



Total marine fisheries catches in the Persian/Arabian Gulf from 1950 to 2010



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HIGHLIGHTS

- Catch data are inaccurate and when estimated result in distinctly different baselines.
- Catches in the Gulf are potentially underestimated by a factor of two from 1950 to 2010.
- Artisanal catches contributed 75% of total catches, followed by industrial (4%).
- Discards, mainly from shrimp trawlers, correspond to 18% of total landed catch.

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ABSTRACT

Fisheries formed the basis of the Gulf's economy for hundreds of years, and yet present-day statistical catch data remain inaccurate. When estimated, these catches often result in distinctly different baselines for historical catches, raising questions about how closely officially reported data resemble reality and the sustainability of certain management decisions. Here, we 'reconstruct' the contribution of missing sectors for all countries surrounding the Gulf (Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the UAE) from 1950 to 2010. Since the 1950s, Gulf countries have primarily reported their artisanal and industrial catches and have substantially misreported their discards, recreational, subsistence, and illegal fishing sectors. Our results suggest all countries in the Gulf under-report their catches, with the exception of the UAE, which over-report theirs. We show that regionally, officially reported catches potentially underestimate capture fisheries by a factor of two between 1950 and 2010, and that discards, mainly from shrimp trawlers, correspond to 18% of total landed catch. We discuss the discrepancy between reported and estimated catches, as well the policy implications for the region's fisheries, food security, and marine ecosystems generally.

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1. Introduction

The Persian/Arabian Gulf¹ is a semi-enclosed body of water, situated within a subtropical, hyper-arid region of the Middle East. It is bounded by the Shatt al-Arab river delta in the northwest and by the Strait of Hormuz in the southeast (Fig. 1). It is bordered by Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates (UAE), all of whom are 1978 signatories of the Regional Organization for the Protection of the Marine Environment (ROPME).

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¹ The name of this body of water remains contentious so we use the term "Gulf" to avoid offending either party.

The Gulf supports highly productive coastal habitats, including intertidal mudflats, seagrass, algal beds, mangroves, and coral reefs (Price, 1993; Sheppard et al., 2010; Sale et al., 2011). These habitats support important commercial fisheries as well as endangered species such as the green turtle (*Chelonia mydas*) and the dugong (*Dugong dugon*). Though the Gulf supports a variety of productive habitats, and contains a number of endemic species, it is less biologically diverse than the adjacent Indian Ocean due to extreme environmental conditions (Khan and Munawar, 2002; Sale et al., 2011).

For hundreds of years prior the discovery of oil, the region was sparsely populated by nomadic and semi-nomadic people, who depended on fishing, pearling, and maritime trade through dhows (Streeter, 1886; Lorimer, 1915; Villiers, 1940). Indeed, archeological records indicate that fisheries have been a significant economic activity for the people of the region since the 6th millennium BC (Beech, 2002). However, the discovery of oil in the late 1930s and



Fig. 1. Map of the Gulf.

the subsequent industrial boom in the 1970s brought enormous wealth to the region, and with it intense economic activity with far reaching environmental, social, and cultural implications for the Gulf's ecosystems (Khan and Munawar, 2002). Presently, fisheries are the second most important natural resource after oil and gas, and the most important renewable resource (Carpenter, 1997; Sale et al., 2011; Grandcourt, 2012). Besides their contribution to the region's food security, fisheries also provide a source of income, cultural heritage, and recreational opportunities to the Gulf's coastal population.

Present-day fisheries are multi-species and multi-gear, and mostly artisanal in nature, with the exception of trawlers in Kuwait, Saudi Arabia, and Iran that target shrimp a few months out of the year. Qatar and Bahrain closed their industrial shrimp fisheries in 1993 and 1998 respectively. Traditional wooden dhows and fiberglass boats are currently the most common vessels, while hook-and-line, gillnets, hemispherical wire traps (*gargoor*), and weirs (*hadrah*) are the most common gears. In general, fisheries predominantly target demersal species in the south and west, while shrimp and pelagic fish species are targeted in the north (Sale et al., 2011; Grandcourt, 2012). According to the United Nations Food and Agriculture Organization (FAO), the fishery potential in the Gulf is estimated to be 550,000 *t* annually, or eight times greater than that of the Gulf of Oman (Kardovani, 1995; Sale et al., 2011).

Data-driven fisheries assessment and management is variable among political jurisdictions in the region, with each littoral state having its own federal policies, legal instruments, and regulations (Grandcourt, 2012). Existing fisheries regulations aim to control effort, however many species in the Gulf are presently overfished and fishing effort exceeds that needed to extract Maximum Sustainable Yield (MSY) for most demersal species (Samuel, 1988; El Sayed, 1996; Grandcourt et al., 2003; Dadzie et al., 2005; Grandcourt et al., 2010; Grandcourt, 2012). Similarly, stocks of pelagic species such as the kingfish, *Scomberomorus commerson* and shrimp are overfished (Siddeek et al., 1999). In addition, stock assessments are rare and most catch data are recorded to family level only, making it impossible to use single-species approaches for assessments, for example catch-at-age models (Sale et al., 2011).

Since its establishment in 2001 the aim of the Regional Commission for Fisheries (RECOFI), has been to "promote the development, conservation, rational management and best utilization of living marine resources, as well as the sustainable development of aquaculture". In 2012 RECOFI agreed on minimum data reporting that includes catch and effort data separated by gear. However,

these data are not readily disseminated and certain sectors such as catches by weirs are missing (Al-Abdulrazzak and Pauly, 2014). In addition, the 2012 decision is based on each member country setting their own standards, which can result in no reporting at all, as was the case in 2013 when Oman, Kuwait, and the UAE, failed to report their catches (Al-Abdulrazzak and Pauly, 2014). Moreover, the submission of discard data is considered voluntary.

The Gulf is changing rapidly due to numerous industrial, residential, and tourism development activities (Sheppard et al., 2010). Meaningful ecological baselines are rare due to extensive ongoing projects such as the artificial Palm Jumeirah Island in Dubai or the extensive land reclamation near Manama, Bahrain, many of which remain confidential for alleged commercial or security reasons (Sheppard et al., 2010). This is one of the main reasons why Gulf marine ecosystems are so poorly understood and why regional coordination efforts are rarely effective (Sheppard et al., 2010). In addition, the Gulf's population has grown dramatically since the discovery of oil, subsequently driving up fisheries exploitation in order to meet demand. The increased demand coincided with the mechanization of fishing fleets, enhancing fishing capacity and exerting further pressure on the region's marine resources.

Since its creation in 1945, it has been the FAO's mandate to collect, analyze and distribute information related to nutrition, food, and agriculture, including fisheries, to assess global trends in hunger and malnutrition. The FAO's global capture fishery database, or FishStat (www.fishstat.org), is the only global sources of time series of national fisheries landings (Garibaldi, 2012), and has provided essential data for a number of global fisheries studies (Swartz et al., 2010; Watson et al., 2012). However, despite their wide usage, studies have called into question the reliability of FAO data (Watson and Pauly, 2001; Clarke et al., 2006; Zeller et al., 2006; Al-Abdulrazzak and Pauly, 2013b). Because member countries voluntarily report their catches and other fishery statistics, the quality of the FAO database is only as good as each country's capacity and political willingness for statistical collection and estimation (Watson and Pauly, 2001; Bhathal and Pauly, 2008; Jacquet et al., 2010). It is generally recognized that the contribution of many sectors, especially those from small-scale fisheries, are frequently absent or substantially under-reported (Zeller et al., 2006, 2007; Le Manach et al., 2012; Al-Abdulrazzak and Pauly, 2013b).

Despite the historical importance of fisheries in the Gulf, the region's fisheries remain understudied and catch data remain inaccurate (Al-Abdulrazzak and Pauly, 2013a,b). Here, an established catch reconstruction approach was used to estimate total marine fisheries catches for all countries in the Gulf from 1950 to 2010 to evaluate the overall magnitude of misreporting and establish more accurate historical baselines.

2. Methods

Official data, as reported by Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the UAE were extracted from the FAO's FishStat database and served as the baseline for the analysis. Minuscule catches from the east coast of the Musandam Peninsula, an enclave of Oman whose short coastline lies within the Gulf, are not included here (but see Khalfallah et al., 2015).

Data from national agencies were compiled and compared to FAO data, but no differences were found. Because Saudi Arabia and the UAE also have coasts on the Red Sea and the Gulf of Oman respectively, the reported national data for each coast were disaggregated and the catch reconstructed separately.

The conceptual framework of the catch reconstruction method as outlined by previous studies (Zeller et al., 2006, 2007; Jacquet et al., 2010; Le Manach et al., 2012) was followed. After locating

Table 1
Score for evaluating the quality of time series of reconstructed catches, based on Figure 1 of [Mastrandrea et al. \(2010\)](#). The uncertainty ranges, here updated from [Zeller et al. \(2014\)](#), are adapted from [Ainsworth and Pitcher \(2005\)](#) and [Tesfamichael and Pitcher \(2007\)](#).

Score	Uncertainty		Corresponding IPCC criteria
	–%	+%	
4 Very high	10	20	High agreement and robust evidence
3 High	20	30	High agreement and medium evidence or medium agreement and robust evidence
2 Low	30	50	High agreement and limited evidence or medium agreement and medium evidence or low agreement and robust evidence
1 Very low	50	90	Low agreement and low evidence

all as much quantitative and qualitative data from both peer-reviewed and gray literature, as well as interviews with local experts, and demographic data such as Fisher populations, were used to estimate total marine catches in the Gulf from 1950–2010. To account for uncertainty, we used the scoring method presented by [Zeller et al. \(2014\)](#) for evaluating the quality of time series of reconstructed catches and the associated uncertainty, which is based on criteria developed by the IPCC criteria ([Mastrandrea et al., 2010; Table 1](#)). The scoring was done separately for three periods, 1950–1969; 1970–1989 and 1990–2010.

Here, methods and results are described regionally, and the major sectors absent from reported data; thus, discards, subsistence, recreational, and other unreported and/or illegal catches are documented. Details of the total catch reconstruction, including minor components, are fully described in the technical report underlying this study (Appendix A; [Al-Abdulrazzak and Pauly, 2013a](#)).

2.1. Discards

Discards are considered to be an integral part of ‘catches’ given global considerations of ecosystem-based fisheries management ([Pikitch et al., 2004](#)), but officially reported data historically focus on ‘landings’, and hence by definition ignore discarded catches. Discards which are mostly associated with the region’s shrimp trawl fisheries, but also result from finfish bottom trawl fisheries, are unaccounted for in officially reported statistics.

In Kuwait, the shrimp fishery has a shrimp-to-fish bycatch ratio of 1:15.3 ([Ye et al., 2000](#)). Of this bycatch, 98% is discarded at sea and the remaining 2% is landed, yet not reported ([De Young, 2006](#)). Thus, both landed and discarded catches are unaccounted for. Species composition ratios were applied from the [Ye et al. \(2000\)](#) study. Marine catfish (Ariidae) and elasmobranchs (sharks and rays), which are not consumed in Kuwait for religious reasons, comprise the bulk of the discarded bycatch. Bycatch was estimated as a multiple of both the reported legal shrimp catch and the unreported illegal catch, and then smoothed by applying a 3-year moving average.

Because of Iraq’s close proximity to Kuwait (and the lack of Iraq-specific data) we apply a bycatch ratio (1:15) to reported, estimated and illegal Iraqi shrimp catches, of which 98% of the fish is discarded and only 2% is retained (as miscellaneous marine fishes), derived from the nearby Kuwait shrimp fishery ([Ye et al., 2000](#)). We also applied the same species composition from Kuwait to the discards.

Bahrain has a similar shrimp-to-fish bycatch ratio of 1:15, as reported by [Abdulqader \(2002\)](#). [Abdulqader \(2002\)](#) and [Kelleher \(2005\)](#) estimate that Bahrain’s discard rate was 24% in the 2000s. It was assumed that more discarding occurred at the start of the fishery, thus a conservative discard rate of 80% was applied from 1950–1979, followed by 50% from 1980–1999, and 24% from 2000–2010. A 3-year moving average was applied for smoothing and species composition ratios were applied from the [Abdulqader \(2002\)](#) study.

For Iran, it was assumed the majority of discarding is associated with large trawlers. A discard ratio of 1:4.2 was applied to landed shrimp and demersal species by large trawlers as per [Alverson and](#)

[Hughes \(1996\)](#). Discarding by the artisanal fleet was not estimated; thus, our estimate of discarding is likely a conservative underestimate.

In Qatar, [Ibrahim et al. \(1989\)](#) estimates that 496–635 t were discarded by Qatar’s bottom trawl fishery for 1986–1987. The study also presents the percent contribution of the bottom trawl fishery to the total finfish landings (excluding sharks) and the average percent contribution (32%) was used to determine the amount of finfish reported landings from 1970 (start of the fishery) to 1993 (when it was closed) that came from the bottom trawl fishery. A discard rate of 50% ([Ibrahim et al., 1989](#)) was applied to the bottom trawl fishery (i.e., 50% of the total catch was discarded). The same study also provided a discard rate of 4% (of the total catch) for the rest of the artisanal fishery, and this rate was applied to all other artisanal finfish catches (reported, unreported, and discarded). Discarded species composition originates from the same [Ibrahim et al. \(1989\)](#) study.

In UAE waters, snubnose emperor (*Lethrinus borbonicus*), smalltooth emperor (*Lethrinus microdon*), yellowbar angelfish (*Pomacanthus maculosus*), and black-streaked monocle bream (*Scolopsis taeniata*) are caught as incidental and generally discarded bycatch by *gargoor*s targeting other emperors, and groupers, jacks, and sweetlips ([De Young, 2006; Grandcourt et al., 2010](#)). [Weizhong et al. \(2012\)](#) estimate *gargoor* discard rates to be 2.6%, and this figure was used to extrapolate total discards for the fishery. The species composition was applied in equal ratios among the above species.

In Saudi Arabia, discards from the industrial trawl fishery were estimated by applying a discard ratio of 1:5.8, derived from the discard ratio for the Red Sea ([Tesfamichael and Rossing, 2012](#)). Species composition was also estimated from the same study based on the Red Sea.

2.2. Subsistence

Despite the high GDP in Bahrain, Kuwait, Qatar, and the UAE, subsistence fishing occurs by the fishing industry’s foreign laborers. To estimate this sector, national statistics were used to determine the number of foreign fishers in each country, and it was conservatively assumed that fishers take home an average of 5 kg of fish per week, starting with the oil boom in 1960 until 2010. Because these take-home catches are made up of less desirable species (which lack a targeted fishery), the species composition data of discarded fish was applied.

Subsistence fishing in Iran and Iraq was approximated using estimates of the coastal population, and combining these with a conservative consumption rate time series based on the assumption that 500 g of fish is consumed per meal and extrapolating to 20.5 kg person^{−1} year^{−1} consumed for Iran and 26 kg person^{−1} year^{−1} for Iraq ([Al-Abdulrazzak and Pauly, 2013a](#)).

Saudi Arabia’s subsistence catch was estimated based on interviews with local fishers on their individual consumption habits and tradition of gifting fish to family members ([Tesfamichael et al., 2014](#)). The fraction of the catch that is given away can be substantial (up to 50% of the catch) and does not appear in any fishery data recording system. Similar to the Red Sea,

subsistence catch was assumed to be 30% of artisanal catch until 1963, the year when the fishery started to be motorized. For more recent years, 20% was allocated to 1964 and 10% to 2010, and the percentage was linearly interpolated between 1965–2009. Before these percentages were applied, some taxa were eliminated which are not customarily given freely. These included taxa usually intended for export market, i.e., sharks fished for their fins and many invertebrates such as shrimp, crab and lobster. Traditionally, most of these taxa were not consumed locally and their consumption was introduced by foreign (mainly European) visitors to the region. However, nowadays, these non-traditional species are consumed by people in the affluent larger urban centers and are not usually given freely to family and friends.

2.3. Recreational

Recreational fisheries are a small but growing sector in the region, particularly given the region's 'youth bulge' and growing wealth and leisure time. To estimate these catches in Kuwait, Bahrain, Qatar, and the UAE, methods were developed based on a recreational participation rate of 0.12% estimated by Cisneros-Montemayor and Sumaila (2010). It was assumed that recreational fishing began in 1960, and thus this participation rate was applied to total populations from 1960 to 2010 to obtain a time series of recreational fishers. It was further assumed that no recreational fishing occurred during and immediately after war periods in countries with a history of war (Iran–Iraq, Persian Gulf War, etc.). A conservative catch rate of 1 kg trip⁻¹, along with 104 fishing trips per recreational Fisher per year (based on the annual number of weekend days) was used to estimate recreational catches.

Saudi recreational catches were estimated based on methods derived for the Red Sea (see Tesfamichael and Rossing, 2012 for further details). Although recreational fishing occurs in Saudi Arabia's Gulf waters, the only data available were for 1996, when it was reported that there were 2528 boats involved in the recreational fishery in the Gulf, while in the Red Sea there were 2446 (Sakurai, 1998). Thus, the recreational fishery and its composition for the Gulf were calculated using the ratio of boats for 1996 and the reconstructed recreational fishery of the Red Sea (Tesfamichael and Rossing, 2012).

Due to the number of wars in Iraq's history and due to its short coastline and minor coastal population, it was assumed that negligible recreational fishing occurs in Iraq and therefore it was unaccounted for.

For Iran, a recreational fishery was assumed to exist from 1950 to 1979, and after the Iran–Iraq war from 1989 to 2010. The 0.12% participation rate of Cisneros-Montemayor and Sumaila (2010; see above) was used for the latter period, and half that (0.06%) for the former, along with an average of 5 kg trip⁻¹, and 1 trip per week.

Species compositions were estimated using all available information for each country (Uwate et al., 1994; Rao and Behbahani, 1999; Bishop, 2002; De Young, 2006; Tesfamichael and Pauly, 2013).

2.4. Other unreported catches

In addition to the sectors described above, certain minor components such as catches from weirs (Al-Abdulrazzak and Pauly, 2013b), illegal catches (De Young, 2006; Al-Sabbagh and Dashti, 2009; Richer, 2009; Lessware and Mahdi, 2010; Barakat, 2012), and shark catches (Moore, 2012; Moore et al., 2012) are unaccounted for. Similar to the previously described methods, gray and peer-reviewed literature were used to identify 'anchor' points, with subsequent interpolations between years. Table 2 provides for example of anchor points used to estimate illegal driftnet catches in UAE; specific details of all other sectors are available in Al-Abdulrazzak and Pauly (2013a).

Table 2
Parameters used for estimating illegal driftnet catches in the UAE.

Year	Number of participating vessels	Annual illegal catch per vessel (t)	Annual illegal catch (t)
1989	564	20	11,280
1990	564	20	11,280
1991	564	20	11,280
1992	564	20	11,280
1993	564	20	11,280
1994	564	20	11,280
1995	564	20	11,280
1996	564	20	11,280
1997	564	20	11,178
1998	770	18	13,762
1999	619	23	14,106
2000	469	27	12,648
2001	459	29	13,500
2002	519	23	11,701
2003	505	23	11,411
2004	556	19	10,793
2005	557	19	10,401
2006	557	18	9,892
2007	557	17	9,388
2008	557	16	8,880
2009	605	15	9,294
2010	605	16	9,538

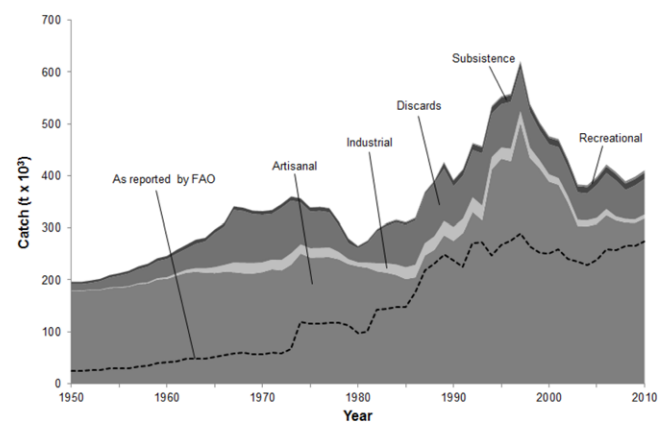


Fig. 2. Total reconstructed catch for the Gulf by sector, as compared to catch reported by FAO.

3. Results

Catch data for the Gulf as reported by the FAO suggest a steady increase in reported landings from 24,136 t in 1950 to 274,134 t in 2010 (Fig. 2). In contrast, the reconstructed total marine fisheries catches suggest a gradual increase from 196,237 t in 1950 to a peak of 621,270 t in 1997, followed by a sharp decline to 381,678 t in 2004, followed by a relative stability in total catches (Fig. 2).

Artisanal catches contributed 75% of total catches, followed by industrial (4%), subsistence (2%), and recreational (0.4%) (Fig. 2). The increased capacity of shrimp trawlers in the 1960s (De Young, 2006) corresponds to an increase in bycatch (landed), and of discards (not landed), the latter averaging 18% of total catches. Declines were seen in all sectors after 1997. The 'dip' in catches between 1980 and 1988 is probably due to the Iran–Iraq war (see declining Iranian catches, Fig. 3).

Iran accounts for the largest catches, with 56%, followed by the UAE (12%), and Kuwait, Saudi Arabia, and Bahrain (all 9%) (Fig. 3). Qatar and Iraq's catch contributions are comparatively minor, with 2% and 3% respectively. All countries, with the exception of the UAE, under-report their catches. Until 2004, the UAE estimated their catches using a market survey program, which included imported seafood, which led to inflated domestic catches (see Al-Abdulrazzak, 2013 for details on the required adjustment).

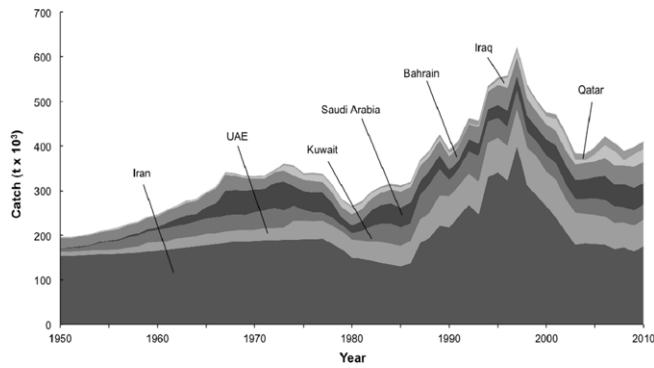


Fig. 3. Total reconstructed catch for the Gulf by country.

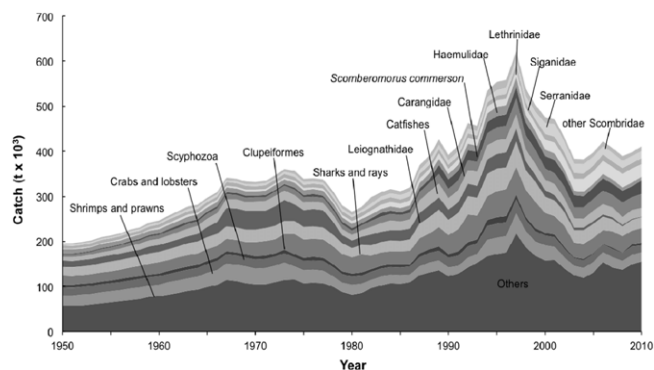


Fig. 4. Total reconstructed catch for the Gulf by major taxonomic groups. The category 'others' consists of 131 additional taxa with smaller individual contributions.

There are 264 taxa that make up the total reconstructed catch in the region as compared to 182 taxa reported by FAO. The dominant invertebrate groups are shrimps and prawns (7%), and crabs and lobsters (6%). The major fish groups consist of herring-like fishes (Clupeiformes, 10%), sharks and rays (8%), ponyfishes (6%), and catfishes (6%) (Fig. 4).

4. Discussion

The overall reported catches for the Gulf's fisheries underestimate total catches by a factor of two over the 1950–2010 time period (Fig. 5). Such large differences between reported landings and reconstructed total catches illustrate the magnitude of the data reporting problems faced by Gulf countries, and, by inference, other countries (see e.g., Zeller et al., 2014). It also points at a fundamental problem of fisheries catch data being viewed purely from a commercial or market perspective, which accounts only for what is landed and utilized for commercial sale or export (Pauly and Zeller, 2003; Zeller and Pauly, 2004).

Small-scale fisheries have often been underrepresented in officially reported catch statistics for political and socio-economic reasons, as well as their physical remoteness from urban centers (Pauly, 1997; Zeller et al., 2011). Although data reported by FAO are not readily distinguishable by sector (e.g., commercial vs. artisanal; Pauly and Charles, 2015), the results suggest that industrial catches make up only 4% of total Gulf catches. The dichotomy between the actual contribution of industrial fisheries and the government attention they receive is directly reflected in the data collection emphasis, which is problematic and misrepresents regional and global trends.

This catch reconstruction justifies concerns over the status of fisheries in the Gulf (De Young, 2006; Sheppard et al., 2010; Sale et al., 2011; Grandcourt, 2012). Sharp declines in all sectors,

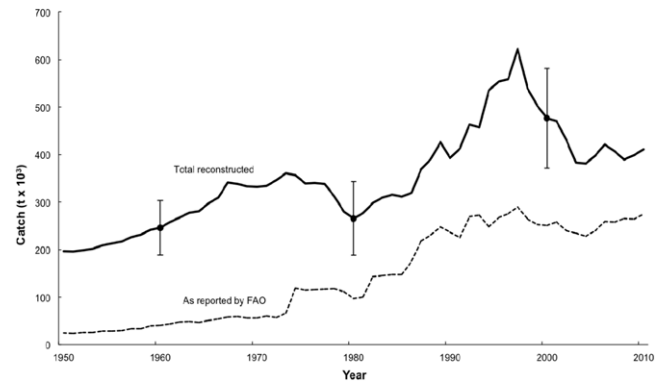


Fig. 5. Reconstructed total catch for all 7 countries in the Gulf as compared to data reported by FAO. The uncertainty associated with the reconstruction is shown for 1960 (representing 1950–1969), 1980 (representing 1970–1989), and 2000 (representing 1990–2010), based on the scoring method in Zeller et al. (2014).

coupled with other indicators of overexploitation such as the reduced mean size of landed fish and decreased catch per effort, suggest that fisheries are suffering from overcapacity (Dadzie et al., 2005; Al-Sabbagh and Dashti, 2009). Although catches from 2004 to 2010 appear to be leveling off after declines since 1998, it is more likely that further declines are masked by previously discarded groups such as sharks (i.e., Jabado et al., 2015), swimming crabs, and jellyfish being retained.

The reconstructed time series also illustrates the magnitude and hence the importance of accounting for discards (Fig. 2). In terms of tonnage, discards, mainly from the shrimp fishery, amounted to 18% of the total landed catch, or 2 times greater than the global average of 8% (Kelleher, 2005). This is particularly problematic in a region that is dependent on fish for its food security. A better utilization of bycatch may lessen dependence on seafood imports and enhance food security.

Fisheries management in the Gulf is rudimentary at best, with no regional management plan for any stock or well-developed institutional arrangements, despite many stocks being shared between countries (De Young, 2006; Grandcourt, 2012). Basic stock assessment data, rates of effort, and fishery market potentials are also lacking, further constraining management. The few management tools in place focus on input controls (i.e., gear restrictions) rather than the badly needed output (i.e., size limits, quotas), or are often designed as a basis for administrative procedures, rather than a strategic policy framework for the long-term sustainability of a sector (De Young, 2006; Grandcourt, 2012). In addition, enforcement of management regulations is weak and cheap migrant labor and low operating costs act as indirect subsidies, maintaining the profitability of fisheries despite declining stocks (Grandcourt, 2012). Combined, unregulated fishing practices and population pressure suggest that 'Malthusian overfishing' occurs in the region, a situation where declining yield coupled with lack of alternative employment drive fishers to overexploit and destroy their resources (Pauly, 2006).

In order to accommodate expanding industries and rapid population growth in the region, major coastal development projects are underway, resulting in land reclamation and dredging, with little to no studies on their short- and long-term ecological impacts on marine life, and hence fisheries resources (Sheppard et al., 2010). These development projects are certain to impact fisheries, yet are not addressed, since no formal management plan exists for any fishery and baseline data is lacking.

If the overall status of the Gulf's fisheries and the marine ecosystems in which they are embedded are to improve, there needs to be a significant shift towards a precautionary approach to the management of the region's marine resources (Sale et al., 2011; Van Lavieren et al., 2011). New management plans should

be data-driven and regional in scale. In addition, efforts should be made to garner public interest and participation in relevant decision-making processes, beginning with making environmental data publicly available.

Given the global trend towards managing fisheries on an ecosystem scale (Pikitch et al., 2004), fisheries data collection, and hence catch accounting needs to include all catches. This requires comprehensive accounting for all fishery extractions, including the reporting (or estimation) of discarded catch, and catches from unregulated sectors such as recreational and subsistence fisheries. Given the high costs of monitoring such sectors using traditional approaches, alternative methods such as utilizing national surveys, census opportunities, and the use of satellite imagery have been suggested for more widely dispersed and hard to monitor fishery sectors (Zeller et al., 2007; Al-Abdulrazzak and Pauly, 2013b).

Despite data uncertainties and the need to appropriately qualify data assumptions, this catch reconstruction provides the best estimate of total marine catches in the Gulf over the last 60 years, and is preferable to the alternative of assuming low levels of catch, or worse, 'zero' catch for sectors with missing data. Fisheries managers and policymakers in the Gulf should focus on the available trends, rather than the uncertainty surrounding the data from which the trends are inferred (Rosenberg et al., 2005). The reliance on incomplete and/or misreported catch data compromises countries' food security and marine ecosystems more generally.

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