RECONSTRUCTION OF MARINE FISHERIES CATCHES FOR WALLIS AND FUTUNA ISLANDS (1950-2007)[1]

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ABSTRACT

Total marine fisheries catches were estimated for Wallis and Futuna between 1950 and 2007. Our estimate included both commercial and subsistence fisheries sectors. Commercial catches were estimated using data supplied to the FAO by Wallis and Futuna, and the limited independent data that were available in the literature. Subsistence catches were based on an estimate for this sector in the recent time period (1990s) and an assumed *per capita* rate for the early time period (1950s). Together, the subsistence and commercial catches totaled approximately 34,700 t over the 1950-2007 time period, which is 6.4 times larger than the landings presented by FAO. Subsistence catches represented the largest portion (over 80%) of the reconstructed catch, highlighting the importance of this small-scale fisheries sector, and its general neglect in official statistics.

INTRODUCTION

Wallis and Futuna Islands are located between Fiji and Samoa at 176°-178° W and 13°-14° S (Figure 1). This French territory is composed of two island groups, Wallis and Futuna (plus Alofi), that are approximately 200 km apart with an Exclusive Economic Zone (EEZ) of nearly 300,000 km²(www.seaaroundus.org). The Wallis islands contain one main island and several small coral islands. The main island is called Uvea by its inhabitants, covers a land area of about 100 km² and its lagoon is protected by a coral reef. Futuna and Alofi (uninhabited) are south-west of Wallis. Futuna has neither a coral reef nor a lagoon, and the island is regularly hit by earthquakes. The territory's economy is limited to subsistence agriculture and fishing. The territory's revenue is supported heavily by remittances from expatriate workers in New Caledonia, French Polynesia and France, and from licensing distant water fleets (mainly Japanese and South Korean) fishing for tuna.

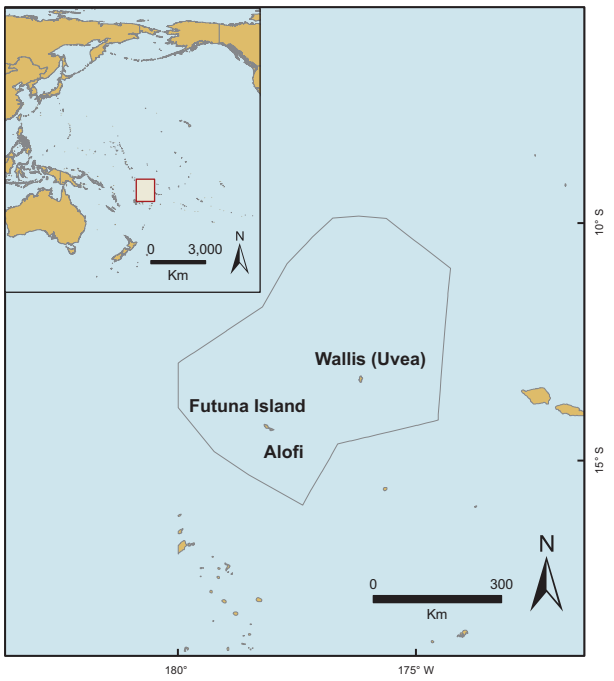

Figure 1. Map of Wallis and Futuna showing the three islands, Wallis, Futuna and Alofi, and their EEZ.

The FAO FishStat database, which offers time series data on marine fisheries landings from 1950 to the present, is based predominantly on national statistical data supplied by its member countries. Therefore,

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the quality of the data depends on the capacity of statistical collection within these countries. The FAO data have been the basis of many influential global fisheries studies (i.e. Pauly *et al.*, 1998) but they are, in fact, incomplete (Zeller *et al.*, 2006; 2007).

The objective of the present study is to provide an estimate of total marine fisheries catches. Although several studies and reports have been published previously, there has been no comprehensive review of potential historical catches, combining both subsistence catches with reported commercial landings.

MATERIALS AND METHODS

Estimates of marine fisheries catches were taken from several reports detailing the weight of fishes taken. While most subsistence catches were not reported, we used a method combining available information on catches and human population to estimate *per capita* subsistence catch rates and consumption rates. Interpolations between data anchor points were done to estimate catch rates over the entire study period (1950-2007). Catch rates were transformed into catch amounts using human population data.

Human population data

Our estimates of subsistence catch required a complete time series of human population data to convert *per capita* subsistence catch rates into catch amounts. Population data for Wallis and Futuna were obtained from several sources: The 'Institut d'Emission d'Outre Mer' (Anon., 2009) and the population statistics historical demography website (www.populstat.info). In years when population data were not available, a linear interpolation was done between neighboring years to derive a complete time series of population data from 1950-2007 (Figure 2).

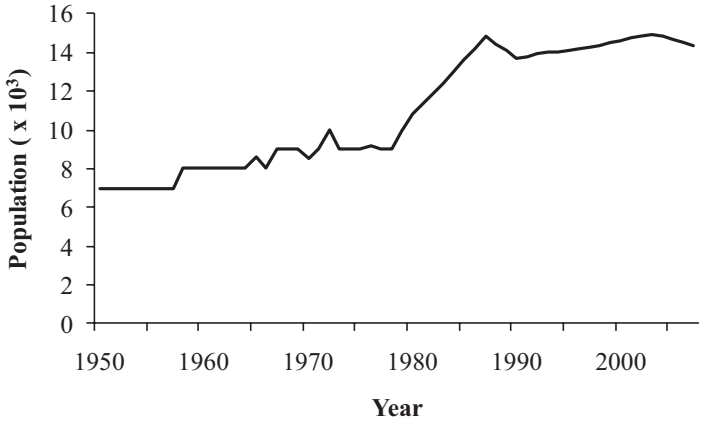

Figure 2. Estimated population of Wallis and Futuna, 1950-2007.

Commercial fisheries

Commercial fisheries data for Wallis and Futuna were taken from the FAO FishStat database for most years. Additional data were obtained from independent reports that reviewed commercial fisheries production in the Pacific region (Angleviel, 1999; Dalzell *et al.*, 1996). Data from these reports were used in years when they provided an apparently more comprehensive assessment of fisheries catches than supplied to the FAO.

From 1950-1969, data supplied to FAO are presented as only 'miscellaneous marine fishes' estimated at <0.5 t·year^{-1}. We assumed that these data were correct as there was a large exodus of the Wallisian and Futunan population in the 1950s to work in the nickel mines of New Caledonia (Anon., 1977; 1984; Taumaia, 1997). This migration included the majority of fishers from Wallis and Futuna that would have been engaged in commercial fishing operations. It was not until the 1970s and 1980s that commercial fisheries were re-established after several government initiatives were brought in to encourage development of the fishery sector (Beverly, 1999).

Commercial catches for the 1989-1994 time period were estimated by Dalzell *et al.* (1996) to be on average 275 t·year^{-1}. This estimate includes reef, deep-slope, pelagic and invertebrate fisheries. We used Dalzell *et al.*'s (1996) estimate for the 1989-1994 period but excluded estimates for trochus shells as these were mainly an export item not for human consumption. Angleviel (1999) estimates commercial catches for 1999 to be 300 t·year^{-1}, which is consistent with data supplied to FAO for that year. For all other years we used FAO catch estimates as presented by FAO.

Subsistence fisheries

Dalzell *et al*. (1996) estimated average annual subsistence catches to be 621 t·year^{-1} over the 1989-1994 time period, which translates into a *per capita* subsistence catch rate of 43.3 kg·person^{-1}·year^{-1}. As for many of the South Pacific Islands, Dalzell *et al*.'s (1996) subsistence data were derived from dietary or *per capita* consumption data, or more commonly, records of frequency of consumption. Bell *et al*. (2009) estimated seafood consumption rates throughout the South Pacific using household surveys. For Wallis and Futuna, Bell *et al*. (2009) estimated a seafood consumption rate of 74.6 kg·person^{-1}·year^{-1} for the early 2000s. Only a portion of this is supplied through commercial catches and the remainder is supplied through subsistence fisheries. We calculated the amount of seafood supplied through subsistence fisheries by subtracting the *per capita* commercial catch from the consumption rate presented by Bell *et al*. (2009). The result was a subsistence catch rate of 55 kg·person^{-1}·year^{-1}, which was higher than Dalzell *et al*.'s (1996) estimate for roughly the same time period. To remain conservative in our estimate, we used the subsistence catch rate given by Dalzell *et al*. (1996) of 43.5 kg·person^{-1}·year^{-1}.

For the early time period (1950s) we assumed that all fish consumed were supplied through subsistence fisheries. As many of the able bodied males left Wallis and Futuna in the 1950s to work in New Caledonia's Nickel industry, the number of fishers engaged in commercial fishing was reduced to almost nothing. Here we assumed that the *per capita* consumption rate for the early 1990s, based on subsistence catch (Dalzell *et al*., 1996) and commercial catch (FAO), was similar to the rate of seafood consumption in the 1950s. Wallisians and Futunans derive the majority of their protein from the sea and although they import some frozen seafood products today, they eat very little in the way of tinned products and/or meat (Lambeth, 1999). Thus, we estimated the total seafood consumption rate for 1950 to be 63 kg·person^{-1} ·year^{-1}, which we assumed to be the subsistence catch rate for that year. To derive a complete time series for subsistence catch, we interpolated linearly from the 1950s subsistence catch rate to the 1989-1994 subsistence rate given by Dalzell et al. (1996). The 1989-1994 rate was carried forward, unaltered to 2007. To derive total subsistence catch (tonnes) for 1950-2007, we then applied the *per capita* subsistence catch rates to the human population data for Wallis and Futuna.

Catch composition

Commercial and subsistence fisheries of Wallis and Futuna take place mainly on the sheltered coastal reefs and lagoons (Kronen et *al*., 2008). Only small amounts of fish are taken from outer reef areas and even fewer are caught offshore. At a national level, approximately 37% of catches are from Lagoon fisheries, 27% from barrier reefs, 22% from fringing reefs and 16% from external barrier reefs (Kronen *et al*., 2008). The catch composition used here was based on work by the Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCFish/C; Kronen *et al*., 2008). Fisher surveys were conducted during the early 2000s covering both Wallis and Futuna, the various habitats fished and include commercial and subsistence sectors. The report documents catch amounts for over 60 species caught in the waters of Wallis and Futuna. While catch amounts were reported by species in Kronen *et al*. (2008), for the purposes of this report, they have been summarized by family. The main families caught were Acanthuridae (approximately 20%), Carangidae (14%), Lethrinidae (14%), Lutjanidae (9%) and Mugilidae (7%; Table 1). The other 15 families listed each represented less than 5% of the catch and miscellaneous marine fishes comprised the remaining 14% (Table 1).

Table 1. Estimated catch composition for commercial and subsistence fisheries of Wallis and Futuna (Kronen *et al*., 2008).

Family	Percentage of catch (%)
Acanthuridae	20.58
Balistidae	0.11
Belonidae	0.04
Carangidae	13.65
Carcharhinidae	0.14
Chanidae	0.05
Coryphaenidae	0.07
Diodontidae	0.34
Holocentridae	3.28
Kyphosidae	2.06
Labridae	0.05
Lethrinidae	14.45
Lutjanidae	9.86
Misc. marine fishes	13.27
Mugilidae	7.35
Mullidae	2.70
Priacanthidae	0.31
Scaridae	4.77
Scombridae	0.08
Serranidae	3.77
Sphyraenidae	3.18

All landings, as supplied to FAO, prior to 1994 were reported as 'miscellaneous marine fishes'. After 1994, catches were also reported for miscellaneous crabs, sea cucumbers and spiny

lobsters. Trochus shells, hard corals and turtles were also presented by the FAO but these categories were excluded from our analysis. The estimated catch composition presented by Kronen *et al.* (2008) was used for the taxonomic breakdown of the FAO's 'miscellaneous marine fishes' category in years when the FAO data were used as the best estimate of commercial catches. For commercial catches in years when independent data were used and for subsistence estimates, we applied the taxonomic breakdown from Kronen *et al.* (2008) to the catch totals.

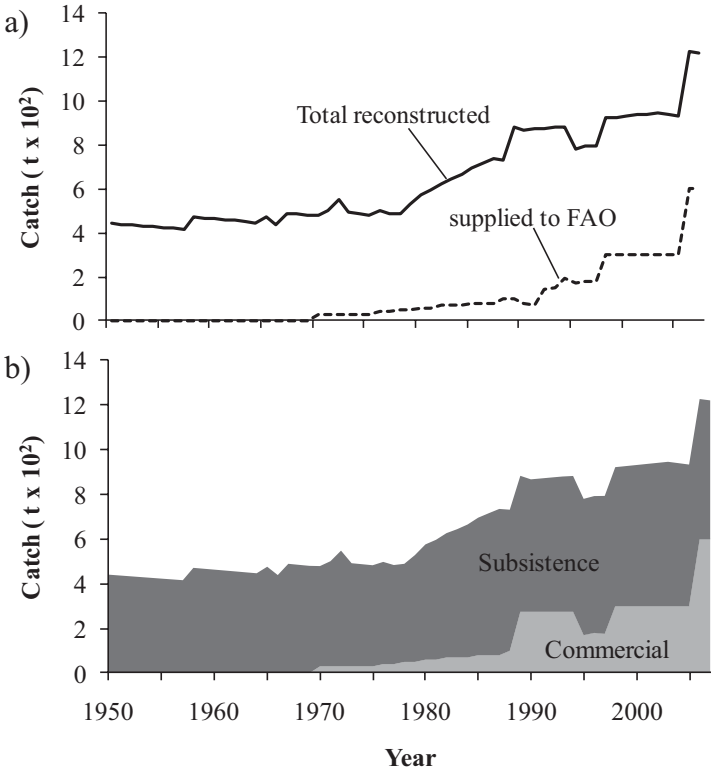

Figure 3. a) Total reconstructed fisheries catches for Wallis and Futuna (commercial and subsistence sectors combined) compared to the FAO's total catches, 1950-2007. b) Estimated catches by the commercial and subsistence sectors of Wallis and Futuna, 1950-2007.

RESULTS

For the period 1950-2007, the reconstructed total catch was estimated to be 37,583 t (Figure 3a). This total is 6.4 times larger than the total catches presented by the FAO on behalf of Wallis and Futuna from 1950-2007. Average annual catches rose from approximately 440 t·year^{-1} in the 1950s to over 1000 t·year^{-1} in the 2000s. Total subsistence catches were estimated to be 30,772 t over the 1950-2007 time period (Figure 3b). In the early time period, subsistence catches represented essentially 100% of fisheries catches, while overall they represented 82% of marine fisheries catches. The estimated commercial catch for the 1950-2007 time period was 6,811 t, the majority of which have been taken since 1980.

The taxonomic composition of commercial and subsistence catches was described to the species level; however, here we have grouped species by family. The reconstructed catch, which combined subsistence and commercial, was dominated by surgeonfish species, with an estimated catch of 7,500 t (Figure 4). Species in the Carangidae, Lethrinidae and Lutjanidae families also represented substantial amounts of the total reconstructed catch, with catches of approximately 5,000 t, 5,300 t and 3,600 t, respectively. Catches in the 'miscellaneous marine fishes' (MMF) grouping represented almost 5,000 t or 13% of the total reconstructed catch. The remaining 17 taxa were grouped into the category 'other taxa' as these families represented only minor proportions of the total catch.

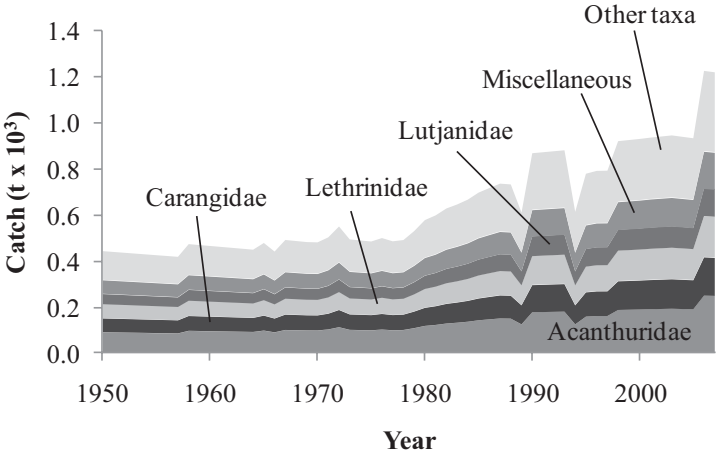

Figure 4. Total reconstructed catch by family for Wallis and Futuna, 1950-2007. The grouping 'other taxa' represents 17 taxa.

DISCUSSION

Our reconstruction of total marine fisheries catches for Wallis and Futuna from 1950-2007 was over six times larger than total catches presented by the FAO on behalf of Wallis and Futuna. This difference was largely driven by the absence of subsistence catches in official data. Commercial catches are not well documented over the 1950-2007 time period; however, we did find independent sources of fisheries data for some years (1989-1994 and 1999). Catches presented in these independent reports were similar in magnitude to the totals reported by FAO, giving confidence to our use of FAO catches in years when these were the only data available.

Subsistence catches were also poorly documented. We obtained a catch estimate for the subsistence sector in the recent time period (Dalzell *et al*., 1996) and a report of *per capita* seafood consumption for the 2000s (Bell *et al*., 2009). Both of these reports indicate substantial contributions by the subsistence sector as compared to the commercial sector. Household surveys conducted in the early 2000s revealed that 86% of annual *per capita* fish consumption is derived from the subsistence sector with the remaining 14% being purchased (Bell *et al*., 2009). Purchased seafood is likely a combination of locally caught and imported products, as local catches are often insufficient to meet local demand (Taumaia, 1997).

The reef and lagoon resources that are the main target of both commercial and subsistence fisheries are considered heavily exploited. Overfishing was reported in both Wallis and Futuna as early as the 1930s (Burrows 1936, 1937 *in:* Kronen *et al*., 2008). Overfishing has been caused mainly by the use of destructive and unsustainable fishing methods such as dynamite fishing and small-mesh gillnets (Kronen *et al*., 2008). These methods continue to be used today as they remain largely unregulated.

Although attempts have been made to develop a domestic offshore fishery that would supply fish to the local market and alleviate pressure on inshore resources, this has been slow to take hold (Kronen *et al*., 2008). Currently, tuna and other pelagics are targeted mainly by foreign fleets fishing in the waters of Wallis and Futuna. In the early 1990s, Fish Aggregating Devices (FADs) were deployed to encourage local fishers to target species further offshore (Kronen *et al*., 2008). These attempts were only moderately successful, as tuna continue to contribute minimally to the total catch. A study conducted in the 1980s by Dalzell and Preston (1992) found potential for the development of a deep-water snapper fishery, yet catches of snapper have not increased since this discovery (Kronen *et al*., 2008).

With local seafood supplies unable to meet local demand, imports are increasingly needed to fill this gap. Agricultural opportunities are limited on Wallis and Futuna, therefore, protein from the sea is a necessity. While imports are increasing and efforts to expand the supply of pelagic species continue, subsistence catches remain a substantial contributor to the seafood demands of Wallis and Futuna, yet are not accounted for in official statistics. This study highlights major deficiencies in the assessment and monitoring of Wallisian and Futunan fisheries.

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