

Daniel Pauly, Sulan Ramdeen and Aylin Ulman

Year: 2015

Email: d.pauly@ fisheries.ubc.ca

Reconstruction of total marine catches for Aruba, southern Caribbean, 1950-2010

Daniel Pauly, Sulan Ramdeen and Aylin Ulman

Sea Around Us, Fisheries Centre, University of British Columbia,
2202 Main Mall, Vancouver, Canada, V6T 1Z4
d.pauly@fisheries.ubc.ca; s.ramdeen@fisheries.ubc.ca; a.ulman@fisheries.ubc.ca

Abstract

Consistent and reliable island-wide fisheries catch data are a challenge for many Caribbean countries. This report represents the reconstruction of total marine fisheries catches by Aruba, in the Lesser Antilles, about 27 km north of the Venezuelan coast, for the 1950-2010 period. The cumulative reconstructed domestic fisheries catches were estimated to be just over 36,300 t, or 75% more than the 20,676 t reported by FAO on behalf of Aruba. However, this is still a conservative estimate based on the limited information available. Although imports play an important role in meeting local seafood demand, which is magnified by tourism, small-scale fishing is likely being underestimated. More comprehensive time data series on total marine catches will enable fisheries managers to make more informed decisions when regulating the fisheries of Aruba.

Introduction

Aruba (12°30'N, 69°58'W) is part of the island chain of the Leeward Netherland Antilles, which also includes the islands of Bonaire and Curaçao (Figure 1). The islands of the Netherland Antilles were all governed by the Central Government of the Netherland Antilles, but Aruba separated from the rest of the Netherland Antilles in 1986. However, its government has remained tied to the Kingdom of the Netherlands.

Aruba, even before separating in 1986, was insistent on having its own fisheries regulations, but the Aruban fisheries agency, i.e., the Fisheries Section in the Department of Agriculture, Animal Husbandry and Fisheries is very similar in structure to its counterparts in the Netherlands Antilles.

Fishing is not a primary industry in Aruba, as it contributes, according to Wikipedia, less than 1% of its Gross Domestic Product. However, since Aruba has a thriving marine-based tourism industry (based on scuba diving and game fishing), it holds an interest in maintaining the biodiversity of both the pelagic ecosystem and the coral reefs surrounding the island.[1] Indeed, as Aruba is located on the northern fringe of the South American Continental shelf and has "extensive shallow water areas" Weidner *et al.* (2001), demersal and reef-associated fish such as snappers and groupers are of greater importance than in other parts of the Lesser Antilles. In part due to the excellent berthing facilities available in Aruba and Curacao, large oil refineries have been established there. As these facilities require large numbers of workers, the fisheries did not experience the influx of excess labor which occurred in other tropical developing countries or territories (Pauly 2006). Indeed, when first attempts were made at developing Aruban fisheries, labour shortage was a major obstacle, even as early as the early 1950s (Van Gelderen 1953).

Figure 1. Aruba and its Exclusive Economic Zone, north of Venezula.

As a result, Aruba imports a large fraction of the seafood that its inhabitants and visiting tourists consume. Currently, these imports come predominantly from Venezuela, while earlier, seafood was imported from a wide range of countries (see Table 12 in Zaneveld 1962), including the USA, from which came "dried shrimps in barrels and in tins" (Van Gelderen 1953).

[1] FishBase reports 577 species of marine fishes from the EEZ of Aruba (see www.fishbase.org)

Methods

General considerations and adjustment of the artisanal catches

The commercial fisheries of Aruba are essentially artisanal in character, with the fishers using small-scale gear, operating near the coast, and selling the bulk of their catch. This differs from subsistence fishing, where the bulk of the catch is consumed by the fishers, their families and friends (see below). A review of all available literature (peer-reviewed and grey, online and archived) was undertaken to obtain the information required to reconstruct Aruba's total fisheries catches (artisanal, subsistence, recreational, and foreign/industrial) for the period 1950-2010 following the approach of Zeller *et al.* (2007).

The landings data in the FAO's Fishstat database, which presents in standardized format the catch statistics submitted by its member countries, including Aruba, were used as the reported catch baseline of this reconstruction. These 'official' data were modified as follows:

1. The baseline (artisanal) catches for the period from 1950 to 1965 were set at 300 $t \cdot year^{-1}$ (see Table 7 in Zaneveld 1962), rather than the lower and/or fluctuating values reported by FAO for these early years;
2. The artisanal catch increase from the late 1970s to the late 1980s in the FAO data appear to be an artefact, as these high catches, including a peak of 790 t, were much too high to be realistic (G. Van Buurt, Head, Curaçao Fisheries Section, pers. comm. to Weidner *et al.* 2001). Here, we settled on an increase to 500 t for 1978-1988, even though this value still seems high;
3. The reported catch time series of Lutjanidae (snappers) and '*Epinephelus* spp.' (groupers, Serranidae), which were taxonomically distinguished from the 'marine fishes nei' category only from 1995 onwards, were plotted against year, and the resulting regressions (Figure 2; Figure 3), which suggested higher early contributions of these two taxa to the 'marine fishes nei' category, were used to infer early catches of snappers and groupers. These catches were disaggregated out of 'marine fishes nei';
4. The residual (non-snapper and non-grouper) fish catches (i.e., the remainder of 'marine fishes nei') were disaggregated using a list of "preferred" fish (see Table 2 in Zaneveld 1962). Half of the 'marine fishes nei' catches were assumed to belong to the "highly preferred" and the other half to the "moderately preferred" category (Table 1); Istiophoridae were accounted for in the "moderately preferred" category only from 1950-1973, and from 1997-2010, and were reported by FAO as a distinct category in between those periods;
5. As sources indicated the presence of a fishery for Queen conch (*Strombus gigas*), lobster (*Panulirus argus*) and 'shrimps' (Penaeidae, without providing quantitative information), a catch of the equivalent of 1% of the demersal fish catch was added to represent, however inadequately, each of these three neglected components;

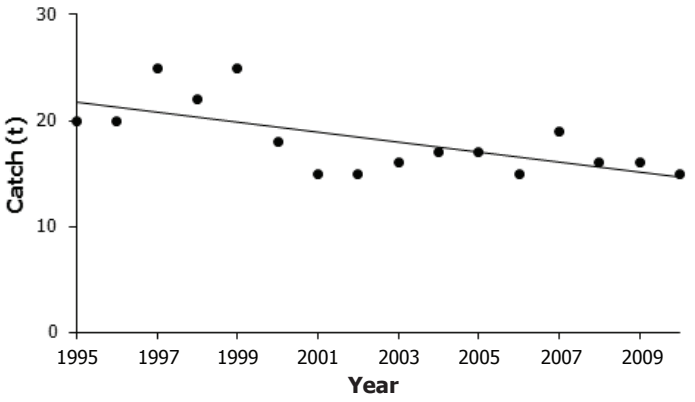

Figure 2. Time series (1995 – 2010) of the reported catch of Lutjanidae (snappers; CL= catch of Lutjanidae, CL = 43-0.47•year since 1950; above).

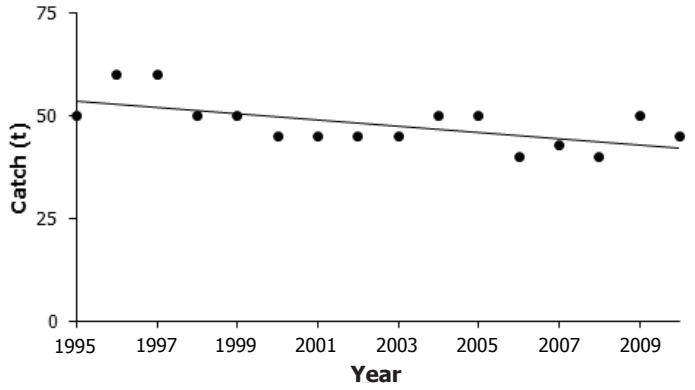

Figure 3. Time series (1995 – 2010) of the reported catch of A) Lutjanidae (snappers; CL= catch of Serranidae (groupers; CS = catch of Serranidae, CS = 88 - 0.77•year since 1950; below), used to infer the catch of snappers and groupers in earlier years (see text and Figure 3).

Table 1. Food fish appreciated in Aruba, according to Table 2 in Zaneveld (1962), with habitats added.

Category	Highly appreciated	Moderately appreciated
Small pelagic	-	Clupeidae, Engraulidae
Medium pelagic	Belonidae, Sphyraenidae	-
	Carangidae, Coryphaenidae	-
	-	Istiophoridae*,
Large pelagic		Thunninae*
	-	Scombridae, Xiphiidae
		Balistidae,
Reef fishes	Exocoetidae	Chaetodontidae
	Hemiramphidae	Dasyatidae, Gerridae
		Haemulidae,
	Priacanthidae	Holocentridae
	-	Labridae, Megalopidae
	-	Mugilidae, Mullidae
	-	Muraenidae, Psettinae
	-	Scaridae, Sciaenidae
	-	Soleidae, Sparidae

*Group in FAO statistics, added for completeness.

6. To account for tourism-based catches of game fishes (i.e., mostly large pelagics) which, we assume, started in the mid-1970s, we multiplied an assumed average catch per fishing day of recreational fishers with a time series of the number of fishing tourists (see below);
7. To account for subsistence fishing, we assumed that the artisanal fishers retain for their own consumption 0.5 kg·day^{-1} on 250 days a year, i.e., that they and/or their families have a consumption of 125 kg·fisher^{-1}·year^{-1}. The number of artisanal fishers was derived by using population trends from 1950-1988, combined with a published fisher to population ratio of 1/166 (Zanveld 1962). For 2010, it was assumed that only 60% of the 1988 subsistence catch was taken by fishers due to the marked decline in artisanal catches. Subsistence catch was interpolated between 1988 and 2010;
8. To account for discards (including of spoiled fish), we assumed that only 98% of the actual artisanal catch is landed, and 2% discarded (see contributions in Reilly 1985; Kumolu-Johnson and Ndimele 2011);
9. To account for foreign (industrial) catch in Aruban waters, we assumed that since the mid-1980s, 1 trawler (from Venezuela) and 2 longliners (1 from Venezuela and 1 from Taiwan) have been operating in the Aruban EEZ (see below); and
10. Finally, we took the global mean discard rate of 22% for longliners (Kelleher 2005), reduced to 20%, to estimate the discards from longliners, and the global mean discard rate of 9.6 % (from the same author) to estimate the discards from trawlers, but rounded up to 10%, if only to indicate that we have no illusion about the precision of these estimates. The discards, for simplicity sake, were assumed to consist of juveniles of the targeted species.

Table 2. Assumed catch composition of Venezuelan demersal trawlers in the EEZ of Aruba, based on the composition of the national catch that Venezuela reported for 2000-2008 to FAO, minus groups not expected to be caught by bottom trawls (i.e., small and large pelagics, small bivalves, etc.).

Fishes	**%**
Weakfishes (Sciaenidae)	10
Sea catfishes (Ariidae)	8
Snappers (Lutjanidae)	8
Largehead hairtail (*Trichiurus lepturus*)	5
Grunts, sweetlips (Haemulidae)	5
Smaller sharks	5
Groupers (*Epinephelus* spp.)	3
Rays and stingrays	3
Spanish mackerel (*Scomberomorus brasiliensis*)	3
Jacks (Carangidae) nei	3
Bigeye scad (*Selar crumenophthalmus*)	1
Common snook (*Centropomus unidecimalis*)	1
Atlantic moonfish (*Selene setapinnis*)	1
Other marine fishes	24
Invertebrates	
Penaeid shrimps	8
Blue crab (*Callinectes sapidus*)	7
Octopuses (*Octopus* spp.)	1
Other marine molluscs	2
Others invertebrates	2

Estimation of the recreational catch by tourists

Aruba conducts a "Tourism Survey" whose results are reported by its Central Bureau of Statistics.[2] For 2000-2010, a mean of 712,600 tourists were registered annually, of which about 50% visit two or more times, and who direct 7% of their expenses toward "entertainment and recreation." To generate a placeholder for an eventual estimate of catches by tourists, we conservatively assume that 100,000 of these tourists, who usually come for one week (Bryden 1973) spend 5 days each on game fishing, with each catching an extremely conservative 1 kg of fish per fishing day, which generates an annual take of 500 t of oceanic fish such as albacore, bonito, king mackerel, wahoo, billfish, rainbow runner, dolphinfish and 'others'. Each of these 8 groups was assumed, based on Weidner *et al.* (2001), to contribute equally to the catch. The catch of game fish by tourists is assumed to have increased linearly to its 2000-2010 level from zero in 1974.

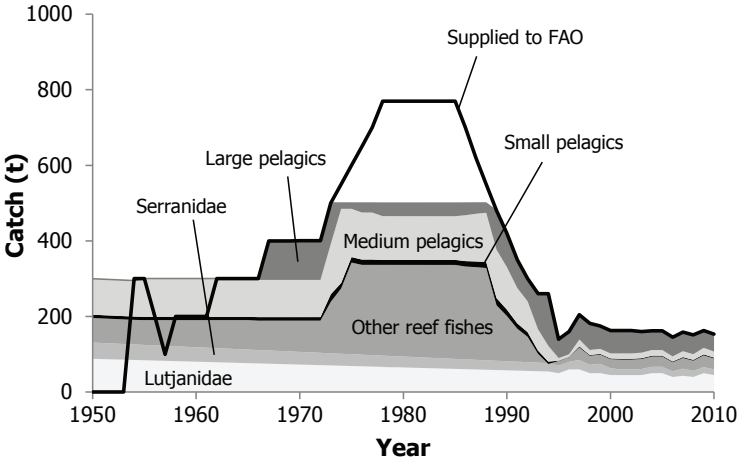

Figure 4. Artisanal catch from 1950-2010 by species grouping, as compared to data reported by FAO on behalf of Aruba (overlaid as dashed line). The suggested decline of the Serranidae and Lutjanidae is inferred from Figure 2.

Estimating the foreign catch by trawlers and longliners

As mentioned above, Venezuelan trawlers and longliners appear to operate in Aruban waters (p. 1100 in Weidner *et al.* 2001), along with Taiwanese longliners (Weidner *et al.* 2001).[3] As trawlers and longliners require catching between 100 and 1000 t·year^{-1} to operate profitably (see Figure 2 in Pauly *et al.* 2013), 1 trawler from Venezuela

[2] See http://www.cbs.aw/index.php/statistics/tables-statistics/71-tables/tourism/international-tourism

[3] The detailed notes and appendices in Weidner et al. (2001) suggest that Taiwanese longliners had a base of operation in the Netherlands Antilles, and caught large scombroids for the Japanese market; also, Weidner et al. (2001) report small quantities of swordfish being exported to the US from Aruba in the 1980s.

would correspond to between 100 and 1000 t of demersal fish being caught illegally in Aruba's EEZ. Furthermore, 200 to 2000 t of tuna and other medium and large pelagics would be caught by one longliner from Venezuela and one from Taiwan. For simplicity's sake, we shall use here, following Weinstein (2012) the geometric midranges, i.e., 316 t·year^{-1} of demersal fish, and 632 t·year^{-1} of tuna as being caught in Aruba's EEZ. We shall further assume that these foreign vessels began their operations in the Aruban EEZ at a very low level in 1985, ramped up their operations in the late 1980s, and maintained a combined catch of 948 t·year^{-1} until 2008. After this, the trawling components declined by 50% in 2009, the year that trawling was banned in Venezuela, and to zero in 2010, while foreign tuna catches remained at the 2008 level.

The catch composition of the Venezuelan trawler was assumed, given their once dominant role in the country's fisheries[4] (Mendoza *et al.* 2003) to correspond to the mean composition of the Venezuelan catch as reported by the FAO statistic, but after the small and large pelagic fishes (i.e., sardinella and large pelagic fishes, respectively) and bivalves were removed, and the contribution of estuarine fish (e.g., weakfishes) was reduced (Table 2). The catch composition of the longliners is assumed, based on scatted information in Weidner *et al.* (2001), to consist of 10% each of albacore, billfish, bonito, dolphinfish, king mackerel, rainbow runner, sharks, swordfish, wahoo and 'others'.

Results and Discussion

Marine landings reported by FAO on behalf of Aruba from 1950-2010, after the adjustments as outlined above, amounted to 20,677 t, all of which pertained to the artisanal sector (Figure 4). When the other sectors (unreported artisanal, recreational, etc.) are taken into account (Figure 5a), the reconstructed total catch for Aruba was just over 36,000 t or 75% more than the adjusted amount reported by FAO.

The main components of the reconstructed total landings were reported artisanal catches (20,677 t), recreational catches (11,750 t), subsistence catches (3,100 t), artisanal discards (420 t), and unreported artisanal catches (300 t). The unreported catches grew strongly from 1986 on, and were, in the 2000s, over 76% higher than the landings reported by FAO (Figure 5a; Appendix Table 1).

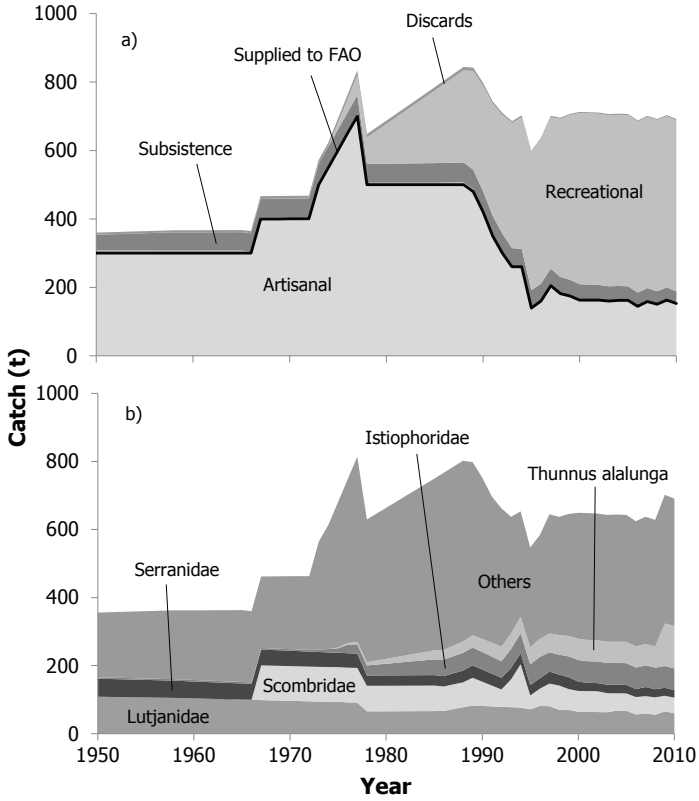

Figure 5. Reconstructed total catches for Aruba by A) fisheries sector, plus discards, for 1950-2010. Landings reported by FAO on behalf of Aruba are overlaid as line graph. Note the likely over-reporting during the 1980s corrected here; and B) by main taxonomic group; note the 'others' category includes 33 additional families (see Appendix Table 2).

Domestic fisheries

Artisanal (reported and unreported)

The reported artisanal catches (modified from the FAO data; see Figure 4) amounted to 20,677 t for the 1950-2010 period, and were highest from 1973 to 1988. The major families caught were, Lutjanidae (3,840 t), Scombridae (3,840 t), Serranidae (1,700 t), Sphyraenidae (1,140 t), Priacanthidae, Carangidae, Belonidae, Coryphinaenidae, Hemiramphidae and Exocoetidae (each 850 t). Unreported artisanal catches from the 1950-2010 period amounted to slightly over 700 t (Figure 5b).

The motorization of the artisanal fishery of Aruba began in the early 1950s, and by 1959, 272 of the 341 boats had motors, notably outboard motors of 15-20 hp (Zaneveld 1962). In that same year, the Aruban fisheries employed around 220 full-time and 150 part-time fishers (see Tables 4 & 7 in Zaneveld 1962), and in which, based on data given to him by a "Dr. G.C. Salmon", he reported an artisanal catch of 300 t for 1958, and an annual catch by fisher of "1.0 ton".

Comparing the number of men engaged in fishing near the middle of the 20th century (Zaneveld 1962) and the beginning of the 20th century (Boeke 1907) it is notable that these numbers have not changed very much. This implies that fishing (along with farming) has become as small part of the Aruban economy, the bulk of it now depending on the oil refining industry and tourism, and that young Aruban men do not want to become fishers.

The artisanal fishery using traps and other gear, which in the 1950s had already much reduced the fish population on the reefs surrounding Aruba (hence the relatively low catch per fisher alluded to above), has now clearly overexploited and degraded these reefs (Burke and Maidens 2004). Thus, Aruba's fisheries have increasingly turned to medium and large pelagic fishes using troll gear, targeting species often taken as by-catch by tuna longliners, e.g., small tunas such as albacore (*Thunnus alalunga*), bonito (*Sarda sarda*), king mackerel (*Scomberomorus cavalla*), wahoo (*Acanthocybium solandri*), billfishes (Istiophoridae and Xiphiidae), rainbow runner (*Elagatis bipinnulata*) and dolphinfish (*Mahi mahi*) as documented in Weidner *et al.* (2001) and Molenaar (2003).

[4] Bottom trawling was banned in Venezuela in 2009.

Recreational and subsistence catches

To determine the number of artisanal fishers, annual population numbers were used (www.bluemarblecitizen.com), combined with a fisher to population ratio of 1:166 (Zaneveld 1962) which was held constant between 1950 and 1988. The 1988 subsistence catch amount thus derived (58.06 t) was reduced by an assumed 60% for 2010 to represent the decline in artisanal catches which began in the late 1980s. Subsistence catch was then interpolated between 1988 and 2010.

Reconstructed total subsistence catches (although estimated very superficially) amounted to around 3,100 t from 1950 to 2010. The major families assumed to be consumed for subsistence purposes were Lutjanidae (1,270 t) and Serranidae (620 t), while Hemiramphidae, Carangidae, Priacanthidae, Coryphinaenidae, Belonidae, and Exocoetidae each contributed 204 t.

Reconstructed total recreational catches amounted to around 11,750 t from 1950 to 2010. Albacore tuna accounted for around 1,600 t during the entire period, while bonito, wahoo, dolphinfish, king mackerel, rainbow runner and marlin each were assigned an estimated catch of around 1,500 t, while marine fishes nei contributed nearly 1,350 t of catches.

Foreign industrial

Industrial catches, excluding discards, from both Taiwanese and Venezuelan longliners, as well as Venezuelan bottom trawlers totalled nearly 26,000 t during the 1985-2010 period. Catches peaked at nearly 1,100 $t \cdot year^{-1}$ from 1988 to 2008. The main taxa caught were billfishes, bonito, wahoo, dolphinfish, king mackerel, rainbow runner and albacore tuna with nearly 2,200 t of catches each, drums and croakers with over 700 t, and shrimps and catfishes with nearly 600 t each.

Discards

Discards from the domestic artisanal sector totalled nearly 420 t for the 1950-2010 period, peaking from 1978 to 1988 at approximately 10 $t \cdot year^{-1}$. Discards from the foreign industrial bottom trawl and longline fisheries totalled just over 3,000 t over the 1985-2010 period, and peaked at just over 126 $t \cdot year^{-1}$ from 1988-2009.

Conclusions

The reconstructed total catches for Aruba as presented here in Figure 4a (estimates of the total withdrawals from Aruba's EEZ by sector) and Figure 4b (withdrawals by species or groups) are very tentative, but they can serve as placeholders until better estimates become available. However, they are clearly more statistically accurate than 'no data' which are generally interpreted as zero catches.

Also note that while our estimates are tentative, the artisanal fisheries of Aruba are very likely dwarfed, in terms of catches (and catch values) over the last few decades by both tourist-based recreational fishing and by illegal (industrial) fishing in the Aruban EEZ, i.e., Venezuelan trawlers and Venezuelan and Taiwanese longliners, as we attempt to illustrate here.

Acknowledgements

This work was completed as part of the *Sea Around Us*, a scientific collaboration between the University of British Columbia and the Pew Charitable Trusts. We also thank Mr. Frederic Le Manach for his help in tabulating data.

References

Boeke J (1907) Rapport betreffende een voorlopig onderzoek naar de toestand van de vissserij en de industrie von zeeproducten in de Kolonie Curacao.I's Gravenhage. 200 p.

Bryden JM (1973) Tourism and development; a case study of the Commonwealth Caribbean. Cambridge University Press, London. 236 p.

Burke L and Maidens J (2004) Reefs at Risk in the Caribbean. Contributing authors: M. Spalding, P. Kramer, E. Green, S. Greenhalgh, H. Nobles & J. Kool. World Resources Institute, Washington, DC. Available at: www.wri.org/biodiv/pubs_description.cfm?PubID=3944 [Accessed: Aug 2013].

Kelleher K (2005) Discards in the world's marine fisheries. An update. FAO Fisheries Technical Paper 470, Food and Agriculture Organization, Rome. 131 p.

Kumolu-Johnson CA and Ndimele PE (2011) A review on post-harvest losses in artisanal fisheries of some African countries. Journal of Fisheries and Aquaculture 6: 365-378.

Mendoza J, Booth S and Zeller D (2003) Venezuelan marine fisheries catches in space and time: 1950-1999. pp. 171-180 *In* Zeller D, Booth S, Mohammed E and Pauly D (eds.), From Mexico to Brazil: Central Atlantic fisheries catch trends and ecosystem models. Fisheries Centre Research Reports 11(6), Vancouver.

Molenaar EJ (2003) Current legal development: marine fisheries in the Netherland Antilles and Aruba in the context of international law. The International Journal of Marine and Costal Law 18(1): 127-144.

Pauly D (2006) Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences. Maritime Studies (MAST) 4(2): 7-22.

Pauly D, Belhabib D, Blomeyer R, Cheung WWL, Cisneros-Montemayor A, Copeland D, Harper S, Lam V, Mai Y, Le Manach F, Österblom H, Mok KM, van der Meer L, Sanz A, Shon S, Sumaila UR, Swartz W, Watson R, Zhai Y and Zeller D (2013) China's distant water fisheries in the 21st century. Fish and Fisheries DOI: 10.1111/faf.12032

Reilly A (1985) Spoilage of tropical fish and product development: Proceedings of a Symposium held in conjunction with the sixth session of the Indo-Pacific Fisheries Commission/working party on fish technology and marketing, Royal Melbourne Institute of Technology, Melbourne, Australia, 23-26 October 1984. FAO Fisheries Report No 317 (Supplement), Rome. 474 p.

Van Gelderen P (1953) Fisheries in the Netherland Antilles. pp. 51-59 *In* GCFI (ed.) Proceedings of the 5th Annual Gulf and Caribbean Fisheries Institute. Gulf and Caribbean Fisheries Institute (GCFI), Coral Gables, USA.

Weidner DM, Laya GE and Serano JA (2001) Montserrat to Puerto Rico. pp. 1053-1145 *In* Office of Science and Technology (ed.) World swordfish fisheries: an analysis of swordfish fisheries, market trends and trade patterns, past-present-future. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Vol. IV. Latin America, Part B. Caribbean, Section 4. , Silver Spring, U.S.A.

Weinstein L (2012) Guesstimation 2.0: solving today's problems on the back of a napkin. Princeton University Press, Princeton, New Jersey. 359 p.

Zaneveld JS (1962) The fishery resources and the fishery industries of the Netherland Antilles. pp. 137-171 *In* CGCFI (ed.) Proceedings of the 14th Annual Gulf and Caribbean Fisheries Institute. Gulf and Caribbean Fisheries Institute (GCFI), Coral Gables, USA.

Zeller D, Booth S, Davis G and Pauly D (2007) Re-estimation of small-scale fishery catches for U.S. flag-associated island areas in the western Pacific: the last 50 years. Fishery Bulletin 105(2): 266-277.

Appendix Table A1. FAO landings vs. reconstructed total catch (in tonnes), and catch by sector with discards shown separately for Aruba, 1950-2010.

Year	FAO landings	Reconstructed total catch	Artisanal	Subsistence	Recreational	Discards
1950	300	360	308	46	-	6
1951	300	361	308	47	-	6
1952	300	362	308	48	-	6
1953	300	363	308	49	-	6
1954	300	363	308	50	-	6
1955	300	364	308	51	-	6
1956	300	365	308	51	-	6
1957	300	366	308	52	-	6
1958	300	367	308	53	-	6
1959	300	367	308	53	-	6
1960	300	367	308	53	-	6
1961	300	367	308	53	-	6
1962	300	367	308	54	-	6
1963	300	367	308	54	-	6
1964	300	368	308	54	-	6
1965	300	368	307	54	-	6
1966	300	364	304	54	-	6
1967	400	467	404	54	-	8
1968	400	467	404	55	-	8
1969	400	467	404	55	-	8
1970	400	468	405	55	-	8
1971	400	468	405	55	-	8
1972	400	468	405	55	-	8
1973	500	572	507	55	-	10
1974	550	623	556	55	-	11
1975	600	693	606	55	19	12
1976	650	763	656	55	38	13
1977	700	834	706	55	58	14
1978	500	648	506	56	77	10
1979	500	668	506	56	96	10
1980	500	687	506	56	115	10
1981	500	707	506	56	135	10
1982	500	726	506	56	154	10
1983	500	746	506	57	173	10
1984	500	765	506	57	192	10
1985	500	785	506	57	212	10
1986	500	805	506	57	231	10
1987	500	825	507	58	250	10
1988	500	844	507	58	269	10
1989	480	842	487	57	288	10
1990	420	798	426	56	308	9
1991	350	743	354	55	327	7
1992	300	710	304	54	346	6
1993	260	685	262	53	365	5
1994	260	703	261	52	385	5
1995	140	598	141	51	404	3
1996	160	637	161	50	423	3
1997	205	701	206	49	442	4
1998	182	696	183	48	462	4
1999	175	707	176	46	481	4
2000	163	713	164	45	500	3
2001	163	712	164	44	500	3
2002	163	711	164	43	500	3
2003	160	706	161	42	500	3
2004	162	708	163	41	500	3
2005	162	706	163	40	500	3
2006	145	688	146	39	500	3
2007	159	701	160	38	500	3
2008	151	692	152	37	500	3
2009	163	703	164	36	500	3
2010	153	692	154	35	500	3

Appendix Table A1. Reconstructed total catch (in tonnes) by major category for Aruba, 1950-2010. 'Others' includes 33 additional taxonomic categories.

Year	Lutjanidae	Scombridae	Serranidae	Istiophoridae	*Thunnus alalunga*	Others
1950	109	-	53	4	-	190
1951	108	-	53	4	-	192
1952	108	-	52	4	-	193
1953	107	-	52	4	-	195
1954	107	-	52	4	-	196
1955	107	-	52	4	-	198
1956	106	-	51	4	-	199
1957	106	-	51	4	-	201
1958	105	-	51	4	-	202
1959	104	-	50	4	-	204
1960	104	-	50	4	-	205
1961	103	-	49	4	-	206
1962	102	-	49	4	-	207
1963	102	-	48	4	-	209
1964	101	-	48	5	-	210
1965	100	-	47	5	-	211
1966	100	-	47	5	-	209
1967	99	102	46	5	-	210
1968	98	102	46	5	-	211
1969	97	102	46	5	-	213
1970	97	102	45	5	-	214
1971	96	102	45	5	-	216
1972	95	102	44	5	-	217
1973	94	102	44	7	-	317
1974	94	102	43	10	-	365
1975	94	102	43	13	2	427
1976	92	102	42	25	5	481
1977	91	102	42	28	7	544
1978	66	75	30	29	10	419
1979	66	75	30	32	12	432
1980	66	75	30	34	14	444
1981	66	75	31	37	17	456
1982	66	75	31	39	19	468
1983	66	75	31	41	22	480
1984	66	75	31	44	24	492
1985	66	75	31	46	26	504
1986	67	72	30	48	29	520
1987	72	73	32	50	31	526
1988	78	73	35	52	34	531
1989	83	82	36	52	36	509
1990	82	71	36	52	38	474
1991	80	61	35	50	41	430
1992	79	51	34	48	43	406
1993	78	82	34	56	46	343
1994	77	128	33	58	48	310
1995	72	41	31	61	50	293
1996	81	51	30	63	53	305
1997	81	66	35	57	55	350
1998	70	71	32	59	58	347
1999	70	61	35	61	60	359
2000	64	61	27	63	63	370
2001	64	61	24	64	63	373
2002	64	61	24	64	63	372
2003	63	56	25	64	63	373
2004	68	51	26	64	63	373
2005	67	51	25	64	63	373
2006	57	51	23	63	63	368
2007	59	51	27	64	63	374
2008	56	51	24	64	63	372
2009	66	46	23	64	125	378
2010	60	46	22	64	125	374