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Historical Fisheries Catch Reconstruction for Lebanon (GSA 27), 1950-2010

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Abstract

The artisanal fisheries sector represents the most dominant fishery sector in Lebanon. The current report aims to estimate the total marine fisheries catches of Lebanon for the period of 1950-2010 using available information on artisanal, subsistence, and recreational fisheries, as well as discards in Lebanon. Recent data available for artisanal fisheries was mainly collected from four major ports in North Lebanon by FLOUCA/UOB. Other available resources included 'local' FAO data, which differed from the values officially reported by FAO on behalf of Lebanon. Overall, the estimated value of total catches for Lebanese coastal regions from 1950-2010 was over 345,000 t, which is 2.4 times the 141,000 t reported by the FAO on behalf of Lebanon. Our estimated total catch provides a more comprehensive measure of fisheries catches in Lebanese coastal regions, as this value reflects a broad range of sectors such as artisanal, subsistence and recreational, and also includes discard estimates. Ultimately, with better understanding of the level of catches over time in the Mediterranean Sea, better monitoring, reporting and management systems could be established to ensure sustained benefit from marine resources.

Introduction

The Lebanese coastline is relatively short and stretches along a north-south axis. Eighty percent of the coast is rocky, with the remaining 20% reported to be sandy with gravel on the landward side. The continental shelf is widest in the north (21 km), narrows down in the north-south axis, then widens up again to 8 km in the south (Figure 1). The shelf is characterized by submarine canyons with depths reaching 1,500 meters or more, creating heterogeneous habitats for an array of marine organisms (Sacchi and Dimech 2011). Typically, well developed vermetid platforms represent an important feature of all Lebanese rocky shores (Abboud-Abi Saab and Nader 2002a, 2002b).

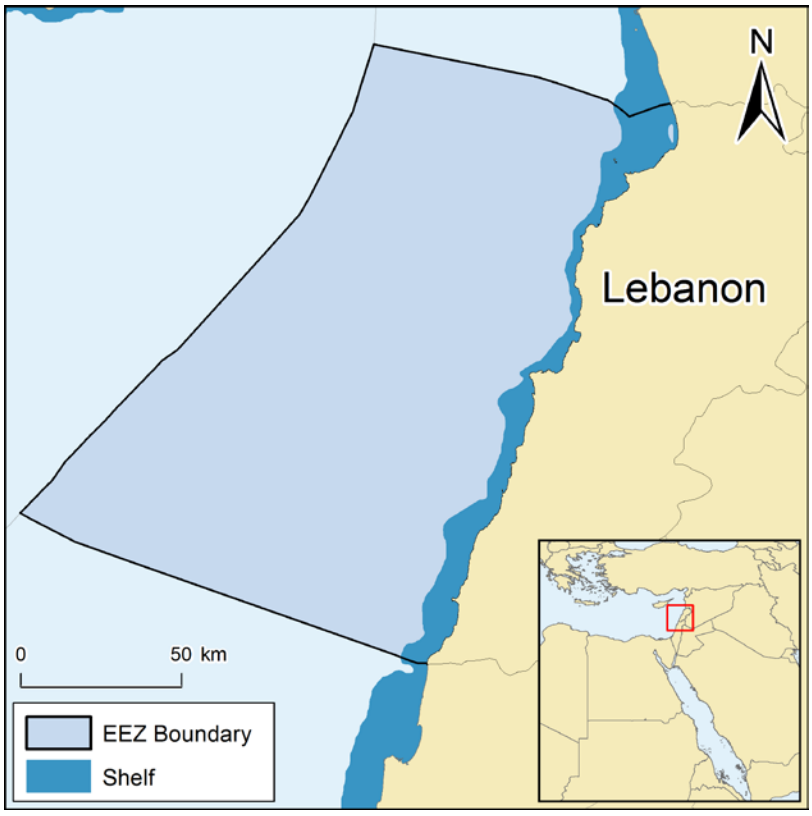

Figure 1: The Exclusive Economic Zone (EEZ) and continental shelf (to 200 m depth) of Lebanon.

The littoral zone has a typical Mediterranean climate, with relatively cool rainy winters and hot dry summers. The average salinity of the marine environment is about 39‰, while surface water temperatures range between a maximum of 32°C in August and a minimum of 17°C in February (Abboud-Abi Saab and Nader 2002b). Waves along the Lebanese coast are characterized by weak amplitude and a short wave length being generally strongest between January and March. Offshore currents follow a northeastern direction, while eddy currents near the shore flow in a clockwise direction (Abboud-Abi Saab and Nader 2002a, 2002b).

The coastal zone of Lebanon is under severe anthropogenic pressure with a very large percentage of the population living in coastal urban areas, and more than half residing in the capital Beirut and its suburbs. This creates substantial land-based pollution sources affecting the coastal marine

environment and its productivity. Moreover, habitat destruction through 'sea-filling' of coastal marine habitats with land-derived rubble and beach erosion due to sand and pebble extraction from coastal areas and riverbeds has been extensive. Exacerbating an already dire situation, the many war years that ravaged the country (Civil war: 1975-1991; Israel-Lebanon conflicts: 1996 and 2006) have intensified the destruction of the coastal environment through ongoing unregulated developments and the depletion of the indigenous fauna and flora. More specifically, the 2006 Israeli war in Lebanon that lasted for several weeks resulted in 15,000 m^3 of crude oil being spilled in Lebanese coastal waters through the bombardment by the Israeli Air Force of the Jiyeh Power Plant fuel tanks in South Lebanon. The oil drifted northward, and more than 150 km of the Lebanese coastline were contaminated. The spilled oil had a devastating impact on the Lebanese marine environment (Steiner 2006; UNEP 2007; World Bank 2007; UN 2011). On another front, the Suez Canal has become a corridor for many alien species originating from the Red Sea that have and continue to invade the Eastern Mediterranean in particular and the Mediterranean in general. A study on the coast of Tyre, South Lebanon, showed that the percentage of Lessepsian species caught in 2008 in the area was 37% of the total species captured, while in 2002 the percentage along the entire eastern Mediterranean did not exceed 14% (Bariche *et al.* 2007; Carpentieri *et al.* 2009; Nader 2011). Thus, the productivity of the Lebanese coastal marine environment has been deeply affected for several decades, threatening the wellbeing of the people depending directly or indirectly on its resources.

Fisheries in Lebanon

Lebanese fisheries are artisanal or traditional in nature, with the country's coastal waters containing at least 1,685 animal species with more than 80 fish species being of commercial importance. Living marine resources are managed by the Ministry of Agriculture, while the Ministry of Public Works and Transport is in charge of the fishing boat registry (Majdalani 2005; Sacchi and Dimech 2011). The Lebanese fishing fleet totals 2,662 registered fishing boats spread along the entire coast. The main gears include trammel nets, gill nets, longlines, purse seine nets (*lampara*) and beach seines. Fishing usually occurs to a maximum depth of up to 200 m, while

most activities take place at an average depth of 50 m. The fishing grounds, gears and habits are similar along the Lebanese coast. Logbooks are not used and catch reporting from fishers, when existing, tend to be underestimates. Moreover, illegal fishing techniques using dynamite and nets with small mesh size are chronic problems that, even though reduced, have not been completely resolved.

In addition, historical fisheries data are sporadic and the country lacks information on stocks, by-catch and discards (Majdalani 2004; Bitar 2008; Nader *et al.* 2012a). Nevertheless, the past few years have seen the launching of several initiatives to address the problems plaguing the sector. The Marine Resources and Coastal Zone Management Program (MRCZM) at the Institute of the Environment (IOE) at the University of Balamand (UOB) initiated a data collection program of commercial fisheries. This includes landings and effort in the Mohafaza (governorate) of North Lebanon and Akkar, covering 45% of the Lebanese coastline. The program has been monitoring commercial fish landings on a regular basis since January 2006.

Currently, information about fishing gear, species, quantity, price and size is collected on a weekly basis for 88 commercial species from the four major ports in North Lebanon: Batroun, Qalamoun, Tripoli and Abdeh (Figure 2). On the other hand, effort data are obtained from the records of the Lebanese Army that registers boat activity on a daily basis. Gathered information is entered in the Fish Landing Operational Utility for Catch Assessment database (FLOUCA) allowing the generation of monthly and yearly trends of catch, catch per unit effort (CPUE), and average price for the monitored species. The main goal of the initiative is to establish long-term monitoring of commercial fish landings and effort in order to contribute to developing appropriate management plans based on scientific data to sustainably benefit from the resource (Nader *et al.* 2012b).

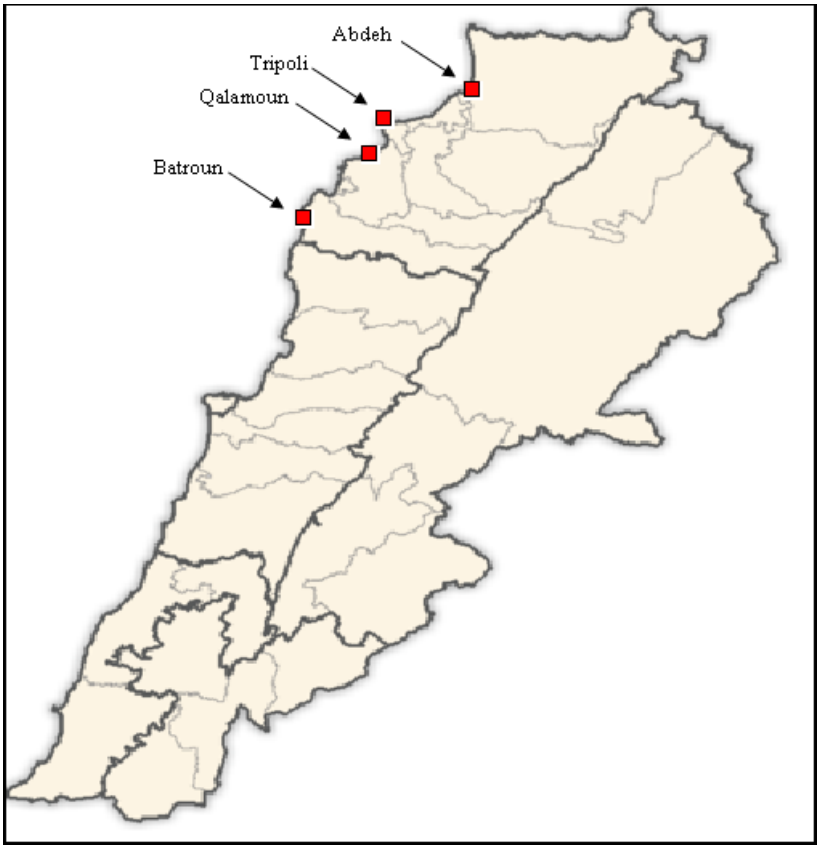

Figure 2: Major fishing ports in North Lebanon (Nader *et al.* 2012b).

Furthermore, the Lebanese National Council for Scientific Research (CNRS; www.cnrs.edu.lb), through the National Center for Marine Sciences (NCMS), is implementing the CANA project (www.cana-cnrs.gov.lb) funded by the "Italian Cooperation for Development in Lebanon and Syria" and the Lebanese Government. The overall objective is to increase the knowledge of coastal and marine environments towards drawing responsible and sustainable development outlines while preparing guidelines for an integrated coastal policy. In addition, the Italian Ministry of Foreign Affairs, in collaboration with the CNRS-NCMS and the CANA team, launched in June 2012 the project PescaLibano. Its main objective is to provide "technical assistance to the Ministry of Agriculture in the field of fishery development".

On another front, the EastMed-Project (www.faoeastmed.org) by the Food and Agriculture Organization of the United Nations (FAO) in collaboration with the Ministry of Agriculture in

Lebanon and funded by Greece, Italy and the European Community, is supporting the development of regionally-consistent fisheries management plans among the Eastern Mediterranean countries. The project's longer-term development objective aims at contributing to the sustainable management of marine fisheries in the Eastern Mediterranean, and thereby supporting national economies and protecting the livelihoods of those involved in the fisheries sector. Within this context, an agreement was signed between the FAO-EastMed project and the IOE-UOB to initiate a "Pilot Survey on Fisheries Dependent Data Collection in Lebanon Including Training". The IOE-UOB will contribute to improve and implement the national fisheries dependent data collection program through the expansion of FLOUCA into FLOUCA Web and through training related staff of the Lebanese Ministry of Agriculture on the expanded application. FLOUCA Web operates as an internet-driven system with outposts at selected major ports of the Lebanese coastline and is quite transparent in its operations. Data input and estimations are performed locally but are visible throughout the network. FLOUCA Web is error-free and robust. It also offers a wide variety of statistical diagnostics that are in line with the latest requirements demanded by regional and international fisheries bodies, specifically FAO and GFCM Task 1. The main output will be delivering FLOUCA Web to the Ministry of Agriculture to be adopted as the national reporting system for the Lebanese Government.

Additionally, the General Fisheries Commission for the Mediterranean (www.gfcm.org) at the FAO hosted the Concerted Actions for Lebanon meeting in December 2012.[1] The goal of the meeting was to identify objectives and priority issues for Lebanon, to review results achieved/to be achieved by organizations, agencies and projects supporting Lebanese fisheries and aquaculture, and to elaborate a multiannual roadmap (2013-2018) to help Lebanon in strengthening its fisheries and aquaculture sectors.

As can be seen, several initiatives have been launched in the past few years to properly and sustainably manage marine and coastal resources, taking into consideration the well-being of coastal communities.

[1] http://151.1.154.86/GfcmWebSite/SAC/SCESS/13/ReportConcertedActionforLebanon.pdf [accessed May 1, 2013]

The present report provides historical reconstructions of the estimated real catch for Lebanon from 1950 to 2010 based on published and unpublished material, and on local knowledge combined with conservative assumptions, following the rationale of Pauly (1998) and the catch reconstruction approach outlined in Zeller *et al.* (2007).

Methods

Artisanal catch

The total artisanal catch values were collected from two major sources. Local FAO data were available for the period of 2000 to 2006 (interpolation was done to fill in a missing value in 2003). It was found that these values were greater than the official data presented by the FAO on behalf of Lebanon. These values were accepted and the data from 2000 was used to calculate a raising factor to apply to the official FAO data from 1950-1999. Also, given the 1996 Israel-Lebanon conflict, we made an assumption that the total catch during this year was reduced by 20%. While the scale (i.e., 20%) seems arbitrary, it is assumed to reflect the reduced fishing opportunities available to local fishers during the conflict, especially in southern areas. A decrease in annual catches during the years of the civil war was already reflected in the official FAO data and was therefore maintained when the raising factor was applied. From 2007 to 2010, artisanal catches were obtained from the data collected by UOB through the FLOUCA initiative. Although data were collected by FLOUCA in 2006, it was determined that the local FAO data better reflected the decrease in catch that was a result of the war and oil spill that affected fisheries that year. Although the FLOUCA data uses superior methods for data estimation, the data that are collected and then extrapolated to the whole of Lebanon are from ports along the northern portion of the coast. The oil spill was concentrated in the south, with the Israel-Lebanon conflict also having a greater effect on the south. Therefore, in order to remain conservative, it was assumed that the data collected by FLOUCA for the north, when extrapolated to the whole country, may not fully account for the effects of these two situations. The local FAO data for

2006, which is substantially higher than the FAO data from Fishstat, nevertheless shows a decrease in the catch (from 2005) which may better represent the impact of events in the south.

The data extracted from FLOUCA for the four major ports in North Lebanon were extrapolated for the whole Lebanon coastal region by using the ratio of boats in the north (1,100) to total boats for all of Lebanon (2,662). It was assumed that the number of boats in Lebanon and the number of boats in the north remained constant over the 2007-2010 time period.

Discards

Discarded catch by the Lebanese artisanal fisheries was calculated using a discard rate of 0.5% as reported by Kelleher (2005) for the neighboring country Syria. This discard rate referred specifically to Syria's artisanal fishery that uses gillnets and trammel nets. These gear types are also frequently used in the Lebanese artisanal fishery, and thus the rate was used as a proxy.

Subsistence catch

Human population data for Lebanon were taken from the historical population demography website Populstat (www.populstat.info/) for the years 1950-1959, and from the World Bank database (www.data.worldbank.org/) for the period of 1960-2010. To estimate the coastal population for both urban and rural areas from 1950-2010, the total population data were multiplied by the percent coastal population (5% of total population is coastal for rural and 49% for urban) within a 10 km range of the coast (CIESIN and Columbia University 2012). The 5% and 49% values remain constant from 1990-2010. Therefore, these values were applied for the whole time period to the total population data gathered from Populstat and World Bank. Even though coastal population has been estimated to be as high as 80%, we used an overall coastal population of 54% in order to remain conservative in our estimation.

Subsistence is here defined as having as primary driver (motivator) to provide food for self- or family-consumption, with some local barter or occasional sale. To estimate the subsistence catches for Lebanon from 1950-2010, the coastal rural and coastal urban populations were multiplied by a consumption rates of 4 kg·person^{-1}·year^{-1} (rural) and 0.5 kg·person^{-1}·year^{-1} (urban). These consumption rates were derived from a paper on food consumption patterns among adults in Beirut, Lebanon (Nasreddine *et al.* 2006). In the study, the fish consumption rate was reported to be 7.19 kg·person^{-1}·year^{-1}. However, due to the nature of the study, this most likely also included fish that was purchased and not personally caught. We therefore used the information as a guide in determining the subsistence consumption rates. Based on the assumption that subsistence consumption is likely higher in rural coastal areas (urban populations have greater access to markets where sources of protein may be purchased), a higher consumption rate was applied to that segment of the population. In this reconstruction we used both a conservative coastal population estimate and conservative consumption rates, as there was little information available for this sector. Future studies are required to get an accurate estimate of the subsistence fisheries catch of Lebanon.

Recreational catch

Due to the lack of available data on recreational fisheries in Lebanon, the recreational catch of Lebanon for 1950-2010 was estimated based on a population participation rate of 0.1181% derived in a global study on marine recreation (Cisneros-Montemayor and Sumaila 2010). To calculate the recreational catches for 1950-2010, it was assumed that this participation rate would only apply to the total coastal population of Lebanon (rural and urban combined) in order to be conservative. An assumption was made that between 1950 and 1974 (before the Lebanese civil war period) recreational fishers would on average go on 1 trip per month and catch 5 kg per trip. Further, for the period 1992-2010 (after the civil war), it was assumed that recreational fishers would make 0.5 trips per month and catch an average of 2.5 kg per trip. For the period of the civil war (1975-1991), it was assumed that recreational fishing immediately declined and that fishing behavior was the same as the period right after the war ended.

Taxonomic breakdown

Data on species composition of catches in coastal regions of Lebanon for the earlier periods are limited, but have improved drastically over the last 10 years. We therefore accepted the species composition of the FAO data for the reported artisanal catch due to the fact that from 1987 onwards it provided a fairly well disaggregated composition. In 1987, the 'marine fishes nei' category disappeared and was replaced by more specific taxonomic categories. To further disaggregate the 'marine fishes nei' category in earlier years, we applied the species breakdown from 1987 to those catches (excluding clupeiods, mackerels, and tuna-like fishes, which were already present in that time period). We applied the species breakdown of the reported artisanal catch (by year) to the unreported component of the artisanal catch.

The species breakdown for the subsistence catch was derived from the artisanal breakdown for the year 2010, which was based on the work of the two senior authors. However, we excluded barracuda (Sphyraenidae), conger eel (*Conger conger*), and sharks (Elasmobranchii) from this composition, and decreased the contribution of Scombridae by retaining 'mackerels nei' but removing 'tuna-like fishes nei' (Table 1).

Table 1. Subsistence species composition applied to Lebanese subsistence catches for 1950-2010.

Taxa	%
Clupeidae	20.4
Carangidae	13.5
Sparidae	13.0
Mugilidae	12.6
Scombridae	11.3
Serranidae	8.9
Mullidae	6.7
Scorpaenidae	4.0
Centrarchidae	3.0
Atherinidae	1.7
Sepiida	0.9
Gadiformes nei	0.9
Octopus vulgaris	0.8
Flatfishes nei	0.3
Miscellaneous marine crustaceans	2.0

Recreational catches were disaggregated using the information available on a local recreational fishery website (www.lebanonboats.com/fishing/). The most common fish captured by recreational fishers in the coastal regions of Lebanon are Serranidae, Scombridae, Haemulidae, Holocentridae, Sparidae, Mugilidae and Sphyraenidae. An assumed breakdown of these taxa was applied to the recreational catches for the whole time period (Table 2).

Table 2. Recreational species composition applied to Lebanese recreational catches for 1950-2010.

Taxa	(%)
Haemulidae	20
Mugilidae	20
Sparidae	20
Scombridae	15
Holocentridae	10
Serranidae	10
Sphyraenidae	5

The species breakdown of discards was assumed to consist of juvenile and/or undersized fish as well as damaged fish of the same species as those landed. Therefore, the 2010 species breakdown of the artisanal sector was applied to the discard tonnage for the whole time period.

Results

Artisanal catch

The reconstruction suggests that artisanal catch followed a fairly steady increase from 1950 to 1974, with a peak value of almost 5,900 t in 1974 (Figure 3a). During the period of civil war (1975-1991), the amount of catch drops significantly, with the lowest value of almost 2,300 t in 1984. From 1992 to 1995, the artisanal catch fairly steadily increases and reaches a peak value of 7,700 t in 1995. The Israel-Lebanon war in 1996 signifies a period decline where the catch amount reduced to 6,200 t. The artisanal catch followed an increasing trend from 1997 to 2005.

The peak value of 8,000 t was reached in 2005. In 2006, the Israeli war in Lebanon occurred, during which the catch value dropped to 6,200 t. Following 2006, the catch trend fell into a decline, but has recovered in 2010 with over 7,100 t. Overall, artisanal catches were estimated at slightly over 266,000 t for the full time period (Figure 3a).

Discards

Discards followed the same trend as the artisanal catches (Figure 3a). Discards increased steadily from 1950 to 1974, with a peak value of 29 t in 1974. During the civil war, discards value from 23 t in 1975 to 16 t in 1991. The lowest discards were in 1984 with 11 t. Following this period, discard increased steadily and reached a peak of 40 t in 2005, and discards averaged 33 $t \cdot year^{-1}$ over the last decade (Figure 3a).

Subsistence catch

The subsistence catches in Lebanon summed to slightly over 76,000 t for 1950-2010 (Figure 3a). Subsistence catches increased from 640 $t \cdot year^{-1}$ in 1950 to 1,880 $t \cdot year^{-1}$ by 2010 (Figure 3a). During the civil war period (1975-1991), the subsistence catches remained relatively constant with an estimated 1,200-1,300 $t \cdot year^{-1}$ (Figure 3a).

Recreational catch

Recreational catches for Lebanon were estimated to amount to just under 3,100 t for 1950-2010 (Figure 3a). Catches increased steadily from around 55 $t \cdot year^{-1}$ in the early 1950s to just over 100 $t \cdot year^{-1}$ in 1974 before the start of the civil war. During and after the civil war, recreational catches were deemed to remain low at around 26-27 $t \cdot year^{-1}$, and reached around 40 $t \cdot year^{-1}$ by the end of the present time period in 2010 (Figure 3a).

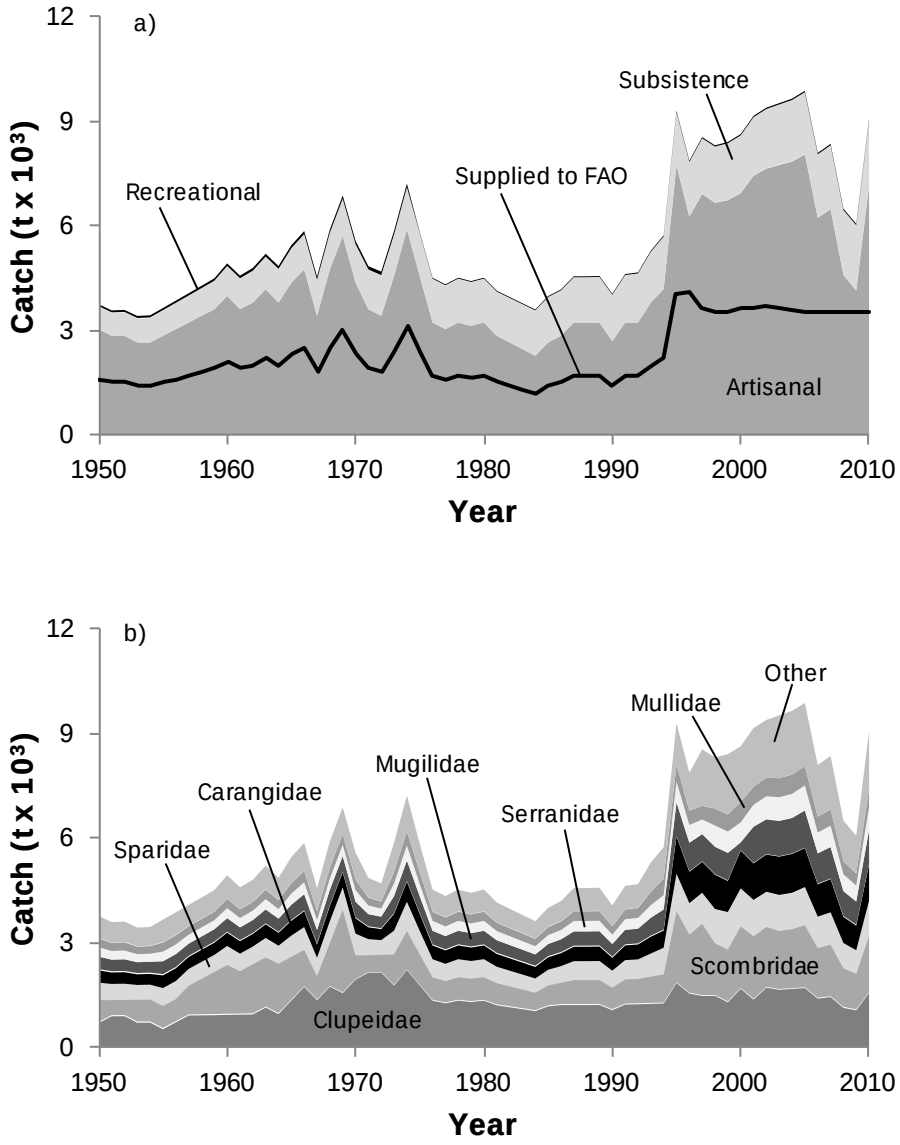

Figure 3: Total reconstructed catches for Lebanon for 1950-2010, (a) by fishing sectors plus discards, with data officially reported by FAO on behalf of Lebanon overlaid as line graph; and (b) by taxon. "Other" consists of 14 additional taxonomic categories.

Species composition

Total reconstructed catches were dominated by the family Clupeidae with 23% of the total catch (over 79,000 t, Figure 3b). Other major contributors included Scombridae (18.8%), Sparidae (11.5%), Carangidae (9.6%), Mugilidae (9.1%), Serranidae (6.7%), and Mullidae (5.8%, Figure 3b).

Discussion

Given that data on fisheries catches are very sporadic, and that the only fish-catch monitoring program (FLOUCA) covers approximately half of the Lebanese coastline, many assumptions (although conservative) had to be made. According to the current study, the total catch in Lebanon from 1950-2010 was estimated to be 345,000 t. This value was approximately 2.4 times the 141,142 t reported by the FAO on behalf of Lebanon. Species that are most commonly captured in Lebanese coastal waters are small and medium pelagics (Clupeidea, Scombridae, Carangidae), as well as sea breams, mullets and goatfish. The fishing industry of Lebanon is dominated by the artisanal fishery which mostly uses trammel nets, gill nets, longlines, purse seine nets (*lampara*) and beach seines. The civil war between 1975 and 1991, as well as the Israel-Lebanon conflicts in 1996 and 2006 (a total of 19 years) had major impacts on the fisheries sector as a whole, while other internal conflicts did not affect the yearly fisheries estimates. Unfortunately, the lack of sufficient management in the fishing sector led to reduction in fish stocks of this region over years. The current study aimed to provide a better estimate of historic catches made by commercial (i.e., artisanal), recreational and subsistence fisheries along the coastal regions of Lebanon.

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References

Abboud-Abi Saab M and Nader M, editors (2002a) Establish conservation strategies for coastal habitats. UNEP-MAP-RAC/SPA (SAP BIO), Lebanon. 40 p.

Abboud-Abi Saab M and Nader M, editors (2002b) National report of the country of Lebanon. UNEP-MAP-RAC/SPA (SAP BIO), Lebanon. 100 p.

Bariche M, Sadek R, Al-Zein S and El-Fadel M (2007) Diversity of juvenile fish assemblages in the pelagic waters of Lebanon (eastern Mediterranean). Hydrobiologia 580: 109-115.

Bitar G (2008) National overview on vulnerability and impacts of climate change on marine and coastal biodiversity in Lebanon. Contract RAC/SPA # 16. 41 p.

Carpentieri P, Lelli S, Colloca F, Mohanna C, Bartolino V, Moubayed S and Ardizzone GD (2009) Incidence of Lessepsian migrants on landings of the artisanal fishery of South Lebanon. Marine Biodiversity Records 2, e71: doi: 10.1017/S1755267209000645.

CIESIN and Columbia University (2012) National aggregates of geospatial data collection: population, landscape, and climate estimates, version 3 (PLACE III).Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). Available at: http://sedac.ciesin.columbia.edu/data/set/nagdc-population-landscape-climate-estimates-v3 [Accessed: June 2013].

Cisneros-Montemayor AM and Sumaila UR (2010) A global estimate of benefits from ecosystem-based marine recreation: potential impacts and implications for management. J Bioecon 12: 245-268.

Kelleher MK (2005) Discards in the world's marine fisheries: an update.470, FAO Fisheries Technical Paper, Rome. xix+131 p.

Majdalani S (2004) The present status of fishery and information system in Lebanon. GCP/INT/918/EC - TCP/INT/2904/TD-4.1. MedFisis Technical Document No. 4.1. iii+45 p.

Majdalani S (2005) Census of Lebanese fishing vessels and fishing facilities. Ministry of Agriculture, Lebanon. 144 p.

Nader M (2011) National document aiming at the identification of important ecosystem properties and assessment of ecological status and pressures to Mediterranean marine and coastal biodiversity of Lebanon. 50 p.

Nader M, Indary S and Boustany L (2012a) The puffer fish Lagocephalus sceleratus (Gmelin, 1789) in the eastern Mediterranean. EastMed Technical Documents 10, EastMed, Food and Agriculture Organization of the United Nations (FAO). vi+33 p.

Nader M, Indary S and Stamatopoulos C (2012b) Assessment of the commercial fish species of the coast of north Lebanon 2006-2011. International Conferences on "Land-Sea Interactions in the Coastal Zone", November, 2012, Lebanon.

Nasreddine L, Hwalla N, Sibai A, Hamze M and Parent-Massin D (2006) Food consumption patterns in an adult urban population in Beirut, Lebanon. Public Health Nutrition 9(2): 194-203.

Pauly D (1998) Rationale for reconstructing catch time series. EC Fisheries Cooperation Bulletin 11(2): 4-10.

Sacchi J and Dimech M (2011) Report of the FAO EastMed Assessment of the Fishing Gears in Lebanon, Lebanon 18 – 22 July 2011. EastMed Technical Documents 9, Food and Agriculture Organization of the United Nations (FAO), EastMed. vi+47 p.

Steiner R (2006) Lebanon oil spill rapid assessment and response mission: final report. IUCN and Green Line, Beirut. 21 p.

UN (2011) General Assembly, 2011 (February 14th). 65th Session. Oil Slick on Lebanese Shores. Resolution Adopted by the General Assembly General (A/RES/65/147).p. 181. 181 p.

UNEP (2007) Lebanon rapid environment assessment for greening recovery. Reconstruction and Reform, United Nations Environment Programme (UNEP). 409 p.

World Bank (2007) Republic of Lebanon economic assessment of environmental degradation due to July 2006 hostilities. Sustainable Development Department – MENA Region. World Bank. 106 p.

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. total reconstructed catch (in tonnes), and catch by sector, for Lebanon, 1950-2010.

Year	FAO landings	Total reconstructed catch	Artisanal	Subsistence	Recreational
1950	1,600	3,740	3,040	642	55
1951	1,500	3,560	2,850	654	56
1952	1,500	3,580	2,850	668	57
1953	1,400	3,400	2,660	683	59
1954	1,400	3,420	2,660	700	60
1955	1,500	3,630	2,850	718	62
1956	1,600	3,840	3,040	737	63
1957	1,700	4,060	3,230	758	65
1958	1,800	4,270	3,420	780	67
1959	1,900	4,490	3,610	802	69
1960	2,100	4,920	3,990	849	73
1961	1,900	4,560	3,610	876	75
1962	2,000	4,780	3,800	902	78
1963	2,200	5,190	4,180	929	80
1964	2,000	4,840	3,800	956	82
1965	2,300	5,440	4,370	981	84
1966	2,500	5,850	4,750	1,004	86
1967	1,800	4,540	3,420	1,026	88
1968	2,500	5,890	4,750	1,048	90
1969	3,000	6,870	5,710	1,071	92
1970	2,300	5,570	4,370	1,097	94
1971	1,900	4,840	3,610	1,125	97
1972	1,800	4,680	3,420	1,156	99
1973	2,400	5,850	4,560	1,186	102
1974	3,100	7,210	5,900	1,212	104
1975	2,400	5,820	4,560	1,231	26
1976	1,700	4,500	3,230	1,241	27
1977	1,600	4,310	3,040	1,244	27
1978	1,700	4,500	3,230	1,243	27
1979	1,650	4,410	3,140	1,242	27
1980	1,700	4,500	3,230	1,244	27
1981	1,500	4,130	2,850	1,249	27
1982	1,400	3,950	2,660	1,258	27
1983	1,300	3,770	2,470	1,269	27
1984	1,200	3,590	2,280	1,278	27
1985	1,400	3,970	2,660	1,284	28
1986	1,500	4,170	2,850	1,285	28
1987	1,700	4,540	3,230	1,284	28
1988	1,700	4,540	3,230	1,284	28
1989	1,700	4,550	3,230	1,292	28
1990	1,420	4,040	2,700	1,312	28
1991	1,700	4,610	3,230	1,347	29
1992	1,700	4,660	3,230	1,393	30
1993	2,000	5,280	3,800	1,446	31
1994	2,205	5,720	4,190	1,497	32
1995	4,065	9,310	7,730	1,541	33
1996	4,115	7,870	6,260	1,575	34
1997	3,635	8,550	6,910	1,601	34
1998	3,500	8,310	6,660	1,622	35
1999	3,540	8,410	6,730	1,642	35
2000	3,646	8,640	6,930	1,665	36
2001	3,650	9,160	7,430	1,692	36
2002	3,673	9,400	7,640	1,721	37
2003	3,613	9,530	7,740	1,751	38
2004	3,601	9,660	7,840	1,779	38
2005	3,523	9,880	8,040	1,803	39
2006	3,541	8,090	6,230	1,823	39
2007	3,541	8,360	6,480	1,840	40
2008	3,541	6,490	4,600	1,854	40
2009	3,541	6,050	4,150	1,868	40
2010	3,541	9,070	7,150	1,881	40

Appendix Table A2. Total reconstructed catch (in tonnes) by major taxa for Lebanon, 1950-2010.

Year	Clupeidae	Scombridae	Sparidae	Carangidae	Mugilidae	Serranidae	Mullidae	Others
1950	701	652	517	351	357	274	254	636
1951	893	464	477	326	332	254	234	585
1952	895	465	478	328	334	255	235	587
1953	709	656	439	304	310	235	215	537
1954	712	659	441	306	312	237	216	540
1955	527	661	528	361	367	281	259	648
1956	720	664	531	364	370	283	260	651
1957	914	856	492	340	347	264	241	602
1958	919	1,048	495	343	350	266	242	606
1959	923	1,240	499	346	354	268	244	610
1960	933	1,436	548	379	387	294	268	671
1961	938	1,249	510	356	364	276	249	622
1962	944	1,442	514	360	368	278	251	627
1963	1,139	1,446	560	390	398	302	273	684
1964	955	1,449	521	367	376	283	254	636
1965	1,339	1,263	610	423	432	328	298	746
1966	1,723	1,078	655	453	462	352	321	803
1967	1,347	701	532	377	386	290	259	647
1968	1,731	1,272	620	433	442	335	303	757
1969	1,548	2,412	624	436	446	337	304	762
1970	1,930	710	627	439	449	339	306	765
1971	2,125	524	462	337	347	258	223	559
1972	2,131	528	425	315	326	240	204	511
1973	1,759	911	682	477	488	369	333	833
1974	2,201	1,143	834	574	585	446	408	1,022
1975	1,768	905	673	483	479	366	336	812
1976	1,334	678	526	392	387	292	262	629
1977	1,259	640	510	382	377	284	254	608
1978	1,335	678	527	392	388	293	263	629
1979	1,297	678	514	384	380	286	256	613
1980	1,335	678	527	393	388	293	263	629
1981	1,203	640	481	364	359	270	240	572
1982	1,148	603	461	352	347	260	230	546
1983	1,093	566	441	340	335	251	220	521
1984	1,038	530	421	328	323	241	210	496
1985	1,172	606	460	353	348	260	229	545
1986	1,211	644	486	369	364	273	242	577
1987	1,210	720	553	411	406	307	276	661
1988	1,210	720	553	411	406	307	276	661
1989	1,212	721	554	412	407	308	276	662
1990	1,064	647	500	367	362	271	240	589
1991	1,223	728	562	420	414	313	280	670
1992	1,233	733	568	426	420	317	283	677
1993	1,244	787	670	481	513	369	381	836
1994	1,255	841	772	488	576	421	480	891
1995	1,834	2,080	1,063	1,063	962	616	483	1,204
1996	1,537	1,704	897	897	815	524	410	1,088
1997	1,467	2,086	882	882	781	432	393	1,628
1998	1,471	1,520	979	979	783	623	489	1,470
1999	1,286	1,523	1,076	887	786	624	490	1,738
2000	1,670	1,809	1,079	1,079	221	589	586	1,601
2001	1,364	1,825	1,042	1,042	1,036	642	520	1,689
2002	1,702	1,760	1,001	1,063	995	676	531	1,668
2003	1,642	1,703	1,028	1,092	1,011	694	545	1,811
2004	1,669	1,731	1,034	1,110	1,016	706	554	1,836
2005	1,691	1,819	1,087	1,110	1,069	734	554	1,818
2006	1,392	1,463	898	919	872	609	456	1,484
2007	1,436	1,515	926	948	899	628	470	1,534
2008	1,131	1,139	731	747	710	495	371	1,168
2009	1,060	1,050	686	700	666	464	347	1,081
2010	1,555	1,655	1,003	1,027	973	680	509	1,672