

RECONSTRUCTING MARINE FISHERIES CATCHES IN THE SOLOMON ISLANDS: 1950–2009¹

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ABSTRACT

The Solomon Islands are a large archipelago in the western Pacific Ocean with rich marine resources. The socioeconomic welfare and food security of the country relies heavily on its fisheries. Global markets, localized population growth, increased migration to urban centres, and growing fishing technology and pressure threaten to undermine many of the Solomon Islands' small-scale fisheries, while the presence of joint venture and foreign access commercial tuna fishing fleets is likely to expand due to international demand and foreign exchange income opportunities. The ability to meet domestic seafood demands may be undermined by declining local stocks, and the extent of domestic fishing pressure is underappreciated due to incomplete national fisheries statistics. National reports are concerned with the large-scale commercial fishing sector, and greatly underestimate the contribution of domestic small-scale fisheries. This study provides a reconstruction of the national fisheries data, as reported by the Solomon Islands to the FAO, but inclusive of the domestic commercial tuna industry, and artisanal and subsistence fisheries estimates. Total reconstructed fisheries removals of the Solomon Islands were estimated to be approximately 1.87 million tonnes over the 1950–2009² time period. While this estimate is only slightly higher than total landings reported by the FAO on behalf of the Solomon Islands (1.81 million t), it includes 211,000 t of unreported subsistence catch, 29,000 t of unreported artisanal shark catches and 18,000 t of unreported by-catch associated with the commercial tuna fishery.

INTRODUCTION

The Solomon Islands are situated between 5°–13°S and 155°–158°E in the south-western Pacific Ocean (Figure 1). The Main Group Archipelago (MGA) consists of a double chain of 6 large islands: Choiseul, Santa Isabel, New Georgia, Malaita, Guadalcanal and San Cristobal (Richards *et al.* 1994). The Solomon Islands includes the MGA in addition to hundreds of other small islands. The capital, Honiara, is located on the island of Guadalcanal.

The total land area of the Solomon Islands is over 27,500 km², with a 2009 population estimate of 523,000. The Exclusive Economic Zone (EEZ), declared in 1978, is 1.5 million km² (www.seaaroundus.org; accessed July 2011). These islands support some of the world's largest lagoons, and fringing and barrier coral reefs along an extensive coastline (Skewes 1990). Formerly a British Protectorate, the Solomon Islands achieved independence in 1977. The islands are high and volcanic, densely forested (though heavily logged), with large mangrove forests, coral reefs and lagoons. The fertile soil supports a growing agricultural sector. The majority of the population lives in small to medium sized coastal villages, although there are considerable inland populations on some major islands (Hviding 1998), and a growing migration to urban centers. Previously lucrative export commodities such as copra, palm oil, timber and minerals have declined in recent years, leaving fishery products as the remaining prospective export.

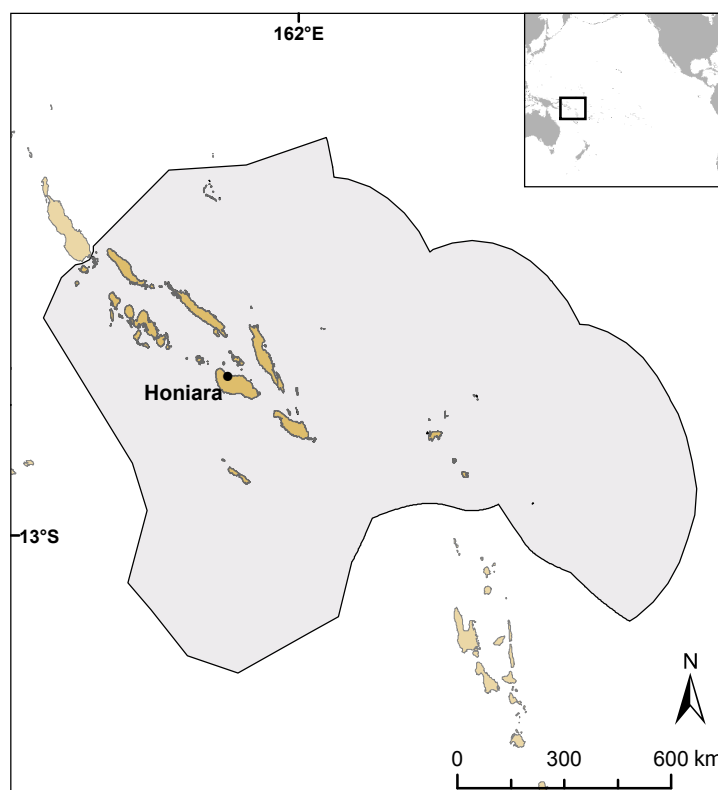


Figure 1. Location of the Solomon Islands and its capital, Honiara. The solid line represents the EEZ.

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² See addendum for updating dataset to 2010.

Small-scale fisheries

Traditionally, the Solomon Islands have been largely a non-market economy until at least the 1970s (Barclay and Cartwright 2007), and unsurprisingly, local subsistence fisheries play an important role. The importance of this sector in fisheries is generally poorly reflected globally in catch statistics (Zeller *et al.* 2007), as the available data are thought to be highly unreliable (Gillett 2005). National food security relies heavily on these fisheries, as the local diet is largely based on marine-derived protein coupled with carbohydrates from root crops (Hviding 1998). Fishing gears employed by subsistence fishers include handline (most common) and dropline, troll, spear, gill nets (seasonally), and *buna* – a poison derived from a local vine plant used on coral reefs (Richards *et al.* 1994). In some areas of the Solomon Islands, religious groups (e.g., the Seventh Day Adventist Church) prohibit the consumption of shellfish or fish without scales.

A large portion of the artisanal fishery is carried out using dugout canoes. The finfish catch is primarily comprised of lutjanids (snappers), serranids (groupers), lethrinids (emperors), scombrids (mackerels), and carangids (trevallies; Richards *et al.* 1994). Small-scale tuna fishing does occur in the Solomon Islands, as tuna remains a culturally significant food source for coastal villages (Barclay and Cartwright 2007). Reporting of small-scale tuna fisheries is negligible, suggesting that tuna caught by this sector involves only a select number of villagers who possess the capacity to do so. Estimates of tuna catches by subsistence or artisanal fishers were unavailable, but are thought to be small relative to the large-scale commercial sector, and are not specifically considered in this reconstruction. There have been complaints from the islanders, however, that local tuna catches are declining as a result of the commercial fishing fleets and baitfish fishery.

Other commercially valuable marine exports (e.g., *bêche-de-mer* and trochus) are produced in a manner that resembles artisanal rather than large-scale commercial fisheries (Gillett 2005). Sea cucumbers are not part of the local subsistence diet and are largely exported to China and Southeast Asia in the form of dried *bêche-de-mer*. Trochus meat, however, is consumed by villagers before the shells are sold to foreign markets (Japan and Southeast Asia) or domestic button factories (Richards *et al.* 1994). Aquaculture is a growing practice in the Solomon Islands to farm oysters, prawns, clams, and seaweed; however, this study considers only marine wild capture fisheries.

Subsistence fisheries have existed in the Solomon Islands for centuries. Though managed according to customary traditions, subsistence fishing pressure is high enough to threaten local species, such as giant clams (*Tridacna* spp.) which have been extirpated from some areas (Richards *et al.* 1994). Coastal fisheries are increasingly under threat from a number of factors, such as agricultural development, mining and logging, which are jeopardizing the health of coastal reefs and lagoons. Coupled with the harvesting of mangrove trees and corals, this has a substantial impact on the coastal fisheries. The harvesting of mangrove wood to fuel the fires used in drying *bêche-de-mer* greatly increased in the late 1980s and early 1990s (Adams and Dalzell 1994).

More recently, changes in social structure are also having an influence on fisheries. The shift from community-cooperation to cash markets threatens the status of village chiefs, although traditional authority remains strong today (Gillett 2007). Women's role in reef fishing is increasing, both in subsistence and artisanal sectors, further adding to fishing effort and pressure (Agassi 2005). Although growing urban consumption demands will be supplemented with alternative sources (e.g., imports), the increasing national population will inevitably maintain pressure on artisanal and subsistence fisheries.

Commercial tuna fishery

The only large-scale commercial fishery in the Solomon Islands is for tuna. The large-scale commercial tuna fishery was virtually non-existent before a Japanese survey documented a large supply of tuna and associated baitfish in 1970. This survey marked the establishment of the Solomon Islands Fisheries Department. The Solomon Islands Government signed a joint venture agreement with the Japanese Taiyo Gyogyo Fishing Company in 1972. This venture produced the first domestic pole-and-line and purse seine fleet, Solomon Taiyo Ltd. (STL; Anon. 1988). STL was to progressively develop and expand the commercial fishery, and was granted the exclusive right, other than by fully local companies, to fish within the territorial waters (Evans and Nichols 1985).

In 1977, a joint venture was formed between the government and STL, establishing the second domestic commercial pole-and-line fishing company, National Fisheries Development Limited (NFD). The purpose of this venture was to develop a national fishing fleet employing Solomon Islanders as a way to stimulate local involvement in the commercial tuna industry and supply additional fish to STL. The initial joint venture agreement deemed STL responsible for receiving, processing and marketing all commercial tuna catches in the country (Anon. 1988), from both STL and NFD. Domestic purse seine operations began in 1980. NFD was later sold to the Canadian company, BC Packers (Lewis 2005), and again to Trimarine Corporation (FAO 2002) based in Singapore.

There is little mention of a third joint venture agreement with the Philippines leading to the formation of the company Markirabelle. Both Trimarine (BC Packers) and Markirabelle catch and export tuna with no land-based processing (Anon. 1993). This type of agreement is referred to as transshipment, and is a widespread problem which complicates fisheries management and global catch estimates, as catches are landed in countries other than where or by whom they were caught. The Solomon Islands Government allotted Markirabelle an annual allowable tuna catch of 35,000 t. In 1991, Markirabelle was reportedly under producing at 1,000 t (Anon. 1993) per year. As cited in Gillett (2009), a total of 121 transshipments by foreign purse seine vessels occurred at the Honiara Port during 2005, with 65,616 t of skipjack tuna (*Katsuwonus pelamis*) and 13,012 t of yellowfin tuna (*Thunnus albacares*) being transshipped. Substantive revenues amounting to millions of SI dollars were collected by the government from

these transshipments. No further information on transshipments was available at the time of the reconstruction, but this practice is likely continuing.

Japanese fleets were present in the Solomon Islands' waters as early as the 1930s, with no available quantitative records. Between 1980 and 2006, several foreign access agreements were negotiated with Japan, Republic of China, Republic of Korea, USA, Vanuatu, Fiji, the Federated States of Micronesia, Spain, France, and Portugal (Access Agreement Database, unpublished data, *Sea Around Us* project). Access fees account for 0.1% (US\$1,707,000; Gillett 2007) of the SI gross domestic product (GDP), based on a 2001 estimate by Gillett and Lightfoot (2001). Fishing contributes 12.8%, or approximately US\$36 million to the SI GDP (Gillett 2007). Japanese longline and pole-and-line vessels, and US Multilateral Fishing Treaty vessels, appear to be the only fleets actively exercising foreign access in Solomon Islands' waters as documented in national reports.

The catch of the commercial tuna industry is largely composed of skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*). Associated with the tuna fishery is the capture of valuable non-target species including marlin, sailfish and shark (Gillett 2005). Tuna accounts for 90% of the marine exports of Solomon Islands, primarily frozen or canned. In 1999, 65% of STL's catch was canned, 20% exported frozen, 13% smoked, and 2% made into fish meal (Government of Solomon Islands 1999, in Barclay and Cartwright, 2007). The vast majority of tuna exports are destined for Japan, the UK, and Thailand. In 2001, there was far less fishing, most of the production was for local processing (canning and smoking) and much less frozen tuna was exported (FAO 2002), presumably due to ongoing domestic conflicts.

Civil war broke out in the late 1990s, culminating in the overthrow of the government in June of 2000 (Barclay and Cartwright 2007) and the subsequent closure of all major industries, including fishing enterprises (FAO 2002). The country remained dysfunctional until 2003, when the Australian police and military led the Regional Assistance Mission to Solomon Islands (RAMSI) to re-establish order (Barclay and Cartwright 2007). Tuna canneries were closed but have since re-opened under local management, though exports remain low.

The coastal areas were struck by a major earthquake and tsunami in 2007, further hindering the coastal commercial and subsistence fisheries. A decline is evident in reported commercial tuna landings after 2007, likely as a result of damaged boats and/or lack of fishery statistical collection following the tsunami. Commercial tuna catches remain well below those recorded before the year 2000.

In terms of governance, the Solomon Islands have been recognized as being corrupt in fisheries management and other governance issues in the Pacific Islands region (Hanich and Tsamenyi 2009). The Fisheries Department suffers from a lack of human and financial resources, in addition to problems of transparency and accountability. There are no published annual fisheries reports for the 1994-2004 time period, although Solomon Islands continued to collect data for the Secretariat of the Pacific Community (SPC) and Forum Fisheries Agency (FFA; Barclay and Cartwright 2007). A domestic audit of the Fisheries Department in 2003 revealed that millions of US dollars from distant water access fees had "disappeared into someone's pocket" (Islands Business 2005, as cited by Barclay and Cartwright 2007). Steps are being taken to improve accountability and build the capacity of the Fisheries Department.

Marine tenure

Adding to the governance situation for commercial, subsistence and artisanal fisheries in the Solomon Islands is the presence of customary marine tenure. Most rural land and virtually all reefs are managed by a complex and dynamic system, whereby kinship-based groups exert control over designated areas and associated resources (Skewes 1990). The leaders of such kin groups are referred to as chiefs. Based on traditional knowledge, chiefs monitor the state of their resources and enforce necessary harvest restrictions on reef areas or specific species. In Morovo Lagoon, for instance, tenure rights include limited entry to the fishing grounds, the complete prohibition of dynamite, and partial bans on gillnets, spearfishing, and fish poisons. There were also temporary closures of fishing grounds to allow for fish populations to rebuild (Hviding and Baines 1994).

All coastal resource development initiatives are assessed by local chiefs. Commercial fishing companies respect customary marine tenures by paying royalties to the chiefs who "own" the baitfish fishing grounds. Fisheries managers also work to integrate traditional values with fisheries development aspirations (Skewes 1990). The Provincial Government Act of 1981 specifies that provincial jurisdiction cannot override customary law (Hviding 1998).

The purpose of this study was to provide a more accurate depiction of total marine fisheries extractions by the Solomon Islands than is currently available from data presented by the FAO on behalf of the Solomon Islands. The FAO FishStat database offers time series data on marine fisheries landings from 1950 to 2009. This study estimates unreported catches as well as reviewing reported landings and export data.

METHODS

Small- and large-scale domestic fisheries catches were estimated using reported and unreported data for the period 1950-2009. Reported landings were obtained from the FAO FishStat database and government reports, whereas unreported estimates were based on independent studies. Domestic commercial tuna landings from national reports were compared to FAO data, supplemented by data from independent studies. Artisanal and subsistence estimates were based on subsistence catch estimates converted to *per capita* catch rates using human population data.

Demographics

Census data were obtained from two online population statistic databases to complete a time series from 1950-2009. Census information for 1950-1960 was derived from Populstat (Figure 2; www.populstat.info; accessed April, 2011) and data from the World Bank (data.worldbank.org; accessed April, 2011) was used from 1960-2009. The majority of the population of Solomon Islands in the recent period lives in rural areas (80% rural and 20% urban; www.indexmundi.com; accessed April, 2011). Cash markets and lucrative urban employment continue to drive the migration from rural to urban areas.

Tuna fishery

FAO tuna landings were compared to those reported in Annual Government reports from 1987, 1988, and 1993 (Anon. 1987, 1988, 1993), and independent studies conducted by Gillett (2007, 2009) and Barclay and Cartwright (2007). This comparison revealed relatively good transfer of commercial tuna data between the Solomon Islands government and the FAO. Therefore, FAO tuna data were accepted as the best available depiction of Solomon Islands large-scale tuna fishery catches. The notable decline in year 2000 tuna catches is thought to be the result of the civil tensions and resulting fisheries closures.

This section pertains to tuna production by the domestic and joint venture fleets, Solomon Taiyo Ltd. (STL) and National Fisheries Development Ltd. (NFD). Foreign access fisheries are described separately (see *Foreign Fisheries*).

Comparing tuna production with tuna exports was indicative of the amount of tuna available for domestic consumption. The data suggest that between 2-20% (240 – 4,800 t·year⁻¹) of tuna production remains in the country each year. When exports collapsed in 2000, 94% (12,000 t) of tuna catches remained within the Solomon Islands.

Large-scale operations of tuna fishing can include fishing grounds outside of the EEZ. Therefore, data from the Forum Fisheries Agency (FFA) for albacore, bigeye, skipjack and yellowfin tuna, were used to determine the spatial allocation of the tuna catch. The FFA data were directly utilized to determine the proportions of the four tuna species inside the EEZ, in another country's EEZ and in the high seas, for the years 1997-2009. The ratio of catches inside to outside the EEZ in 1997 was used to allocate the catches for all previous years.

By-catch

Large, non-tuna pelagic species are often caught alongside the tuna fishery as non-targeted by-catch. Gillett (2009) adjusted reported tuna catches by 30% for longliners and 5% for seiners to account for by-catch. Using the same catch rates, pelagic by-catch was calculated based on reported tuna catches by gear-type.

Prior to 1980, tuna were mainly targeted using pole-and-line. This relatively selective gear-type is associated with low levels of by-catch. The low catches of non-tuna pelagic species seen in national reports during the 1970s (Anon. 1987), and subsequent increase in the following years, likely reflects the change in gear-type from predominantly pole-and-line to less selective gears such as longline.

National and FAO categories for pelagic species other than tuna were assumed to represent landed by-catch from the large-scale commercial tuna industry. These landings were used in combination with calculated by-catch estimates, based on Gillett (2009), to account for the removal of non-tuna pelagic species from Solomon Islands' waters.

National tuna reports present an "others" category, assumed to be non-tuna pelagic species, which were the only available data source for the 1971-1979 time period. From 1980 to 1991, by-catch estimates from Gillett

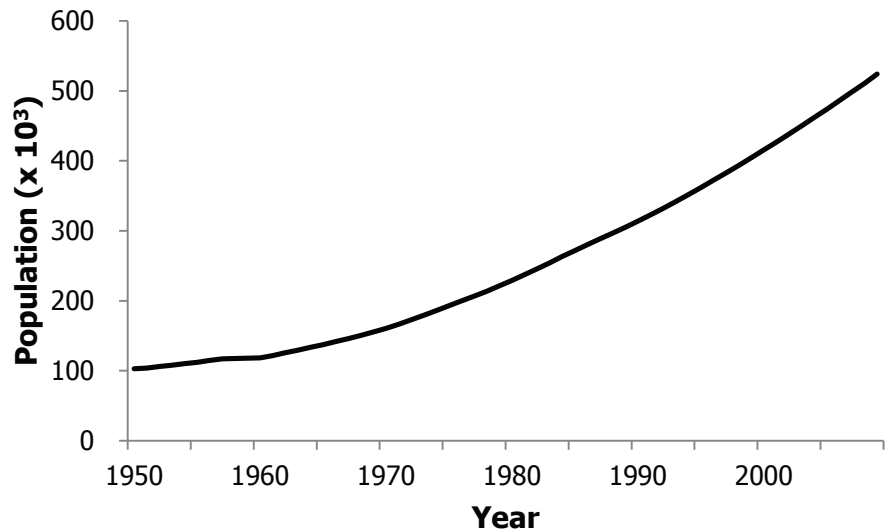


Figure 2. Human population of Solomon Islands, 1950-2009.

Table 1. Species composition of shark catches in the Solomon Islands, based on Nichols (1992).

Taxon name	% of catch
<i>Carcharhinus amblyrhynchos</i>	15
<i>Carcharhinus sorrah</i>	15
<i>Carcharhinus melanopterus</i>	15
<i>Triaenodon obesus</i> ^a	15
<i>Carcharhinus albimarginatus</i>	10
<i>Sphyrna lewini</i>	10
<i>Galeocerdo cuvieri</i>	10
Other sharks	10

^aIncluded only in the breakdown for the artisanal shark catches as it is a reef associated species. This species was excluded and the composition re-scaled for the breakdown of shark by-catch.

and Lightfoot (2001) were used. FAO landings for non-tuna pelagic species (black marlin, blue marlin, striped marlin, “marlins, sailfishes, etc. nei”, “sharks, rays, skates, etc. nei”, and swordfish) were used for 1995–1999. By-catch estimates based on Gillett and Lightfoot (2001) were used for 1999 to 2007, since these values seemed most accurate and consistent. A linear interpolation was used to complete the time series between the 1991 (by-catch estimate) and 1995 (FAO Landing) anchor points. Tuna catches by gear-type were unavailable for 2008 and 2009. Landings by gear-type were estimated for these years using an average percentage for the 2000–2007 time period. The Gillett and Lightfoot (2001) adjustments were then applied to estimate by-catch for 2008 and 2009.

FAO FishStat presents landings data for black marlin, blue marlin, striped marlin, swordfish, a “sharks, rays, skates, etc. nei” category and a “marlins, sailfish, etc. nei” category. We applied the taxonomic composition of non-tuna pelagic species presented in the FAO data to estimates of unreported by-catch. The shark category was further disaggregated using species data presented in Nichols (1992; Table 1).

By-catch associated with the large-scale tuna fishery was also spatially allocated using the proportions of the spatial distribution for total tuna catches each year.

Baitfish

The baitfish fishery operated in parallel to the pole-and-line fishery for skipjack tuna (Evans and Nichols 1985) and was carried out through negotiations under local marine tenure. Baitfish does not appear to be exported from the Solomon Islands, as baitfish exports are prohibited under joint venture agreements. Baitfish catch has been systematically under-reported in the past (Evans and Nichols 1985) and records are assumed unreliable prior to 1981. Baitfish landings were reported in annual government reports (Anon. 1987, 1988, 1993). As we were unable to confirm otherwise, we assumed baitfish production was included in the FAO category “marine fishes nei” (MMF). Therefore, using national reports, we disaggregated baitfish catches from the MMF data. This portion of the MMF catch was then assigned to baitfish taxa, which included anchovies (Engraulidae), sprat and herring (Clupeidae) based on information presented in Evans and Nichols (1985; Table 2).

Table 2. Baitfish fishery taxonomic breakdown, based on Evans and Nichols (1985).

Common name	Taxon name	Catch (%)
Devis' anchovy	<i>Encrasicholina devisi</i>	40.0
Shorthead anchovy	<i>E. heteroloba</i>	40.0
Buccaneer anchovy	<i>E. punctifer</i>	5.0
Spotty-face anchovy	<i>Stolephorus waitei</i>	5.0
Indian anchovy	<i>S. indicus</i>	5.0
Sprat	<i>Spratelloides</i> spp.	2.5
Bluestripe herring	<i>Herklotsichthys quadrimaculatus</i>	2.5

Small-scale sector

Small-scale fisheries of the Solomon Islands were predominantly non-commercial (i.e., subsistence) in the early time period. The increasing migration of people to urban centers starting in the 1970s saw a shift from a mainly subsistence to an increasingly market-based economy. Exports of marine invertebrates existed as early as the 1950s; however, the export of marine products caught by small-scale commercial fishers became more prevalent in later decades. Small-scale catches destined for export consisted mainly of marine molluscs. These catches appear to be relatively well reflected in the official landings data. This sub-sector of the artisanal fishery is considered further in the *Export fisheries* section.

Table 3. Anchor points used in calculating subsistence and artisanal catch for Solomon Islands, 1950–2009.

Year	Population	Catch (t)		Catch rate (kg/person/year)		Source
		Subsistence	Artisanal ^a	Subsistence	Artisanal	
1945	-	-	-	-	0.0	Assumption ^b
1950	103,000	-	-	60.0	-	Assumption ^c
1960	118,294	-	-	56.0	-	Assumption ^d
1970	160,668	-	-	52.0	-	Assumption ^e
1999	404,415	13,000	3,200	32.0	5.5	Gillett and Lightfoot (2001)
2002	438,317	13,000	3,100	30.0	5.2	Gillett (2005)
2007	498,240	15,000	3,250	30.1	5.6	Gillett (2007)

^aArtisanal catches were adjusted using baitfish catch estimates to reflect only domestic consumption sales; ^bArtisanal catch rate was assumed to be zero in 1945; ^c1950 subsistence catch rate assumed to be 60% higher than 1999 combined subsistence and artisanal catch rates; ^d1960 subsistence catch rate assumed to be 50% higher than the 1999 combined subsistence and artisanal catch rates; ^e1970 subsistence catch rate assumed to be 40% higher than 1999 combined subsistence and artisanal catch rates.

While no system existed in the early time period for the collection of small-scale catch data (aside from exports), rough estimates were likely made based on consumption data (Cook 1988). The FAO “marine fishes nei” category was therefore assumed to include some portion of the small-scale finfish catches.

Subsistence and artisanal catches were estimated by Gillett and Lightfoot (2001) to be 13,000 t in the late 1990s. Gillett (2005) provides subsistence and artisanal catch estimates of 13,000 t and 3,100 t, respectively for 2002,

while Gillett (2007) provides subsistence and artisanal catch estimates of 15,000 t and 3,250 t, respectively for 2007. Coastal commercial catches estimated by Gillett and Lightfoot (2001) include catches from the industrial baitfish fishery. Baitfish catches were therefore subtracted from the artisanal catch estimates to derive the portion of the catch for domestic consumption. Subsistence and artisanal catch estimates for 1999, 2002 and 2007 (adjusted to reflect only the domestic consumption portion) were used in combination with population data to calculate *per capita* subsistence and artisanal catch rates (Table 3). The *per capita* catch rates of 1999, 2002, and 2007 were used as anchor points to calculate catch rates and landings for the remainder of the time period, with catch rates being interpolated between these years.

In 1950, we assumed a subsistence catch rate of 60 kg·person⁻¹·year⁻¹, based on the assumption that the catch rate was 60% higher than the 1999 small-scale catch rate (subsistence and artisanal combined). For 1960, the subsistence catch rate was assumed to be 50% higher (i.e., 56 kg·person⁻¹·year⁻¹) than the 1999 combined subsistence and artisanal small-scale rates. The subsistence catch rate in 1970 was assumed to be 40% higher (i.e., 52 kg·person⁻¹·year⁻¹) than the combined 1999 rates (Table 3). For the artisanal (i.e., commercial) catch rate, we assumed zero catches in 1945, increasing gradually after WWII. Linear interpolations between anchor points (Table 3) were made to derive a complete time series of subsistence and artisanal catch rates from 1950–2009. These catch rates were applied to the total population to derive total subsistence and artisanal catches.

The taxonomic composition of artisanal and subsistence catches was derived from Dalzell and Preston (1992) and Gillett (2007; Table 4). For the artisanal fishery, we applied only a taxonomic breakdown for fish species as we assumed the invertebrates reported by the FAO comprised the majority of commercial invertebrate catches. The taxonomic composition of the subsistence fishery included 30% invertebrates, which were assigned to taxa based on species presented in Richards *et al.* (1994; Table 4). The subsistence breakdown also excluded deepwater snappers of the Etelinae and Apsilinae sub-families, as these were assumed to be taken only by the commercial sector.

Live reef fish and other species

Live reef fish trade, aquarium collectors, tourism-related seafood consumption and sport fishing all contribute to additional marine removals; however, data on these were either unavailable and/or these sectors are not covered in this catch reconstruction (e.g., aquarium collectors). While there are reports of live export of coral trout, snappers and other groupers (FAO 2002), these have not been quantitatively accounted for. The Solomon Islands supply the Chinese Live Reef Food Fish (LRFF) trade to a lesser extent than other Indo-Pacific or Southeast Asian countries. Fishing trials for the LRFF began in the Solomon Islands in 1994 at spawning aggregation sites in Marovo Lagoon, followed by operations in Roviana Lagoon and Ontong Java (ADB 2004). A moratorium was placed on the LRFF in the Solomon Islands after trials were complete, and no LRFF fishing activities have commenced since it was lifted in 2000 (ADB 2004). After adverse social, economic and ecological repercussions of the LRFF, several marine tenures have created no-take zones.

There is an indigenous dolphin fishery that kills hundreds of dolphins each year (Barclay and Cartwright 2007), and which facilitated the live export of 28 dolphins to Mexico in 2003 and 30 to Dubai in 2007. This reconstruction excludes the aquarium trade and cetacean catches. Sport fishing and tourism-derived marine catches were unavailable at the time of the reconstruction but are thought to have low tonnage.

Foreign fisheries

Foreign tuna fisheries catch data are available in national reports from 1987, 1988 and 1993, as well as independent studies by Gillett (2005, 2007) and Barclay and Cartwright (2007). Foreign fisheries statistics have been included separately in this report to portray the additional fishing pressure present in the area (Appendix Table A3). These data are not included in the reconstruction of total fisheries removals by Solomon Islands' fisheries from Solomon Islands' waters.

Another issue of concern surrounding the foreign access fishery is the occurrence of non-tuna pelagic catches, considered by-catch in this report. Non-tuna pelagic catches were recorded in national reports (Anon. 1987, 1988, 1993) as either "other" or "billfish" caught by Japanese foreign based fleets (Appendix Table A4). Taxonomic breakdowns were not available, but were assumed to include the same species as domestic by-catch. No data were available for US purse seine tuna catches regarding non-tuna pelagics. Non-tuna pelagics caught by foreign based fleets are not included in the total reconstructed fish removals from the Solomon Islands.

Table 4. Taxonomic composition % of the artisanal and subsistence sector based on Dalzell and Preston (1992), Gillett (2007) and Richards *et al.* (1994).

Taxon name	Artisanal (%)	Subsistence (%)
Etelinae	30.50	0.0
Apsilinae	30.50	0.0
Lutjanidae	14.30	26.6
Lethrinidae	0.40	0.7
Serranidae	10.80	19.4
Carangidae	0.95	1.7
Scombridae	0.95	1.7
Gempylidae	0.03	0.1
Sphyrnidae	7.80	14.0
other Teleosts	3.80	6.8
<i>Birgus latro</i>	n/a	10.0
<i>Panulirus</i> spp.	n/a	10.0
<i>Tridacna</i> spp.	n/a	10.0

Table 5. Trochus shell landings as compared to national export data.

Year	FAO trochus landings	National trochus data
1985	500	500
1986	662	662
1987	"44502"	445
1988	"46001"	460
1989	"37107"	371
1990	"30606"	300
1991	"8705"	87

^aData in quotation marks considered erroneous, see text.

Export fisheries

Triggered by the decline of the copra industry, an export market for marine products developed with trochus (*Trochus niloticus*), *bêche-de-mer*, shell, blacklip (*Pinctada margaritifera*) and goldlip (*P. maxima*) pearl oysters, green snail (*Turbo marmoratus*) and shark fins as the most valued products (Skewes 1990). In 1993, an export ban was placed on blacklip and goldlip oysters (Richards *et al.* 1994).

Sharks

FAO trade data present quantities of exported shark fins (dried, salted, etc.) from 1987–2008. FAO shark fin exports were converted to whole (wet) weight equivalents using a conversion factor of 2.44% for the genus *Carcharhinus* (Biery 2012; Biery and Pauly 2012). Richard *et al.*'s (1994) estimate of 2 t of exported shark fins in 1985 was also converted to whole wet weight. Exported fins as presented by FAO trade data in 1995 were substantially higher than any other year of reported fin exports. Assuming that this was a data error, we used a five-year average (1993–1997) to represent fin exports for 1995. FAO exports in whole wet weight were then compared to FAO landings (assumed to be the reported by-catch from the industrial tuna fisheries) and estimates of unreported industrial shark by-catch. Export amounts in excess of the estimated shark by-catch, were assumed to be unreported artisanal sector catches of *Carcharhinus*. Sharks caught as by-catch in the artisanal fisheries are sold to the shark-fin export market, while subsistence fishers will consume the meat (Richards *et al.* 1994). Unreported artisanal shark catches for the early time period were estimated based on the first three years of available data (1985–1987) converted to a *per capita* rate and applied to the population from 1950–1984. From 2000 onward, we used the 1997–1999 average unreported artisanal shark estimate, carried forward unaltered to 2009.

Invertebrates

Bêche-de-mer: exports of non-fish marine species include substantial amounts of dried sea cucumber. These are among the most economically valuable resources that can be obtained immediately at the village level (Anderson *et al.* 2010). Among the 20 harvested sea cucumber species in the Solomon Islands, the three most valuable species for *bêche-de-mer* exports are Sandfish (*Holothuria scabra*), White teatfish (*H. fuscogilva*), and Prickly redfish (*Thelenota ananas*; Richards *et al.* 1994). The available FAO *bêche-de-mer* (catch and export) data are assumed to have been recorded as dry weight. *Bêche-de-mer* exports published by Richards *et al.* (1994) were “processed” specimens, meaning they were boiled, cleaned, dried and smoked, and matched reported FAO landings and export data. Thus, FAO landings data, which are supposed to be wet weight, were misreported as dry weight. Based on Conand (1991), a conversion factor of ten was used to derive wet weight equivalents.

Trochus: An export market for trochus shells has long existed in the Solomon Islands. Colonial reports dating back to the 1950s, present export quantities of trochus shells, which are processed into buttons. While the shells are almost entirely exported, the meat is consumed by locals. FAO provides landings of trochus shells starting in 1964. Independent sources present almost identical estimates between 1973 and 1986. However, FAO landings from 1987–1991 are exactly 100 times larger than those presented in national trade reports (Anon. 1988; Table 5). From 1992 onward, FAO trochus shell landings fluctuate considerably from year to year and were, in some years, much higher than estimates from independent studies. These major discrepancies in the data since 1986 suggest a problem in the validation of the data. The large quantities reported by the FAO on behalf of the Solomon Islands (e.g., 44,502 t in 1987; Table 5) are greater than the estimated total allowable catch for the country by a factor of 100. Therefore, we did not accept the FAO data from 1987 onward. The reconstructed time series of trochus catches was thus derived as follows:

- 1951–1963: export data presented in British colonial reports (Anon. 1953, 1955, 1957, 1959, 1961, 1963, 1966).
- 1964–1986: FAO landings were accepted as the best available representation of trochus catches.
- 1987–1990: exports presented in Annual Reports of the Fisheries Department (Anon. 1988).
- 1991: exports presented by Richards *et al.* (1994).
- 1992–1998 and 2000–2005: linear interpolation between 1991 and 1999 anchor points and 1999 and 2006 anchor points, respectfully.
- 1999 and 2006: annual production estimates given by Lasi (2010).
- 2007–2009: estimate for 2006 carried forward.

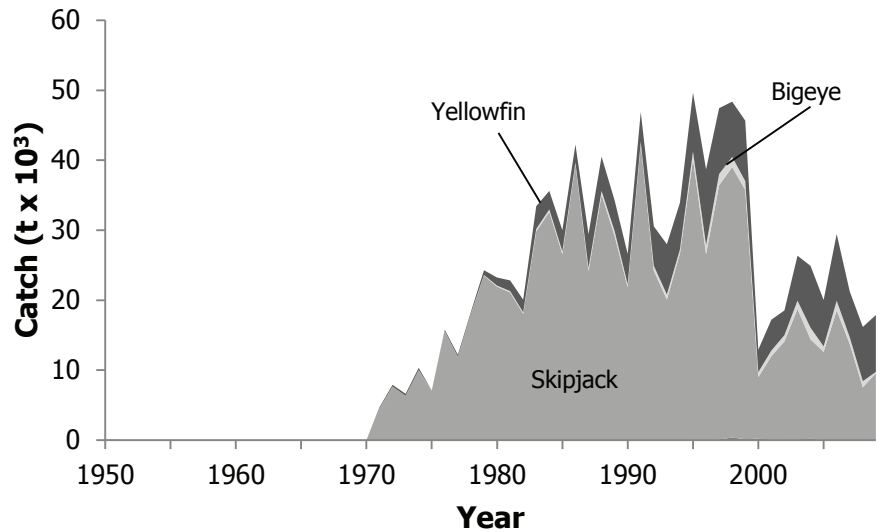


Figure 3. Domestic tuna landings as presented by the FAO on behalf of the Solomon Islands, 1950–2009. Note: Pacific bluefin tuna and albacore catches, although included in this graph, do not appear as catches are small.

RESULTS

Large-scale fisheries (tuna landings, by-catch and baitfish)

The tuna fishery, as reported by FAO, shows strong cyclical variation with peaks every three or four years, coinciding with El Niño events (FAO 2002; Figure 3). Large-scale tuna catches were estimated to be greater than one million tonnes over the 1950–2009 time period (20,500 t·year⁻¹ since 2000). As reported to FAO, the main species caught were skipjack tuna (81%), yellowfin tuna (17%), bigeye tuna (2.2%) and albacore tuna (0.2%).

Commercial tuna industry by-catch was estimated to be approximately 24,860 t over the 1950–2009 study period (Figure 4). Unreported by-catch constituted 18,400 t (74% of total by-catch) over the study period. This amounts to a 187% increase of non-tuna pelagics (6,400 t reported by FAO for 1950–2009). Estimated by-catch included a total of 4,300 t of reported and 5,800 t of unreported shark by-catch (Figure 5) over the 1950–2000 time period.

The baitfish fishery supporting the commercial pole and line tuna fishery accounts for an estimated 9% (47,465 t from 1972–2009; 467 t·year⁻¹ since 2000) of the FAO MMF category (Figure 6). Baitfish catches account for 3% of the overall catch. Baitfish catches were dominated by anchovy of the family Engraulidae and the genus *Encrasicholina*, specifically, accounting for 85%.

As part of the allocation process, it was estimated that approximately 2.4% of the large-scale commercial catches were taken from outside of the EEZ. These catches represent 1.4% of the total reconstructed catch.

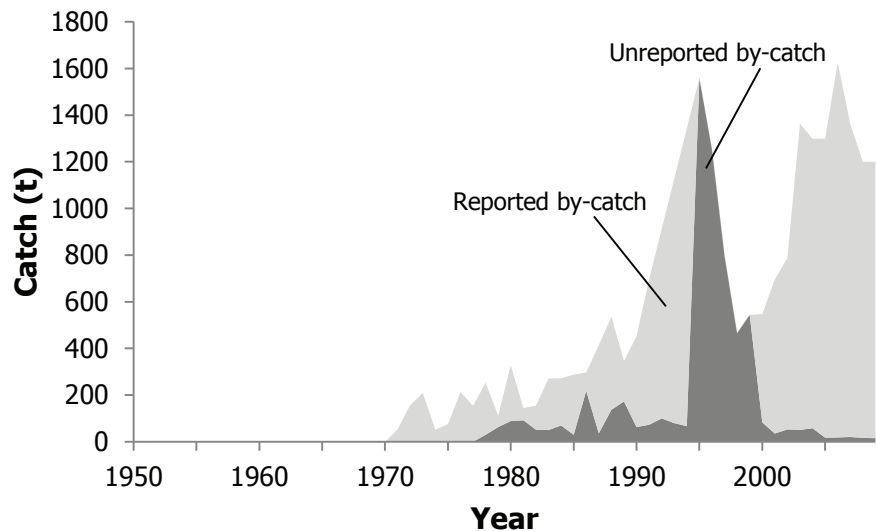


Figure 4. By-catch associated with the Solomon Islands commercial tuna fishery, including a reported component (FAO non-tuna pelagic) and an unreported component, 1950–2009.

Small-scale fisheries

Artisanal finfish catches for the study period (1950–2009) were estimated to be approximately 63,700 t (2,500 t·year⁻¹ in the 2000s), and accounted for 13% of the FAO MMF category. The reported component of the subsistence catch for 1950 to 2009 was estimated to be almost 400,000 t. Over 210,000 t of subsistence catches were deemed unreported for the Solomon Islands for 1950–2009 (Figure 6). Unreported artisanal shark catches were estimated to be 29,217 t over the 1950–2009 time period, which is 74% of the total shark catches (Figure 5). This estimate was derived using trade data.

Export fisheries

Invertebrate catches by the commercial sector (primarily export) amounted to over 71,000 t (Figure 7). *Bêche-de-mer* catches represented the majority of artisanal invertebrate catches and amounted to 52,400 t over the 1950–2009 study period. Reconstructed trochus shell catches represented the second largest individual component with an estimated 18,000 t between 1950 and 2009. The remaining catches (abalone, banana prawn, clams, and gastropods) were grouped as ‘other artisanal invertebrates’, which amounted to 1,200 t between 1950 and 2009 (Figure 7).

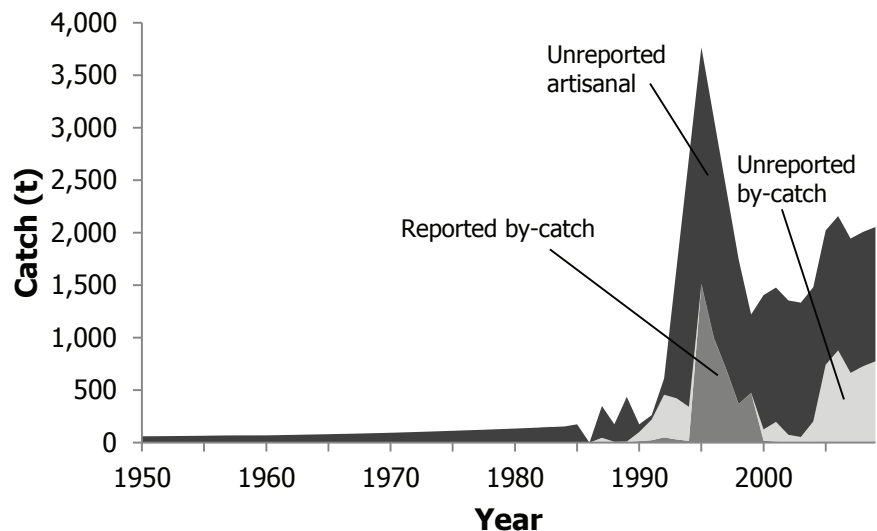


Figure 5. Shark catches for the Solomon islands including by-catch associated with the commercial tuna fishery (reported and unreported), and unreported artisanal catch, 1950–2009.

Foreign fisheries

Combined tuna landings of the Japanese and US foreign based fleets totalled approximately 407,000 t from 1972 to 2007, and another 99,000 t of catch from unnamed foreign countries (Appendix Table A3). Fisheries data were unavailable for 1991-1999. National reports suggest that Japan had a monopoly over the Solomon Islands foreign access allowances until 1988, when US purse seine operations began. The US purse seine fleets immediately started producing higher tuna catches than the Japanese. In 2004, Japan reportedly caught 620 t, whereas the US landed 70,184 t.

The total reported non-tuna pelagic by-catch by Japanese foreign based fleets was approximately 2,770 t from 1974 to 1991. Non-tuna pelagic removal statistics were not available for the US purse seine or other foreign access fleets. The foreign based tuna and non-tuna pelagic catches are presented here but not included in the total catch reconstruction for Solomon Islands fisheries.

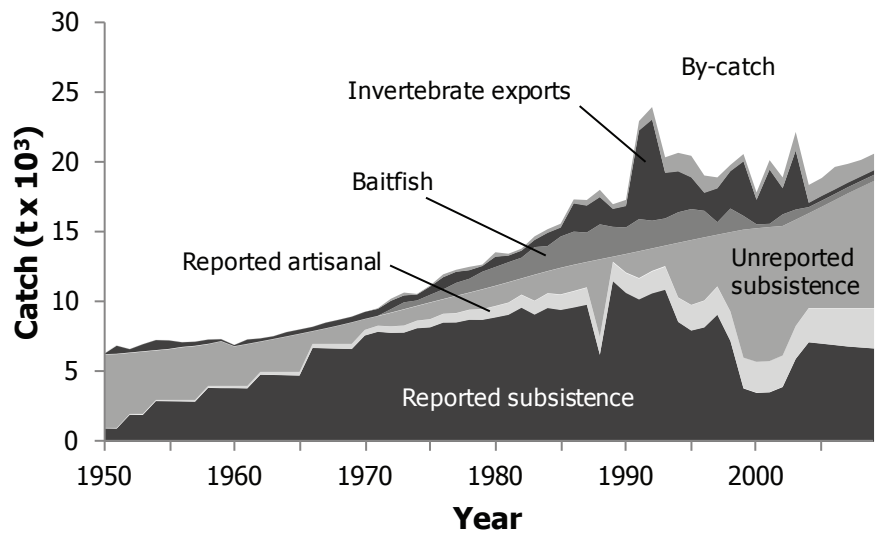


Figure 6. Total fisheries catches for the Solomon Islands by sector and/or fisheries component, excluding tunas and trochus, 1950-2009.

Total reconstructed catch

Total reconstructed catches for the Solomon Islands were estimated to be approximately 1.87 million t from 1950-2009 (41,400 t·year⁻¹ since 2000; Figure 8). The FAO on behalf of the Solomon Islands reports landings of 1.81 million tonnes (33,000 t·year⁻¹ since 2000). A relatively large adjustment was made to the trochus shell landings, which were considered to be over-reported for some years in the FAO landings data. The main sources of under-reporting were shark and other non-tuna pelagic by-catch and subsistence catches. Subsistence sector catches represented 90% of small scale catches for domestic consumption. Commercial invertebrate catches (exports) represented 4% of the total reconstructed catch and consisted mainly of sea cucumber, trochus shell and other molluscs. Baitfish catches, assumed to be included in the official data, represent 3% of the total reconstructed catch. The reconstructed subsistence fishery represents 33% of the total reconstructed catch. Artisanal catches, including unreported shark landings, comprised 11% of the total reconstructed fisheries removals with the remaining 56% accounting for large-scale, industrial fisheries.

DISCUSSION

Total marine fisheries catches by the Solomon Islands between 1950 and 2009 were estimated to be 1.87 million tonnes, which is only slightly higher than the 1.81 million tonnes reported by the FAO on behalf of the Solomon Islands. Our estimates likely continue to underestimate the total fisheries removals from Solomon Islands' waters, given the exclusion of tourism-derived consumption, the live reef fish sector, and recreational fisheries. Our estimate accounts for substantial small-scale fisheries catches, which were unaccounted for in the official data. Additional Illegal, Unregulated and Unreported (IUU) catches are likely to occur in Solomon Islands' waters; however, our estimates were limited here to unreported small-scale

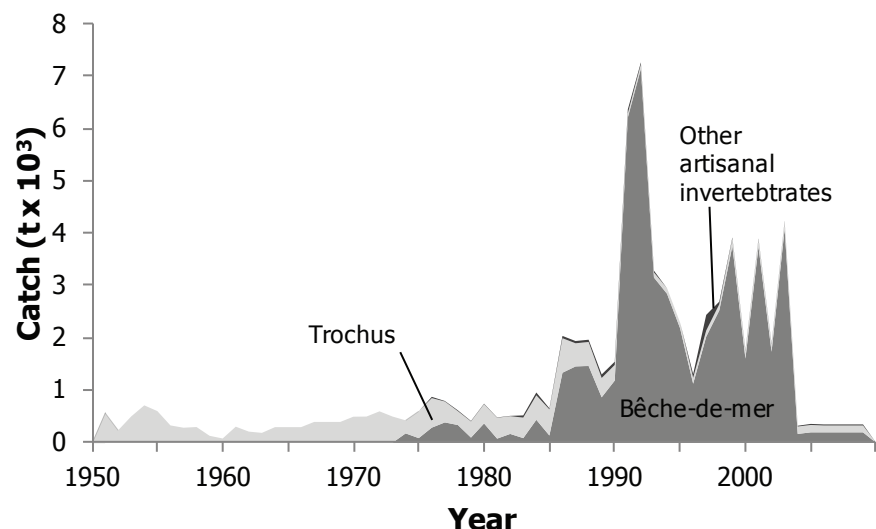


Figure 7. Total invertebrate catches by the commercial sector for the Solomon Islands, 1950-2009.

catches. While we were unable to determine under-reporting of tuna catches in this study, IUU catches of tuna are a problem globally and more attention is urgently needed to estimate the true catches by this fishery in the Solomon Islands and all countries where tuna fishing occurs.

Currently in the Solomon Islands there are no government quotas on the level of catch for any species other than tuna (Skewes 1990) and most invertebrate species caught in the artisanal fishery have been fully- or over-exploited in recent years (Richards *et al.* 1994).

This reconstruction highlights a need for improved monitoring and reporting of small-scale fisheries in the Solomon Islands. In the capital Honiara, 75% of marketed fresh fish is provided by small-scale fishers (FAO 2002). In response to increasing prices of domestic and imported foods, the growth of the subsistence and artisanal fisheries will likely continue. The under-representation of subsistence fisheries in the reported data may have significant implications on the state of local reef fisheries and food security for rural villages and urban centers.

Stock assessments for exploited species other than tuna are lacking in the Solomon Islands due to limited financial and technical resources. There are currently no published stock assessments of finfish associated with the small scale fisheries.

The Solomon Islands' sea cucumber fishery exemplifies a boom-and-bust pattern similar to that described by Anderson *et al.* (2010) which typically follows a rapid increase, short peak and a substantial downward trend. A declining sea cucumber fishery could result in social and economic consequences for the coastal villages of the Solomon Islands from a lack of alternative income sources (Anderson *et al.* 2010). In response to declining stocks of sea cucumbers, several marine tenures have restricted *bêche-de-mer* harvesting to every second year (Richards *et al.* 1994). Even with harvesting closures, sea cucumber stocks are slow to recover due to their physical vulnerability to harvesters, slow growth, maturity and recruitment rates, and Allee effects at low densities (Anderson *et al.* 2010). Landings of lower value species are increasing in the Solomon Islands (Richards *et al.* 1994), which is a sign of over exploitation (Anderson *et al.* 2010). The dramatic decrease in *bêche-de-mer* production may be the result of domestic tensions, tsunami impacts, and decline in species abundance.

Solomon Islands' trochus (*Trochus niloticus*) catches are the largest in the Pacific Islands region (www.spc.com; accessed April, 2011). Exports of trochus shell decreased substantially in 1991 as a result of a depressed overseas market coupled with declining catch per unit effort (Richards *et al.* 1994). Increased sales to domestic button factories maintained harvesting pressure, and the stock began showing signs of over-exploitation. Trochus stock assessments have not been conducted in the Solomon Islands (Richards *et al.* 1994).

The commercial tuna fishery is well below the total quota allocation of 120,000 t (Richards *et al.* 1994); however, the unknown extent of transshipments and village level catches occurring in the Solomon Islands could result in significantly higher tuna removals than accounted for in official records, as would other IUU tuna fishing activities. The systemic corruption, particularly by locally based foreign fishing companies (Hanich and Tsamenyi 2009), is an ongoing concern that could threaten the status of commercial tuna and other fisheries in the Pacific Islands region.

Available foreign access fisheries data suggest that Japanese longline and pole and line vessels, and US purse seine fleets were the only foreign fisheries operating in Solomon Islands' waters. In reality, given the number of countries permitted access, these data are likely misrepresentative of the foreign fisheries presence and contribution to total fish removals. Although foreign access catches are not included in the total reconstruction, the tuna and non-tuna pelagic removals of these countries is a concern that poses challenges for fisheries management in the Solomon Islands.

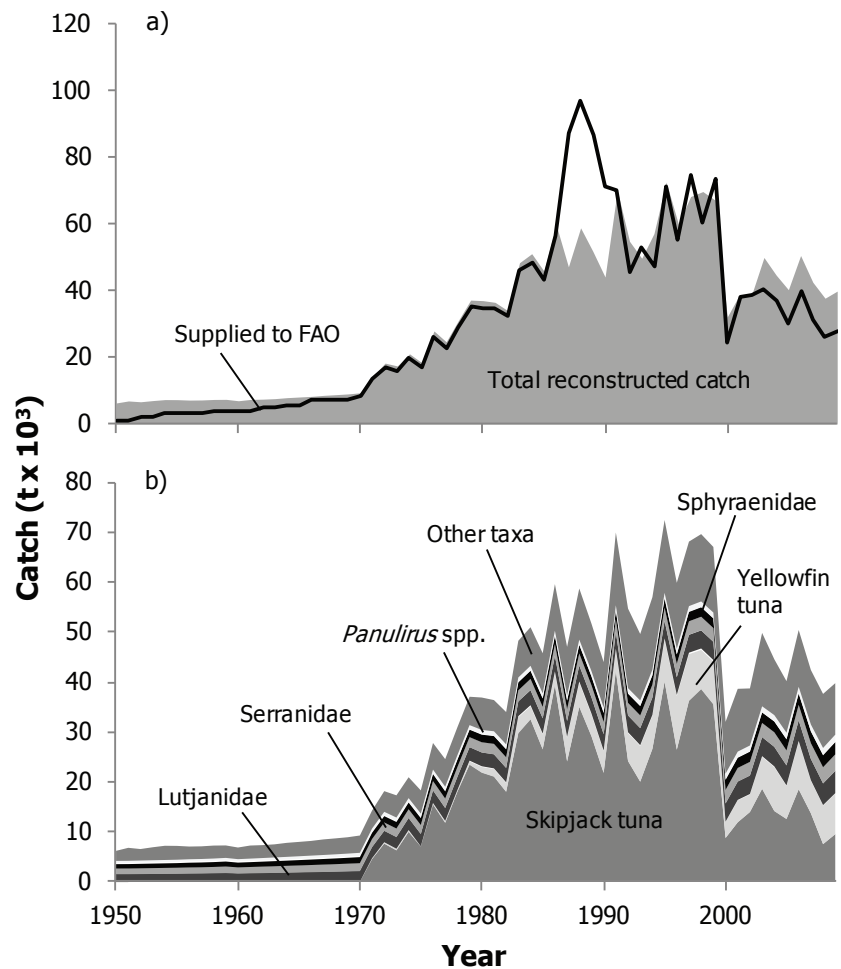


Figure 8. a) Total reconstructed catch compared to total landings supplied to FAO by the Solomon Islands, 1950–2009, and b) total reconstructed catch by major taxa. Others includes 36 taxa and a miscellaneous marine fish category.

Increased demand for seafood is projected for the Solomon Islands. Forecasts of seafood requirements to meet future *per capita* consumption rates have been estimated by Bell *et al.* (2009) at 18,000 t in 2010, 25,500 t in 2020 and 30,000 t in 2030. *Per capita* seafood demands will likely be partially met by subsistence fisheries, which are currently severely under-represented in the official data. Based on our reconstructed estimate, nearly 16,000 t of subsistence finfish and invertebrate catches were consumed domestically in 2009.

To sustainably secure diverse marine resources, the Solomon Islands government should employ a co-management strategy and work collaboratively with marine tenure chiefs to improve data collection, monitoring, regulation, and enforcement in their waters.

ADDENDUM

Since completing this reconstruction, FAO data became available to 2010. In the 1950-2010 FAO dataset, the erroneous “Trochus” landings identified in the present reconstruction have been corrected. A “Tuna-like fishes nei” category has also been added with catch values for 2008 and 2010 only. The majority of these catches have been disaggregated into albacore, bigeye, skipjack and yellowfin tuna, based on information in the FFA dataset, with the exception of 350 t in 2008 remaining as “Tuna-like fishes nei”. To update this reconstruction to 2010, FAO data were added for all reported categories. Unreported catch components for 2010 were then estimated based on the 2009 total reconstructed catch (i.e., the difference between the reported FAO 2010 total and the 2009 total reconstructed catch). The sectoral breakdown (artisanal, subsistence, large-scale etc.) for 2010 for the reported component was based on taxa for the industrial component and for the subsistence and artisanal sectors, the 2009 proportions were used. For the unreported data, the artisanal catch amount was carried forward unaltered and the remaining sectors were estimated accordingly, using proportions. Spatial allocation of the large-scale commercial catches was determined based on the proportions of the 2010 FFA data.

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Appendix Table A1. FAO landings vs. total reconstructed catch (in tonnes) for the Solomon Islands, 1950-2009.

Year	FAO landings	Total reconstructed catch
1950	1,000	6,290
1951	1,000	6,900
1952	2,000	6,650
1953	2,000	7,010
1954	3,000	7,310
1955	3,000	7,280
1956	3,000	7,150
1957	3,000	7,190
1958	4,000	7,350
1959	4,000	7,370
1960	4,000	6,960
1961	4,000	7,350
1962	5,000	7,440
1963	5,000	7,590
1964	5,300	7,890
1965	5,300	8,080
1966	7,300	8,270
1967	7,400	8,570
1968	7,400	8,780
1969	7,400	9,010
1970	8,500	9,360
1971	13,510	14,340
1972	17,010	18,220
1973	15,920	17,390
1974	19,640	21,000
1975	16,920	18,370
1976	26,220	27,850
1977	22,780	24,620
1978	29,130	30,990
1979	35,420	37,090
1980	34,800	36,930
1981	34,710	36,420
1982	32,490	34,030
1983	45,980	48,280
1984	48,660	50,980
1985	43,340	45,780
1986	56,450	59,600
1987	87,310	47,050
1988	96,840	58,720
1989	86,700	51,700
1990	71,460	44,010
1991	70,360	69,920
1992	45,720	54,700
1993	52,740	49,620
1994	46,980	57,000
1995	71,450	72,410
1996	55,140	59,860
1997	74,650	68,100
1998	60,210	69,590
1999	73,710	67,020
2000	24,590	32,070
2001	38,250	38,670
2002	38,380	38,750
2003	40,140	49,850
2004	36,700	44,580
2005	30,100	40,210
2006	39,540	50,430
2007	31,320	42,430
2008	26,260	37,660
2009	27,960	39,800

Appendix Table A2. Total reconstructed catch (in tonnes) for the Solomon Islands by major taxa, 1950-2009.

Year	<i>Katsuwonus pelamis</i>	<i>Thunnus alalunga</i>	Lutjanidae	Serranidae	Sphyrnidae	<i>Panulirus</i> spp.	Others ¹
1950	-	-	1,590	1,200	869	618	2,010
1951	-	-	1,600	1,210	872	620	2,600
1952	-	-	1,620	1,220	884	628	2,300
1953	-	-	1,640	1,240	895	635	2,600
1954	-	-	1,660	1,260	907	642	2,840
1955	-	-	1,680	1,270	918	650	2,760
1956	-	-	1,720	1,300	937	662	2,540
1957	-	-	1,740	1,310	947	669	2,530
1958	-	-	1,770	1,340	966	682	2,590
1959	-	-	1,820	1,370	992	699	2,490
1960	-	-	1,720	1,300	941	662	2,330
1961	-	-	1,770	1,330	963	678	2,610
1962	-	-	1,810	1,370	986	693	2,580
1963	-	-	1,850	1,400	1,010	709	2,620
1964	-	-	1,900	1,430	1,035	725	2,800
1965	-	-	1,940	1,470	1,060	742	2,870
1966	-	-	1,990	1,500	1,085	759	2,940
1967	-	-	2,040	1,540	1,111	776	3,110
1968	-	-	2,090	1,580	1,139	794	3,190
1969	-	-	2,140	1,620	1,168	814	3,270
1970	-	0.3	2,200	1,660	1,201	835	3,460
1971	4,570	141.0	2,250	1,700	1,229	854	3,600
1972	7,670	237.0	2,310	1,740	1,260	874	4,130
1973	6,320	286.0	2,370	1,790	1,291	895	4,440
1974	10,020	310.0	2,430	1,830	1,324	916	4,170
1975	7,080	18.0	2,480	1,880	1,355	936	4,620
1976	15,520	209.0	2,540	1,920	1,386	956	5,310
1977	11,850	312.0	2,600	1,960	1,416	975	5,520
1978	18,050	259.0	2,650	2,000	1,446	993	5,590
1979	23,500	685.0	2,710	2,040	1,476	1,013	5,670
1980	21,910	1,154.0	2,760	2,090	1,508	1,033	6,480
1981	21,110	1,531.0	2,820	2,130	1,541	1,053	6,230
1982	18,060	1,796.0	2,890	2,180	1,575	1,074	6,460
1983	29,830	3,234.0	2,950	2,230	1,609	1,095	7,340
1984	32,590	2,647.0	3,010	2,270	1,641	1,115	7,710
1985	26,570	3,011.0	3,060	2,310	1,670	1,132	8,030
1986	39,430	2,555.0	3,110	2,350	1,697	1,148	9,320
1987	24,140	4,806.0	3,150	2,380	1,721	1,162	9,680
1988	35,080	4,894.0	3,200	2,410	1,743	1,174	10,220
1989	29,190	4,383.0	3,240	2,440	1,765	1,186	9,490
1990	21,840	4,342.0	3,280	2,480	1,788	1,198	9,080
1991	42,300	4,224.0	3,320	2,510	1,811	1,211	14,550
1992	24,220	5,630.0	3,360	2,540	1,834	1,223	15,890
1993	20,080	7,193.0	3,410	2,570	1,858	1,235	13,280
1994	26,660	6,671.0	3,450	2,600	1,881	1,247	14,490
1995	40,140	8,433.0	3,490	2,630	1,903	1,258	14,550
1996	26,490	10,820.0	3,530	2,660	1,924	1,268	13,170
1997	36,310	9,411.0	3,570	2,690	1,945	1,278	12,890
1998	38,660	7,902.0	3,600	2,720	1,964	1,286	13,450
1999	35,610	8,643.0	3,640	2,750	1,983	1,294	13,110
2000	8,790	3,208.0	3,660	2,760	1,996	1,302	10,350
2001	11,940	4,410.0	3,680	2,780	2,007	1,309	12,550
2002	14,000	3,529.0	3,700	2,790	2,017	1,315	11,400
2003	18,650	6,431.0	3,800	2,870	2,074	1,351	14,670
2004	14,200	8,840.0	3,910	2,950	2,132	1,387	11,160
2005	12,610	6,630.0	4,020	3,030	2,192	1,424	10,300
2006	18,560	9,550.0	4,130	3,120	2,252	1,462	11,360
2007	13,740	6,546.0	4,240	3,200	2,313	1,500	10,890
2008	7,560	7,749.0	4,350	3,280	2,371	1,537	10,800
2009	9,560	8,133.0	4,450	3,360	2,429	1,575	10,290

¹ Others category includes 36 additional taxa and a miscellaneous marine fish category.

Appendix Table A3. Nationally reported foreign tuna catches.

Year	Tuna Catch (t)	Country	Source
1972	55	Japan	Anon. (1987)
1973	267	Japan	Anon. (1987)
1974	6,828	Japan	Anon. (1987)
1975	8,176	Japan	Anon. (1987)
1976	191,714	Japan	Anon. (1987)
1977	8,090	Japan	Anon. (1987)
1978	462	Japan	Anon. (1987)
1979	2,956	Japan	Anon. (1987)
1980	3,165	Japan	Anon. (1987)
1981	6,000	Japan	Anon. (1987)
1982	3,267	Japan	Anon. (1987)
1983	2,933	Japan	Anon. (1987)
1984	1,288	Japan	Anon. (1987)
1985	7,572	Japan	Anon. (1987)
1986	2,752	Japan	Anon. (1987)
1987	833	Japan	Anon. (1987)
1988	7,715	Japan	Anon. (1988)
	160	USA	
1989	4,589	Japan	Anon. (1993)
	30	USA	
1990	10,200	Japan	Anon. (1993)
	57	USA	
1991	4,155	Japan	Anon. (1993)
	1,774	USA	
1999	948	Foreign	Gillett (2007)
2000	835	Japan	Barclay and Cartwright (2007)
	3,885	USA	
2001	500	Japan	Barclay and Cartwright (2007)
	10,883	USA	
2002	1,267	Japan	Barclay and Cartwright (2007)
	10,883	USA	
2003	1,474	Japan	Barclay and Cartwright (2007)
	31,751	USA	
2004	619	Japan	Barclay and Cartwright (2007)
	70,184	USA	
2007	98,023	Misc. countries	Gillett (2009)

Appendix Table A4. Japanese catches of non-tuna pelagic species.

Year	Catch (t)	Source
1974	3	Anon (1987)
1975	79	Anon (1987)
1976	151	Anon (1987)
1977	48	Anon (1987)
1978	16	Anon (1987)
1979	214	Anon (1987)
1980	207	Anon (1987)
1981	419	Anon (1987)
1982	260	Anon (1987)
1983	174	Anon (1987)
1984	146	Anon (1987)
1985	290	Anon (1987)
1986	227	Anon (1987)
1987	40	Anon (1987)
1988	136	Anon (1988)
1989	182	Anon (1993)
1990	49	Anon (1993)
1991	127	Anon (1993)