Chapter 6.3 Tuna Catches from 1950 to 2010: who catches what and where will this end?

Lead Authors:

V.W.Y. Lam[1] and D. Pauly[1]

[1]Sea Around Us, Fisheries Centre, University of British Columbia, Canada.

Chapter Citation:

Lam, V.W.Y., Pauly, D. (2016). Chapter 6.3: Tuna Catches from 1950 to 2010: Who Catches What and Where Will This End? In UNESCO IOC and UNEP (2016). The Open Ocean: Status and Trends. United Nations Environment Programme, Nairobi, pp. 246-251.

6.3 Tuna Catches from 1950 to 2010: who catches what and where will this end?

6.3.1 Summary and Key Messages

The world catch of tuna in the open ocean, taken beyond the Exclusive Economic Zones (EEZs) of maritime countries, has increased from about 125,000 tonnes per·year^{-1} in the early 1950s to a plateau of about 3.5 million tonnes per·year^{-1} from 2000 to 2010. This overall catch, consisting of declining landings from the Atlantic and Indian Oceans and increasing landing from the Pacific is not likely to increase in the future, or even to be maintained. Most of this catch, consisting of skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*) and albacore tuna (*T. alalunga*) is traditionally taken by Japan, South Korea and Taiwan, but new entrants are attempting to increase their share, notably in the Pacific. Given the current states of tuna stocks in the open ocean and the effects of ocean warming on tuna stocks, this should result in increased competition among the subsidized fleets of developed countries with distant-fishing fleets, and between established fleets and new entrants. Of these new entrants, three are developing countries (Indonesia, the Philippines and Mexico) which appear among the 10 countries with the largest tuna catches in the open ocean.

Key messages

- The major stocks of tuna in the open ocean are either fully exploited or overexploited, with current abundance near or lower than 50% of unexploited biomass. This precludes higher catches that would be sustainable;
- Of the three oceans, the Atlantic has the tuna stocks whose catch declined first (in the 1990s), followed by the Indian Ocean (2000s). Only the Pacific Ocean has increasing catches, but stagnating and declining catches can be expected there, given the current increasing trend of multinational fishing effort; and
- The increasing fishing effort of traditional tuna fishing countries, and the added effort of new entrants to open ocean tuna fisheries will, given the present state of the stocks, result in higher competition and economic losses, likely to be offset by subsidies.

6.3.2 Main Findings, Discussion and Conclusions

While tuna have been exploited for thousands of years - for example in the Mediterranean (Tekin 1996) - their exploitation mostly depended on tuna populations being within reach of coastal (mainly fixed) fishing gear (Ravier and Fromentin 2001).

Oceanic tuna, on the other hand, became systematically exploited only after the Second World War, first using pole and lines (which required live baitfish), then longlines, driftnets and purse seines (Majkowki 2007). Since the 1970s, purse seine operations have been increasingly aided by fish aggregating devices (FADs). This started in the southern Philippines, where '*payaos*' initially consisted of bundled palm fronds and/or bamboo rafts (Floyd and Pauly 1984). With rapidly changing technology methods worldwide now consist of sophisticated concrete and/or steel contraptions with electronics capable of monitoring the tuna and other fish they attract, and of communicating via satellite with the fleet that has deployed them (Dagorn et al. 2007).

In this Chapter, the main trends of tuna catches in the open ocean beyond areas of national jurisdiction (outside of EEZs, or their equivalent areas in the years before they could be claimed), are presented and discussed, after a brief presentation of where the catch data originate, and how they are distinguished between open ocean and EEZ areas. The period covered is 1950, when the FAO began publishing annual effort statistics, to 2010, the last year for which the *Sea Around Us* was able to assemble consistent catch data.

The growth of open ocean tuna fisheries and catches

Figure 6.14 illustrates the growth of tuna catches in the open ocean resulting for the increased power and sophistication of the vessels and gear used in the tuna fisheries. Note the flattening of the graph since 2000. Correlating to this, Table 6.2 details the 10 countries with the highest tuna catches in the open ocean between 2000 and 2010, and as well shows how catches in these countries have changed markedly per decade since 1950.

Figure 6.14. Annual catch of tuna species in the open ocean from 1950 to 2010.

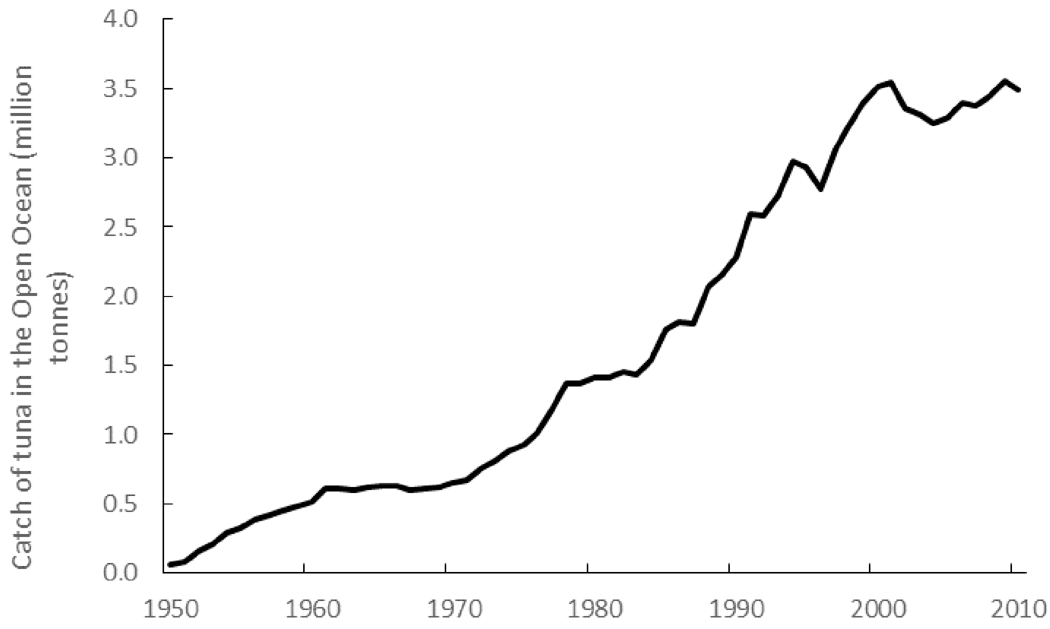

Table 6.2 Decadal catch of tuna in the open ocean from the 1950s of the top 10 countries with the highest landings from 2000 to 2010

Country	Annual mean catch (103 t)					
	1950 – 1959	1960 - 1969	1970 - 1979	1980 - 1989	1990 - 1999	2000 - 2010
Japan	1,640	3,929	3,469	5,451	8,246	4,617
Taiwan	53	246	563	1,148	2,764	2,351
South Korea	1	110	1,199	1,954	3,197	2,339
Indonesia	0	124	338	977	2,269	1,945
Spain	9	39	258	717	1,377	1,188
Ecuador	0	0	101	314	727	1,121
Philippines	86	106	716	955	1,032	1,027
Mexico	8	44	138	742	1,226	917
France	19	171	490	818	1,106	721
USA	971	1,155	1,504	1,500	1,334	689

Although requiring open waters, tuna are also caught within the 200 mile (EEZs) of maritime countries, particularly in the Western Central Pacific. Thus, the catch of tuna that is currently taken in the open ocean (Figure 6.14) is only about 65 per cent of the total catch of tuna in the world ocean. These tuna are mainly taken by Japan, South Korea and Taiwan (Table 6.2). The main species caught in the open ocean are skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*) (Table 6.3).

Table 6.3 Annual mean decadal catch from the 1950s, of the top 10 species (or groups) with the highest landings in the open ocean from 2000 to 2010.

Common name	Scientific name	Mean annual catch (103 t)					
		1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2010
Skipjack tuna	*Katsuwonus pelamis*	777	1,233	2,815	5,640	11,365	10,440
Yellowfin tuna	*Thunnus albacares*	937	1,862	3,025	5,444	9,053	7,122
Bigeye tuna	*Thunnus obesus*	347	1,067	1,631	3,017	4,833	3,282
Albacore	*Thunnus alalunga*	457	1,180	1,306	1,610	1,975	1,443
Kawakawa	*Euthynnus affinis*	86	103	238	495	677	654
Tunas, bonitos & mack.	*Scombridae*	5	122	208	585	842	540
Longtail tuna	*Thunnus tonggol*	0	6	132	233	328	507
Southern bluefin tuna	*Thunnus maccoyii*	115	331	299	211	128	91
Pacific bluefin tuna	*Thunnus orientalis*	110	193	154	148	127	71
Atlantic bluefin tuna	*Thunnus thynnus*	18	27	23	23	29	23

Table 6.4 gives the location of these catches in terms of the statistical areas used by the Food and Agriculture Organization of the United Nations (FAO). As might be seen, FAO Area 71 (Western Central Pacific), with an average of 1.4 million tonnes per year and FAO area 77 (Eastern Central Pacific), with 0.5 million tonnes per year, show the highest tuna catches.

Table 6.4 Average annual catch of tuna species in the open ocean part of each FAO Statistical Areas (see Figure and Table 6.1) by ocean, from 2000 to 2010.

Ocean	FAO	Annual tuna catch (10^3 t)
Pacific	71	1,365
	77	468
	87	280
	61	210
	81	29
	67	13
Indian	51	463
	57	272
Atlantic	34	203
	47	39
	41	35
	31	30
	27	8
	21	1

Conclusion - status of open ocean tuna stocks

Figure 6.14 suggests that the catches of tuna from the open ocean reached a plateau, and the detailed, stock-by-stock analysis of Juan-Jorde et al. (2011) suggest that these catches will not increase anymore. A few species (notably Atlantic Pacific and Southern bluefin tuna) have been severely overfished (Fromentin 2009; Mori et al 2001) and will require lower quotas to recover. In addition the fishing mortality on the few species that presently contribute the bulk of tuna catches (yellowfin, albacore, skipjack and bigeye tuna) are, as a whole, currently experiencing the fishing mortality roughly generating maximum sustainable yield (Majkowski, 2007; Sibert et al. 2006). Hence additional effort increases are more *likely* to decrease than to increase catches. Also, the biomass of the most abundant species are near or below 50 per cent of their unexploited values (Juan-Jorda et al. 2011), which also precludes sustainable catch increases.

These generalizations hide obvious differences between oceans and species; thus, the open Atlantic Ocean, where catch has been declining since the mid-1990s, is more impacted than the Indian Ocean, where open ocean catches are stagnating (and declining if that entire ocean is considered) and the Pacific Ocean, where catches are still increasing (Miyabe et al. et al. 2004). Similarly, large tuna species (notably the three bluefin tuna species) are far more impacted than the small tuna, for example: skipjack (Juan-Jorda et al. 2011).

Scenarios for future developments

It is now obvious that long distance from coastlines has ceased to protect oceanic tuna populations and hence the pelagic ecosystems of the open ocean. Instead, the level of fishing effort that is deployed in the open ocean as only a function of the cost of fishing (and especially the cost of fuel; Lam et al. 2011) relative to the ex-vessel value of the tuna catch, which can be extremely high (Swartz et al. 2012).

To the extent that distant-water countries are willing to continue subsidizing their distant-water tuna fleet (and they seem to be, see Sumaila et al. 2010, 2013), the cost factor becomes less important and fishing effort is thus *likely* to continue to increase. With total catch not being able to follow suit, tuna fishing in the open ocean will turn into a zero-sum game, with some new players, such as China (Pauly et al. 2013), displacing more established players. Whether the developing countries with EEZs near the open ocean areas with high tuna catches (for example in the South West Pacific, or the Indian Ocean) will be able to increase their share of open ocean catches - or even acquire one - is an open question, as is the long-term sustainability of the stocks.

The above considerations, however, do not account for the effects of ocean warming, and the increased stratification and acidification of the open ocean, discussed in Chapters 6.1 and 6.4. These effects will eventually probably impact the distribution and recruitment of tuna wherever they occur. Thus, it is difficult to give a positive prognosis for the future of open ocean tuna fisheries. For further information on the potential influence of ocean warming and acidification on marine ecosystems, see Sections 4 and 5 of this Report.

6.3.3 Notes on Methods

The method used for this report, to map fisheries catches onto about 180,000 half degree longitude and latitude spatial cells, has been described by Watson et al. (2004) and Pauly et al. (2008) in some details, and is summarized in five steps:

1) Assemble the catch data to be mapped, here consisting mainly of the catch data reported by member countries to FAO, and distributed via the Fishstat database after their assignment to FAO statistical areas, complemented by data from the FAO's 'Atlas of Tuna and Billfish Statistics[33]';
2) Create, for each taxon (species, genus or family) for which at least one country reports landing, distributions range map (for tuna mainly based on FishBase[34]);

33 www.fao.org/fishery/statistics/tuna-atlas/4/en
34 www.fishbase.org

3) Allocate the catch reported in (1) to the distribution range in (2) subject to the constraint that an access agreement (or traditional access in pre-EEZ times) must exist for the catch to be allocated to cells that are part of an EEZ other than that of the reporting country;
4) When necessary, identify the reason(s) why a catch cannot be allocated, which may be due to (a) a faulty distribution map, (b) the non-availability of an access agreement, or (c) one or several other constraints – omitted here - not being met;
5) Aggregate the half degree cells (and the catch assigned to them) into a large area of interest, for example: the EEZs of maritime countries, Large Marine Ecosystems, or here, the open ocean part of FAO statistical areas (Watson et al. 2004; Pauly et al. 2008, and Sea Around Us[35]).

Acknowledgements

This is a contribution of the *Sea Around Us*, a scientific collaboration at the University of British Columbia funded by the Pew Charitable Trusts and the Paul G. Allen Family Foundation.

COUNTERPOINT: The above chapter is the opinion of the authors. There are differing views on the status of tuna stocks. The reader is encouraged to explore widely, for example, the International Seafood Sustainability Foundation (ISSF) Technical Report 2015-03-A: *Status of the World Fisheries For Tuna* (November 2015) uses more recent data:

http://iss-foundation.org/resources/downloads/?did=602

35 www.seaaroundus.org

References:

Dagorn, L., D. Pincock, C. Girard, K. Holland, M. Taquet, G. Sancho, D. Itano and R. Aumeeruddy. 2007. Satellite-linked acoustic receivers to observe behavior of fish in remote areas. *Aquatic Living Resources* 20(4): 307-312.

Floyd, J. and D. Pauly. 1984. Smaller size tuna around the Philippines - can fish aggregating devices be blamed? *Infofish Marketing Digest* 5/84: 25-27.

Fromentin, J.-M. 2009. Lessons from the past: investigating historical data from bluefin tuna fisheries. *Fish and Fisheries* 10(2): 197-216.

Juan-Jorda M.J., I. Mosqueira, A.B. Cooper, J. Freire and N.K. Dulvy .2011. Global population trajectories of tunas and their relatives. *Proceedings of the National Academy of Sciences of the USA* 108(51): 20650-20655

Lam V.W.Y., U.R. Sumaila, A. Dyck, D. Pauly and R. Watson. 2011. Construction and Potential Applications of a Global Cost of Fishing Database. *ICES Journal of Marine Science* 68(9): 1996-2004.

Majkowki, J. 2007. *Global fisheries resources of tuna and tuna-like species*. FAO Fisheries Technical Paper (483), Food and Agriculture Organization of the United Nation, Rome, 54 p.

Miyake, M.P., N. Miyabe H. Nakano. 2004. *Historical trends of tuna catches in the world.* FAO Fisheries Technical Paper (467), Food and Agriculture Organization of the United Nation, Rome, 74 p.

Mori, M., T. Katsukawa and H. Matsuda. 2001. Recovery plan for an exploited species, southern bluefin tuna. *Population Ecology* 43(2)): 125-132.

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

Pauly, D., J. Alder, S. Booth, W.W.L. Cheung, V. Christensen, C. Close, U.R. Sumaila, W. Swartz, A. Tavakolie, R. Watson, L. Wood and D. Zeller. 2008. Fisheries in Large Marine Ecosystems: Descriptions and Diagnoses. p. 23-40. *In:* K. Sherman and G. Hempel (eds.) *The UNEP Large Marine Ecosystem Report: a Perspective on Changing Conditions in LMEs of the World's Regional Seas.* UNEP Regional Seas Reports and Studies No. 182.

Ravier, C. and J.-M. Fromentin. 2001. Long-term fluctuations in the eastern Atlantic and Mediterranean bluefin tuna population. *ICES Journal of Marine Science* 58(6): 1299-1317.

Sibert, J., J. Hampton, P. Kleiber and M. Maunder. 2006. Biomass, size, and trophic status of top predators in the Pacific Ocean. *Science* 314: 1773-1776.

Sumaila, U.R., A. Khan, A.J. Dyck, R. Watson, G. Munro, P. Tyedmers and D. Pauly. 2010. A bottom-up re-estimation of global fisheries subsidies. *Journal of Bioeconomics,* 12: 201–225.

Sumaila, U.R., V. Lam, F. Le Manach, W. Swartz and D. Pauly. 2013. *Global fisheries subsidies.* European Parliament, Directorate General for Internal Policies. Policy Department B: Structural and Cohesion Policies - Fisheries. Brussels, 44 p.

Swartz, W., E. Sala, R. Watson and D. Pauly. 2010. The spatial expansion and ecological footprint of fisheries (1950 to present). *PLoS ONE* 5(12) e15143, 6 p.

Swartz W., U.R. Sumaila and R. Watson. 2012. Global ex-vessel fish price database revisited: a new approach for estimating 'missing' prices. *Journal of Environmental and Resource Economics* 56: 467-480.

Tekin, O. 1996. The Pelamydes of Byzantanium and the Golden Horn. *Anatolian Arastirmalari* XIV: 470-478.

Watson, R., A. Kitchingman, A. Gelchu and D. Pauly. 2004. Mapping global fisheries: sharpening our focus. *Fish and Fisheries* 5: 168-177.