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Philippine Marine Fisheries Catches: A Bottom-up Reconstruction, 1950 to 2010

Fisheries Centre, University of British Columbia, Canada

Philippine Marine Fisheries Catches: A Bottom-up Reconstruction, 1950 to 2010

edited by
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Preface

The *Sea Around Us* and its worldwide network of collaborators have been involved from the mid-2000s to mid-2014 in a massive project of 'catch reconstruction', i.e., estimating the actual – as opposed to officially reported – catches of the marine fishes of all countries and territories of the world. These reconstructions, of which about 200 were completed, are usually 10-20 pages long - even for large countries. This is because, in most cases, we added to the official statistics components that we were missing from these statistics, e.g., discards and/or recreational and subsistence fishery catches. Not so for the Philippines, where the official statistics for industrial ('commercial') fisheries may be adequate once corrected for obvious problems, but artisanal ('municipal') fishery catches are not reliably estimated.

In this volume of the *Fisheries Centre Research Reports*, a methodology is therefore presented which allows an independent estimation of artisanal catches based on observed daily catches of artisanal fishers, multiplied by annual numbers of days fished and time-series of number of fishers, this procedure being applied separately in four different parts ('subzones') of the Exclusive Economic Zone of the Philippines. Also, due emphasis was given to subsistence catches (i.e., catches primarily destined for household consumption), notably reef gleaning, and marine recreational fisheries, which are not covered at all by official statistics.

These studies, presented here in the form of separate chapters, are then pulled together in a synthesis chapter which presents our estimation of the total marine catches of the Philippines from 1950 to 2010. Overall, our estimate is 26% lower than the total reported by the Philippines to the Food and Agriculture Organization of the United Nations (FAO). In this, the Philippines differs from other countries in Southeast Asia, and from developing countries in general, whose reconstructed catch is usually higher – often two times or more – than their officially reported catch. This should have consequences, and we elaborate on this on the final synthesis chapter of this report.

We hope that this report will be found useful everywhere, but particularly in the Philippines.

The Editors
Los Baños, Philippines and Vancouver, Canada

Philippine marine fisheries 101[1]

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Abstract

Fish being an important part of the Filipino protein intake makes fisheries equally an important activity of more than one million Filipinos living in coastal areas. The management of fisheries in the Philippines is, however, beset with chronic challenges, which is exacerbated by the rapidly declining environmental conditions of many of its coastal habitats. One major challenge is the lack of adequate catch data needed for the estimation of, e.g., catch per unit of effort and catch limits. We review some of the history leading to conditions and events that might have contributed to such challenges. We also identify a terminology for use in Philippine capture fisheries equivalent to that used in other parts of the world, and which will be used throughout this report.

Introduction

This introductory chapter was initially entitled as "The history and profile of Philippine marine fisheries". However, numerons historical overviews of Philippine fisheries have been published (see e.g., Storer 1967; DNR 1976a; BFAR 1978; Smith and Pauly 1983; Poblete 1984; Spoehr 1984; Pauly 1986; Israel 1999; Barut *et al.* 2003; Cruz-Trinidad 2003; DA-BFAR 2004; Luna *et al.* 2004; Lachica-Alino *et al.* 2006; Briones 2007; Muallil *et al.* 2012; SEAFDEC 2012) and fisheries profiles are also published regularly, if not on an annual basis, in Philippine government websites (e.g., Bureau of Fisheries and Aquatic Resources, BFAR)[2], regional (Southeast Asian Fisheries Development Center, SEAFDEC)[3] and international organizations (the Food and Agriculture Organization of the United Nations, FAO)[4]. It would thus be redundant to write a history or profile. Thus, we content ourselves with mentioning the basic information that readers require to understand the intricacies and peculiarities of Philippine marine fisheries, i.e., similar to the content of an introductory first-year university course ('101'), hence the title. This chapter will describe the important features of and current perceptions on Philippine marine fisheries, and identify the challenges which have plagued the sector over decades of management attempts.

The Philippines, with over 7,000 islands of various sizes, encompasses most of the Sulu-Celebes Sea Large Marine Ecosystem (LME), a world hotspot of marine biodiversity (Randall 1998; Carpenter and Springer 2005; Hoeksema 2007; Carpenter *et al.* 2011). These islands cover a land area of 300,000 km^2,

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[2] http://www.bfar.da.gov.ph/pages/AboutUs/maintabs/statistics_2010.html
[3] http://www.seafdec.org/index.php/publications/viewcategory/10-fishery-statistics-and-information
[4] http://www.fao.org/fishery/countrysector/FI-CP_PH/en

while the Exclusive Economic Zone (EEZ) that might be claimed by the Philippines[5] covers an area of over 2 million km^2 (ADB 1993; Lugten and Andrew 2008), including parts of the heavily contested Spratly Island group, Scarborough Shoal, and Miangas Island (see also Fig. 1 of Barut *et al.* 1997; Bautista 2008). About 12 % of this sea area consists of productive continental shelf (to 200 m; ADB 1993; Barut *et al.* 1997)[6] hosting coral reef (27,000 km^2, to depths of <30 m; Rivera *et al.* 2002), mangrove and algal ecosystems. These ecosystems form the habitats of the large number of species supporting coastal marine fisheries.

Fisheries play an important role in the Philippine economic and social fiber. The Philippine islands are divided into 15 administrative regions with 81 provinces, of which 80 % are coastal (Rivera *et al.* 2002), themselves comprising1,514 municipalities, of which 65 % are coastal (ADB 1993). In 2009, the Philippines reported 4.1 million tonnes[7] of total fish 'production' (i.e., including aquaculture), about 59 % of which were from marine fisheries (and 54 % were catches of mackerels, tunas, herrings, sardines, anchovies, jacks, mullets and sauries) valued at 2.65 billion USD (SEAFDEC 2012). Of the 10 Southeast Asian countries, the Philippines ranked second in terms of fish catches, next to Indonesia, accounting for 17 % of the total for the region (SEAFDEC 2012). In 2003, the Philippines ranked 11th worldwide (FAO 2004-2012).

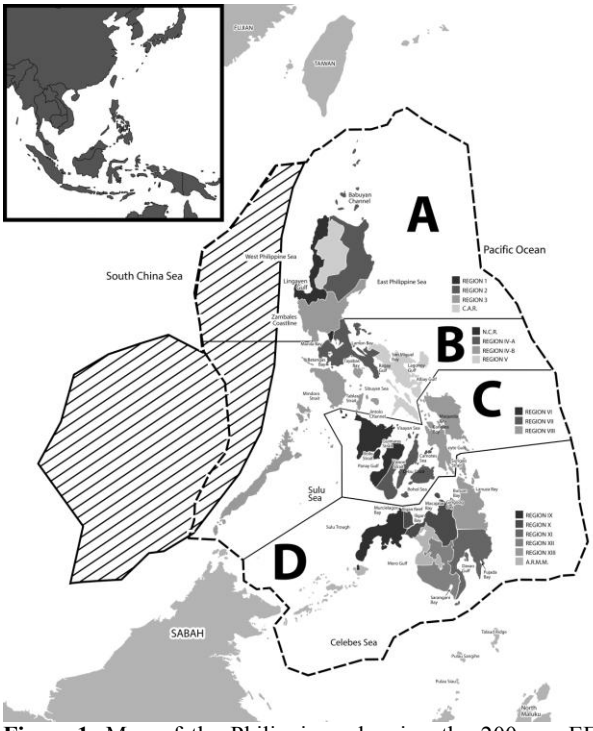

Figure 1. Map of the Philippines showing the 200 nm EEZ that it may claim. Shaded area indicates parts of the EEZ being disputed by other countries (redrawn by Mr. Mike Yap from a composite of several open source maps).

In 2001, 55 % of the 76 million Filipinos lived in coastal municipalities (Costales and Garcia 2009), which increased to 85 % in 2005 (WB 2005). If we take the average of the 2001 and 2005 estimates of the ratio of coastal area inhabitants to the total population (70 %)[8] and apply that to the 2010 population (over 92 million), we obtain a value of over 64 million people inhabiting Philippine coastal areas. Though not all of these people are directly involved in fishing activities, such a high coastal population is undoubtedly the origin of relatively high exogenous impacts on the relatively shallow water area (Barut *et al.* 1997), and will generate "*an enormous pressure on the fisheries"* (Salayo *et al.* 2008, p. 693). Such impacts may be exacerbated by the high incidence of poverty among these mostly rural coastal populations, i.e., 34 % of the about 77 million Filipinos in 2000 (NSO 2012) lived below the poverty line, and of this, over 72 % are from rural areas (SEAFDEC 2012). The high population growth in the Philippines (one of the highest in Asia) also implies a bleak future, both in terms of the economic status of these rural populations, and in their use of coastal resources. Fishing and/or gleaning are activities which can be performed without or with very little capital, and is often the easiest food provision option of poor coastal families (Israel and Roque 1999). In the 1990s, over 66% of Filipinos' animal protein consumption was based on fish (Israel and Banzon 2000), with an average per capita fish consumption of

[5] This tortuous wording is based on the fact that the Philippines' claim is based not on UNCLOS, as might be expected, but on the 1898 Treaty of Paris, which formalized the transfer of colonial territories from Spain to the United States (Bautista 2008).
[6] see also http://www.seaaroundus.org/eez/608.aspx
[7] 1 metric ton = 1,000 kg, denoted as 't' hereon after.
[8] Over 60 % in the late 1990s (La Vina 1999).

36 kg·person·year^{-1} (Barut *et al.* 2003). This reportedly increased to 53.4 kg·person·year^{-1} in 2009 (SEAFDEC 2011).

The fisheries sector employed over 807,000 fishers in 1990, 46 % of whom worked in the small-scale, 44 % in the industrial, and 9 % in the aquaculture sectors (Costales and Garcia 2009). Given the annual population growth rates estimated by NSO (2012) between 1.9 % (2000) to 2.3 % (1990), or an average of 2.1 %, we can estimate about 1 million fishers[9] recently employed by all three sectors. This is almost 20 % more than the number of fishers employed by these sectors in 1975, i.e., over 844,000 fishers, 68 % of whom were employed by the small-scale sector (so called 'traditional' fishers), reported to contribute 55 % of the 1.3 million t of fish domestic output (BFAR 1978). Note, however, that there was an almost 35 % decrease in the number of small-scale fishers over these two decades, which may be indicative of an evolution that is directly tied to overexploitation of shallow coastal resources, resulting in a move towards industrial fisheries, targeting higher-value species like tuna and small pelagic fishes usually caught in offshore areas. Spoehr (1984, p. 34) recounts the evolution of fishing since the Second World War from a coastal to an offshore activity as boats became motorized with an *"increase in fishing range and endurance [which] has resulted in a movement of the fishing pattern offshore with the exploitation of new grounds. However, this has not reduced fishing pressure on inshore and traditional grounds; in fact, the opposite has occurred"*.

The 1960s and 1970s saw the rapid expansion of the commercial fleet as small-scale fisheries evolved towards motorized (though small) commercial operations (Cruz-Trinidad 2003, p. 553). This industrialization further led to a productivity-oriented thrust, the consequences of which were felt as early as the 1980s, when "*overfishing led to lower returns per unit effort, squeezing dry the profitability of fishing as a livelihood. Moreover, conflicts of resource access and use were heightened by the inducement for large-scale exploitation of aquatic resources"* (Briones 2007, p. 29).

In addition, the government's attempts to "*cope with modal shifts [in the fisheries sector] brought about by socio-ecological factors in the last decades"* (Lopez 2006, p. 79) led to conflicting policies that may have contributed to inefficiency with regards to managing the sector (Shannon 2002; Lugten and Andrew 2008; Salayo *et al.* 2008). The industrialization boost of the 1970s was fueled largely via the "*Integrated Fisheries Development Plan which sets as its goal the attainment of self-sufficiency in fish supply through expanded production and development of import substitutes and promoting exportation of fishery products"* (BFAR 1978, p. 10). Foreign aid via several organizations of the United Nations (e.g., UNDP, FAO) and the regional body, SEAFDEC, assisted the government in implementing its expanded fish production program and in "*exploratory fishing for schooling fishes such as tuna"* (BFAR 1978, p. 10). Government subsidies in terms of loans meant primarily for artisanal fishers to motorize their fishing operations (Green *et al.* 2003) ranged from 2.7 million pesos in 1987 to 10.6 million pesos in 1997[10] (Israel and Roque 1999, Table 24, p. 87) with loan to output ratios of 7.4 in 1987 to 13.9 in 1992 (Israel and Roque 1999, Table 23, p. 86). These were in addition to earlier government loans obtained through the World Bank for the National Fisheries Development Project "*channelled only to commercial fishermen"* (WB 1991, p. 1). The concerted effort to obtain self-sufficiency in fish since the 1970s (Anon 1979) culminating with the "*1997 Agriculture and Fisheries Modernization Act [which] is production-oriented [… and thus] encourage excess capacity [conflicts with] the 1998 Fisheries Code [which] advocates resource conservation"* (Salayo *et al.* 2008, p. 698) have not alleviated the chronic problems that have beset the post-war Philippine fisheries industry. In fact, the *"social conflicts which have developed between the small-scale fisheries and the commercial fisheries over the years […] in effect exacerbated excessive fishing efforts, particularly in municipal waters"* (Delmendo 1992, p. 35).

[9] This might be an underestimate as Briones (2007) reported 1.5 million people with fisheries as their main livelihood in 2004. However, this figure included fishers also employed in the aquaculture sector.

[10] In 1987, 1USD=20.6PHP. In 1997, 1USD=29.5PHP (see http://fx.sauder.ubc.ca/etc/USDpages.pdf).

We enumerate further below the major challenges that this particular history and culture of Philippine fisheries has created and we pay particular attention to the facets of Philippine fisheries that are important to one of the major objectives of this report, i.e., the reconstruction of fisheries catches.

Some indispensable definitions

The Philippine Fisheries Act of 1932 classified the sectors of marine fisheries …

"… according to their government and disposition: national, municipal and reserve fisheries. Falling under national fisheries are: 1) deepsea or offshore fishing; 2) marine mollusca fisheries; 3) sponge fisheries; 4) hawksbill turtle fisheries; and 5) inland fisheries. Under municipal fisheries Section 6 defined the extent thereof which is three nautical miles at most from the shoreline of the municipality, while Section 7 dealt on the authority of the municipal council to grant the exclusive fishery privileges of erecting fish corrals, operating fishponds, or taking or catching of bangus fry (kawag-kawag) or fry of other species. For the reserve fisheries, Sections 73 to 73-B provided for the establishment thereof in any of the Philippine waters by presidential proclamation for the exclusive use of the government or of the inhabitants, for the culture of fish and other aquatic animals, for educational and scientific purposes, while communal fisheries may be established by the Secretary of Agriculture and Natural Resources in any municipal waters" (BFAR 2012c).

Presidential Decree No. 704 of July 14 1975 superseded this earlier Fisheries Act and became the basis of all fisheries regulations and rules defining thus:

(i) 'commercial' fisheries as operations *"for commercial purposes in waters more than seven (7) fathoms deep with the use of fishing boats more than three (3) gross tons* […] *within a distance of seven (7) kilometers (3.78 nautical miles) from the shoreline"*;
(ii) 'municipal' fisheries as operations *"utilizing fishing boats of three gross tons or less, or using gear not requiring the use of boats"*; and
(iii) 'municipal' marine waters as *"marine waters included between two lines drawn perpendicular to the general coastline from points where the boundary lines of the municipality touch the sea at low tide and a third line parallel with the general coastline and three (3) nautical miles from such coastline."*[11]

This decree gave provisions for the: (a) creation of the Fishery Industry Development Council in Chapter III; (b) regulating the use and exploitation of fishery/aquatic resources in Chapter IV; (c) reserve fisheries and fish sanctuaries in Chapter V; (d) prohibitions (including illegal fishing and gears) and penalties in Chapter VI; and (e) fisheries subsidies and loans in Chapter VII. However, it lacks any mention of subsistence fisheries. In fact, Chapter IV-C Section 29b requires the municipal or city council to issue licenses to <u>all</u> fishing operators, except when it is beyond *"… the power of the municipal or city council to impose a license for the privilege of gathering marine mollusca or the shells thereof, for pearling boats and pearl divers, or for prospecting, collecting, or gathering sponges or other aquatic products, or for the culture of fishery/aquatic products"*.

Thus, the gleaning of invertebrates is effectively the only form of subsistence fishing considered. The catching of fish, even in small quantities for direct consumption by fishers as stipulated in (ii) above, is considered 'municipal' fishing.

[11] Presidential Decree No. 704 http://www.bfar.da.gov.ph/pages/Legislation/presdecree704.html [accessed 23/10/2012]

Sea Around Us currently engaged in catch reconstructions for all maritime countries of the world has elaborated a set of definitions which will be used throughout this report, and which are compatible with the definitions of fisheries used in most of the English-speaking world. These definitions, however, differ sharply from those used in the Philippines, but which, we fear, mask rather than identify major differences between different fishery types in the Philippines (Table 1).

'Commercial' fisheries

The 'commercial fleet', which we call 'industrial' (see Palomares and Pauly, this vol.), is directly under the jurisdiction of the national government, i.e., the Fish and Game Administration (Department of Agriculture and Commerce) in the 1930s, Division of Fisheries in the 1940s, post-WWII Bureau of Fisheries, and the current Bureau of Fisheries and Aquatic Resources (BFAR) under the Department of Agriculture (BFAR 2012a). The national government decides on licenses, taxes and levies and the collection of fisheries data via monthly reports from registered (licensed) vessels as promulgated in the Presidential Decree No. 704 and by the Philippine Fisheries Code of 1998 (Delmendo 1992). The Fisheries Code also redefined 'commercial' fisheries in three categories, i.e., small-scale (3.1-20 GT), medium-scale (20.1-150 GT), and large-scale 'commercial' vessels (>150 GT), respectively.

The average number of 'commercial' vessels in the 1960s was about 2,100, peaking at 2,544 in 1966 with an estimated 31,000 fishers in 1967 in both powered and non-powered boats (PFC 1969). The number of 'commercial' vessels tripled in 2007 to 6,400 vessels with an estimated 16,500 fishers in 2002 (BFAR 2009). The 'commercial fleet' employs trawls[12] for demersal species and bagnets[13], purse seines[14], ringnets[15], longlines[16] with fish aggregating devices (FAD or '*payao'*) for pelagic species (Barut *et al.* 1997; Schoppe *et al.* 1998). Bagnets include *muro-ami*, an extremely destructive gear/fishing method introduced to the Philippines in the 1930s from Okinawa, and which uses a large bagnet held open by the current, with two detachable wings that guide fish (e.g., reef-associated species such as groupers), which are herded to the net by swimmers using scare lines. An operation may have as many as 7,000 swimmers, grouped in 200-300 individuals led by a master fisher and 4-5 assistant master fishers ferried by ~9 m long non-motorized bancas hosted in one or two ~47 m mothership of ~400 GT, i.e., with a capacity of about 180 t of fish in an operation that may last 2-3 months per trip (Corpuz *et al.* 1983). Major *muro-ami* fishing grounds included the Sulu-Celebes Sea and as far as the Spratly Islands in the South China Sea. Fisheries Administrative Order No. 163 amended Sections 4 and 7 of Presidential Decree No. 704 to ban the use of *muro-ami* and its local versions in 1986.[17] However, BFAR permitted the use of *muro-ami "... under the guise of a new name and a somewhat re-redesigned, experimental technology that supposedly avoided the traditional muro-ami's well-known damage to coral reefs. The legality of this permit extended only to three months, but for unknown reasons the "new" muro-ami has continued to be defiantly practiced up to the present day"* (Olofson *et al.* 2000, p. 224-225).

In 1969, these vessels were reported to have landed 0.4 million t, 80 % of which are spread over 11 species topped by round scads (of the genus *Decapterus* spp, 30 %), sardines (*Sardinella* spp, 9%) and slipmouths (*Leiognathus* spp, 8 %), with 'miscellaneous species' making up 2 % of the total reported landings (PFC 1969). This fleet's reported landings increased 2.5 fold in 2007, 79 % of which are spread

[12] In the late 1950s, the otter trawl fishery of Manila Bay was assessed to have reached its maximum capacity and thus, bagnets and twin engine in larger trawlers were introduced to exploit the pelagic stocks outside of the Bay (Ronquillo *et al.* 1960).
[13] Most common gear employed in the 1950s and 1960s (Storer 1967).
[14] Gear developed via technical assistance and training from the FAO in the early 1960s because it had the potential to increase the catch of '*basnigan*' (bagnet) from 3.5 to 35-100 t per trip (Storer 1967).
[15] Also used in the 'municipal' fisheries to catch tunas and oceanic pelagic species (Olaño *et al.* 2009).
[16] May also be used to catch some demersal species, i.e., lethrinids, polynemids, priacanthids and nemipterids (Jeremias and Ganaden 1983).
[17] http://www.bfar.da.gov.ph/pages/Legislation/FAO/fao163.html [accessed 24/10/2012].

over 9 species topped by Indian sardines (genera *Dussumieria* and *Thryssa*, 21 %), skipjack tuna (*Katsuwonus pelamis*, 16 %), and round scads (14 %), with miscellaneous species making up 17 % of the total reported landings (BFAR 2009). In addition, landings of tunas, i.e., yellowfin (*Thunnus albacares*), frigate (*Auxis thazard*), skipjack (*Katsuwonus pelamis*) and bonito (*Auxis rochei*), increased to almost 90 times from the 1960s figures. Also, previously important demersal species, such as lizard fishes (Synodontidae), shrimps (Decapoda) and croakers (Sciaenidae) considerably decreased in reported catches. These statistics (which we assume to be representative of the fleet, for now) help us to infer the following trends of the past 6-7 decades: (a) that there was a 4-fold decrease in the number of fishers per boat, which can be attributed to an increase in the efficiency of boats and gears, and thus loss of employment in many coastal communities; (b) that there was a 5-fold increase in the catch per 'commercial' fisher, likely due to the expansion of the fisheries to offshore areas; and (c) that the target species has shifted from predominantly demersal to mainly offshore pelagic, a result of the increasing focus on tuna and tuna-like species (see Morgan and Staples 2006, p. 16).

The increase in efficiency and capacity of motorized banca-type vessels (wooden outrigger boats, traditionally limited to fish in municipal waters) enabled them to reach offshore fishing areas. This was (and still is) facilitated by the government's incentives in Article II Section 35 of the Fisheries Code of 1998 for 'commercial' fishing operators *"... to fish farther in the EEZ and beyond, new incentives for improvement of fishing vessels and acquisition of fishing equipment shall be granted in addition to incentives already available from the Board of Investments (BOI)"*.[18]

These incentives include long-term loans for vessel and equipment upgrades, tax-exemption on imported vessels, and duty and tax rebates on fuel consumption. Thus, artisanal operations turned industrial and expanded their operations to the outer edges of the Philippine EEZ and even to areas beyond Philippine jurisdiction and/or within disputed zones. However, as many of these 3 GT efficient vessels are allowed within municipal waters, they can also exploit near shore resources (Smith and Pauly 1983). Thus, the fine line that supposedly separated 'commercial' from 'municipal' became blurred (Delmendo 1992) and may be the origin either of an over-reporting of artisanal catch in offshore waters, e.g., *"the attribution of all handline catches as municipal"* Lewis (2004, p. 19), or of an under-reporting of 'commercial' catch in municipal waters. This issue is recalled in our synthesis chapter (Palomares and Pauly, this vol.)

'Municipal' fisheries

The small-scale or artisanal fisheries, referred to as 'municipal fisheries' in Philippine parlance, is under the jurisdiction of the municipal government. The Local Government Code of 1991 (Republic Act 7160) mandates *"municipal governments to manage their municipal waters* [that is within 15 kilometers of the shoreline and states that] *Local government units (LFUs) shall share with the national government the responsibility in the management and maintenance of ecological balance within their territorial jurisdiction* […]. *LGUs were granted powers for effective governance* [and] *to enact municipal fisheries ordinances and enforce these as well"* (Lopez 2006, p. 81-82).

'Municipal' fishers traditionally fish from *bancas*, which may be as small as a one/two person paddle boat to as big as a 3 GT motorized vessel (but with engines of not more than 10 HP), according to conditions identified in item (ii) of the definitions above. The gears usually employed by municipal fishers range from cast/gill nets, hook and line, spear, traps and pots, barriers (Barut *et al.* 1997; CTI 2012). In the 1960s, *"municipal or sustenance fishing [production] is the largest component […] accounting for 51 per cent of the total catch [… but represented …] a somewhat smaller share of value, 43 percent [… and employed] 65 per cent of those directly or indirectly engaged in the industry [260,000 of 400,000 then*

[18] Department of Agriculture Administrative Order No. 3. Implementing rules and regulations pursuant to Republic Act No. 8550. The Philippine Fisheries Code of 1998.

involved in Philippine fisheries, 3% of Philippine labor force …], but it is never in its individual or mass effect an efficient way of exploiting the resource or of providing a livelihood for its practitioners. […] The pressures upon these people to fish are tremendous and essentially add up to a complete lack of alternatives […]" (Storer 1967, p. 367). This condition, unfortunately, has not changed, and in many municipalities, has even deteriorated as evidenced by the various reports cited above.

The development of scaled-down industrial operations ('baby trawlers') led to intensive fishing in inshore waters and in waters less than 12.8 m deep, traditionally reserved for artisanal fisheries (Tapiador 1978; Pauly and Smith 1983; Cruz-Trinidad 1998). Thus, the highly heterogeneous municipal sector, which is clearly suffering from dwindling resources, as indicated by a minuscule and declining catch/day of individual fishers (Simpson 1979; Dalzell *et al.* 1987; Dickson 1987; Munoz 1991; Sunderlin 1994; Shannon 2002; Stobutzki *et al.* 2006; Muallil *et al.* 2012), and an ever increasing number of fishers, i.e., the 'Malthusian overfishing' of Pauly (2006), is linked to the ever-increasing industrial fleet, which obtains an increasing share of their ill-assessed catches from (mostly illegal) fishing in the waters of their neighbours, especially in Malaysia (Sabah) and Eastern Indonesia (Lewis 2004).

Subsistence or gleaning?

The term 'subsistence' was very recently redefined to categorize 'municipal' fishers whose livelihood is mainly *"fishing and [whose] earnings fall below the food threshold;* [who] *uses the catch for a combination of purposes – family consumption, barter, and balik puhunan"*, i.e., selling the fish caught to regain capital spent on fishing operations (CTI 2012). This amorphous use of the terms 'municipal' and 'subsistence' exacerbates the already difficult estimation of small-scale fisheries catches. In addition, this recent review by CTI (2012), suggested that 'gleaning', which was exempted from what was deemed as fishing in previous definitions by the 1975 Act and the 1998 Code, may be considered as 'subsistence' fishing.

Note, however, that in general, with the exception of some areas, such as the Visayas, where gathering shellfish is an established fishery (Floren 2003), or in the Sulu Sea, where sea cucumber fisheries are commercial operations (Subaldo 2011), most gleaned shellfish and invertebrates are either underestimated or not estimated at all. This is due, in part, to the misuse and resulting confusion of the terms 'municipal' and 'subsistence' (see Table 1) and possibly also because their catch is believed to be small and/or consisting of species of low value. However, there are indications that gleaning provides for fishers affected by the recent decline in many of the municipal fishing operations (del Norte-Campos *et al.* 2005). Also, the *"productivity of subsistence fishers in coral reef regions can be similar to the productivity of artisanal fisheries, although the latter has been considerably more studied"* (Baran 2002-2012, p. 5).

Thus, for our purposes, we define subsistence fishing as a part of small-scale fisheries (see Table 1), and we will thus not discuss its separate estimation from that of the 'municipal' catch. However, we will consider 'gleaning' to be the gathering, for local consumption, of shellfish, invertebrates and shallow water or small fishes from the shoreline to the level of the receding tide, which may be performed with the use of implements or tools but without the use of boats.

To collect statistics or not, is the question …

Due to the archipelagic nature of the Philippines, with monsoon seasons affecting a huge amount of marine biodiversity (over 3,200 fish species and about 10,000 invertebrates)[19], no single (or small group of) species dominates its fisheries catches (Barut *et al.* 2003). In fact, even abundant taxa, such as '*galunggong*' (i.e., 'round scads', of the genus *Decapterus*) consists of different species, and different populations, caught in different parts of bays, gulfs and seas, depending on the season (Alix 1976); none of these, even if optimized in terms of increased biomass and lower fishing effort (and hence *higher* catches), would noticeably affect the total catch (Ronquillo 1975; Calvelo and Dalzell 1987).

The Philippines produces, publishes, and distributes annually immense amounts of extremely precise fisheries statistics (BFAR 2012b) that are readily cited by various non-government organizations (NGOs). However, the *real* catch of the marine fisheries is essentially unknown. Lack of funds and repeated reorganisations of the government divisions handling fisheries statistics prevented the establishment of a comprehensive fisheries data collection system dealing, to the same level of detail, with the catch of industrial, small-scale and subsistence fisheries (DNR 1976b; FIDC 1979). It took more than seven decades since the creation of the Division of Fisheries by the Philippine Commission under the Department of the Interior in 1901 (BFAR 2012a) before a structured fisheries statistics data collection system could be put in place (Chakraborty 1976). This was implemented after several training workshops for enumerators organized by the South China Sea Fisheries Development and Coordinating Programme in the mid-1970s (Chakraborty and Wheeland 1976). The first of a series of annual fisheries statistics accounting for all sectors was published by BFAR in 1977 (BFAR 2012a). Further changes in the governing institutions in the late 1980s transferred the responsibility of fisheries data collection from BFAR to the Bureau of Agricultural Statistics in 1988 (BFAR 2012a). Again, the continuous problems of funding, which has beset this sector in decades, prevented regular/consistent data collection until the 2000s with the support of foreign government aid (FAO-SEAFDEC 2005; Itano and Williams 2009).

'Commercial' landing statistics were collected since 1954 by the Bureau of Fisheries (which later became the Bureau of Fisheries and Aquatic Resources) for ten fishery districts (Simpson 1979), based on monthly catch reports of fishing operators. It was determined that these landings were "inadequate", and they were summarily corrected by an expansion factor derived from monthly landings collected by enumerators from randomly sampled survey areas to estimate regional and national production values (DNR 1976b). Already then, *the problem of obtaining reliable statistics of the catch and effort [… was] very real* (Simpson 1979, p. 3). Storer (1967, p. 366) clearly describes one of the major problems besetting data collection in Philippine fisheries, which sadly is still happening today:

"Formidable difficulties also arise from the fact that most of the data are collected as an adjunct to the taxation system. All commercial fishery vessels are supposed to land their catch at one of the official landings. The boats tend, however, to arrive at about the same time, between 0300 and 0400 hours, in order to take advantage of the early morning retail market. The great number of vessels, most of them small, and the rapidity with which the catch is disposed of, make checking by the few wardens a haphazard affair.

[19] Based on the August 2012 versions of FishBase (www.fishbase.org) and SeaLifeBase (www.sealifebase.org). Though these two online biodiversity information systems probably have the most recent checklists of species for the Philippines, they are by no means complete as work on recent expeditions, e.g., by the Muséum National d'Histoire Naturelle (Paris, France) and the California Academy of Science (San Francisco, California, USA), will add new species descriptions to this list.

Table 1. Types of capture fisheries considered in this study compared with terminology employed in the Philippines and some definitions regarding these.

Type of capture fisheries considered in this study	**Terminology used in the Philippines**	**Remarks**
Small-scale	*Municipal*	The term 'municipal' is associated with 'municipality', i.e., the local government authority.
Recreational	Rarely mentioned	Spear fishing (considered a destructive form of fishing along with dynamiting and is prohibited) in conjunction with water sports (snorkeling and diving) is practiced mainly by tourists (especially from Japan and Korea) though not monitored by local authorities. Hook and line fishing from yachts privately operated by individuals or through tourism (may also be associated with diving tourism) also occur occasionally, though again not monitored by local authorities (see Espedido *et al.* this volume).
Subsistence	Rarely identified; Usually referred to as 'sustenance'	Traditionally refer to the catching of fish either with or without the use of outrigger boats and/or canoes. True 'subsistence fishing' occurs in the Philippines in the form of reef gleaning (mostly for invertebrates), which is discussed at length in Palomares *et al.* and Cabanban *et al.* this volume.
Artisanal	Small-scale or municipal	Artisanal fishers are small-scale fishers who sell the bulk of their catch; see below
Large-scale/Industrial	*Commercial*	The term 'commercial' is associated with selling the landed catch, which is conceptually confusing, because artisanal fishers also sell theirs.
≈ 3 gross tons	Municipal/small-scale commercial	Motorized vessels of 3 gross tons and less have capability to fish offshore, but are also allowed to fish inshore (in municipal waters).
> 3 gross tons	Small-scale commercial	Before the 1980s, only two categories were used in reporting the catches, i.e., boats >3 gross tons were considered commercial. Recent re-categorizations provide for a gradation of operations, as presented here.
> 20 gross tons	Medium-scale commercial	Recent categorization.
>150 gross tons	Large-scale commercial	Recent categorization.

Operators of such vessels are also required to provide a monthly tally of the catch and to pay on the basis of this, 2 pesos per ton to the Fisheries Commission. In addition, on the basis of the same catch data, they are supposed to pay the Bureau of Internal Revenue a tax of 7 per cent of the value of the catch (ex-vessel price). The pressure of these two tax measures tends to distort the reporting of the data; the underreporting of the volume of the catch and a downgrading of the species of fish caught in order to provide, for the record, a lower value of fish landed. The estimates of the extent of this downward bias vary but they have run as high as 50 per cent on the volume and even higher on the value.

A further problem in obtaining reliable statistics is that the jurisdiction of the fisheries is divided between the federal government and municipalities. (The provincial governments have no authority in this instance.) The federal government licenses all boats of over 3 gross tons […]. *On the other hand, the largest proportion of the total volume of catch is ascribed to the category of municipal or sustenance fishing. Over this fishery there is no effective control or statistical reporting. A tremendous degree of "guesstimating" enters into the statistical development of this component."*

Small-scale fisheries catches were estimated from only six municipal reports since 1951, which was discontinued later on (FIDC 1979). Since the 1960s, the catch of municipal fisheries has been estimated from the same fixed ratio for the relationship between small-scale and industrial catches (FIDC 1979). This ratio most likely originated from the projected increase of fisheries catches to respond to domestic demand, i.e., 6-7 %, needed for self-sufficiency in fish by 1976, and thus, for surplus production by 1977 (DNR 1976b).

Thus, it appears that even before the conjugal dictatorship of Ferdinand and Imelda-she-of-the-shoes-Marcos, the fisheries statistics generated showed regular catch increases, a distortion which has not been addressed since democracy was somehow restored in 1986.

MSY, CPUE, and what we actually know about catch trends

Numerous assessments of the status of fisheries in the Philippines were conducted, especially in the 1980s, when the International Center for Living Aquatic Resources Management (ICLARM), then based in the Philippines, was very active. These analyses can be grouped into three categories:

i) Surplus-yield models pertaining to the demersal and/or pelagic fish of a local fishing ground;
ii) Single- or multispecies yield-per-recruit analyses pertaining to a given fishing ground;
iii) Philippine-wide analyses based either on data such as used in (i), (ii), or other approaches.

Though they tend to provide over-optimistic results (Pauly 1986), simple surplus-yield models (Schaefer 1954; Fox 1970) can be, and were used extensively in the Philippines, to assess the status of multispecies stocks and the demersal or pelagic fisheries exploiting them (Dalzell *et al.* 1987; Culasing 1988; Silvestre and Pauly 1997). These models, in the aggregate, suggested that the majority of fishing grounds in the Philippines, which were extremely productive in the 1950s and 1960s (Butcher 2004), were overfished by the late 1970s and/or 1980s.

This is confirmed by yield-per-recruit analyses, i.e., analyses of the 'yield' (or catch in weight) that could be obtained by letting individual fish grow to their optimum size, i.e., by regulating not only fishing intensity, but also mesh sizes, which determines size at first capture (Beverton and Holt 1957; see Figures 17 and 19). Analyses of this sort can be performed without detailed catch time series, given that the size composition of the catch is available (length-frequency data; Pauly 1998a). In fact, methods to analyze length-frequency data were developed throughout the 1980s by ICLARM (Pauly and Morgan 1985, 1987), and were applied to a vast number of stocks (see e.g., Floyd and Pauly 1984). Jointly, these

analyses confirm that from the 1980s onwards, Philippine marine fishes were massively 'growth overfished' throughout the country.

Conclusions

Considering the above assessment of the fisheries statistics of the Philippines, the report of which this contribution is a part, we will attempt to re-estimate catch statistics which may better approximate the catch that was actually realized. The methodology applied for this is detailed in the next contribution, by Palomares and Pauly (this vol.) and its applications to 4 groups of regions, each representing about a quarter of the Philippine EEZ ('subzones'), of different fisheries types (small-scale, industrial and gleaning) in the subsequent contributions. A final contribution by Palomares and Pauly (this vol.) then combines these regional catch estimates into a new reconstruction of the total marine catch of the Philippines, and discusses some of its implications.

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Reconstructing Philippine marine fisheries catches: a rationale and a methodology[20]

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Abstract

The standard methods developed by *Sea Around Us* for catch reconstructions are presented and adapted to Philippine conditions. Artisanal catches were reconstructed using independent (from national statistics) estimates of annual catch per fisher and national fisheries census estimates of number of fishers. Subsistence fishing was equated with gleaning and annual catch per gleaner estimates were combined with the number of subsistence fishers (assumed to be women and children aged 10-14 in rural coastal communities) to obtain subsistence catches. Industrial catches were obtained from national statistics estimates with a top up of 20-40 %, assuming that, on average, 30-50 % of the total industrial catches are unreported. It was assumed that discards, where they are reported, are small and usually made up of incidental catches of whales, dolphins, sea turtles and sea snakes, and thus can be largely ignored from this analysis.

Rationale

The world's fisheries are in crisis – everybody knows that. This crisis is frequently reported in terms of the fate of individual species or groups – bluefin tuna turned into sushi, or sharks used for shark fin soup. Actually it is the demise of marine ecosystems that we are facing, i.e., of the systems in which these and other fishes are embedded, and which enable them to maintain themselves. And marine ecosystems, throughout the world, do much more than support emblematic food species; notably they produce the prey of marine mammals and seabirds, and last but not least, support thousands of fishers who contribute to the food security of over 1 billion people, besides providing jobs – directly or indirectly – to hundreds of millions.

But what do we know about global fisheries? Essentially, all we know is what member countries choose to report to the Food and Agriculture Organization of the United Nations (FAO) – and that is not much. Contrary to the situation prevailing with other major food commodities (e.g., rice), for which numerous databases exist (FAO, Rome; U.S. Dept. of Agriculture, Washington DC; International Centre for Rice Research Institute, Los Baños, Philippines), there is only one global database for fish captures, that of the Food and Agriculture Organization of the United Nations (FAO).

Research conducted in the last 10 years by *Sea Around Us* of the University of British Columbia shows that the FAO database of fisheries catches is deficient (Watson and Pauly 2001), not in regards to quibbles one could have with this or that country's estimate being imprecise, but profoundly, such that policy decisions based on its numbers are fundamentally misleading (Zeller and Pauly 2005; Zeller *et al.* 2007; Jacquet *et al.* 2008; Jacquet *et al.* 2010; Varkey *et al.* 2010; Le Manach *et al.* 2012). This also applies to the Philippines, whose catch statistics, notably because their collection is closely associated

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with the collection of taxes (see Palomares *et al.* this vol.), are widely seen as inaccurate. The contributions in this report will provide the basis for a hopefully more accurate 'reconstructed' marine catch time series for the Philippines.

Methodology

Fisheries catch statistics are the basic blocks in the management of fisheries resources. Thus, we cannot but reiterate the importance of reliable statistics in structuring viable resource management strategies, notably in the setting of catch limits, in the implementation of fishing restrictions, and in predicting the capacity of the fisheries resources to supply fish demand within and outside of a country. Maximum sustainable yield (MSY) and total allowable catch (TAC) were identified by the Philippine Fisheries Code of 1998 (Chapter I Section 2d; Chapter II Section 7)[21] as limiting factors to the development of the fisheries. Unfortunately, even in cases where data are available, the use of MSY is not *"extensively applied in practice"* because of the lack of baselines and the associated scientific training and understanding needed to establish these baselines (Lugten and Andrew 2008, p. 30). Furthermore, the amorphous definitions applied to the different fisheries sectors highlighted in Palomares *et al.* (this vol.) make it difficult to separate the catches of these sectors, notably by trawlers of 3GT, which are considered small-scale (i.e., 'municipal' in the Philippines), operating outside and within the municipal water boundaries. We thus cannot take the statistics presented by the FAO for the Philippines at face value because we know that there are inherent problems associated with their assembly.

The reconstruction process we employed for the Philippines applies a specific terminology used in the different sectors of the marine capture fisheries of all maritime countries (Table 1). This terminology is used throughout this report to avoid the confusion caused by the local usages. The reconstruction methodology described in Pauly (1998) and laid out in Zeller and Pauly (2007) was modified to account for the bias created by the inadequacies inherent in the national marine capture fisheries data collection scheme, following the steps below:

1. National and FAO catch statistics were assembled for the Philippines and the transfer of official data from the Philippines to FAO was assessed by comparing these two data sets;
2. The national statistics assembled in (1) were separated for each region, lumped into 4 subzones (see Figure 1) and categorized as *industrial* and *artisanal* fisheries; any recorded or observed discards were added to industrial fisheries (see Appendix A);
3. Number of fishers by sector were obtained from Census of Fisheries reports by the National Statistics Office of the Philippines (NSO) and from the Census of Population and Housing reports of the NSO (see Appendix B);
4. Estimates of daily and annual artisanal catch per fisher (c/f) per subzone were assembled from the literature and used to define temporal trends of c/f;
5. Artisanal catches in (2) were replaced by the product of the predicted number of fishers from (3) and the predicted catch per fisher from (4) for the 1950-2010 period;
6. Subsistence and gleaning catches missing from (1 and 2) were estimated independently, as were recreational catches; Catches obtained in (2), (5) and (6) were summed up by region to obtain the Philippine total catch time series from 1950-2010 (see Appendix C);
7. Catches in (6) were disaggregated by major species groups exploited by the Philippine marine fisheries fleets using average percent species composition of the reported catch by decade (see Appendix D); the species composition of the nearest decade was employed in cases where no data is available, e.g., the 1960s species composition was assumed similar to, and thus used for the 1950s.

[21] http://www.bfar.da.gov.ph/pages/Legislation/fisheriescodera8550.html

Note that the national data collection scheme for industrial fisheries represents a longer time series and is based on monthly fish catch reports of registered operators in major ports or landing centers (which was later extended to minor ports; see also Palomares *et al.* this vol.). The compiled and consolidated statistics were raised to a factor of 3 (during the experimental stage of data compilation by the Bureau of Agricultural Statistics in 1988); this correction factor was increased to 4 (in the 1990s) to account for the underreporting of catches (E. Ocampo, Bureau of Agricultural Statistics, Municipal Fisheries Statistics Section pers. comm.). Given this information, and some indications of the extent of underreporting from published sources, we assumed that the national statistics for the industrial sector can be accepted, with corrections as noted in (2) above.

The same, however, cannot be assumed for the artisanal catches because this sector has not been properly monitored for the reasons mentioned in the above rationale and given in Palomares *et al.* (this vol.). A data collection system analogous to that of the industrial statistics data collection scheme for the artisanal sector was implemented only after 1976. However, the sampling design only required the monthly data collection from 6 major ports and 3 minor ports out of the almost 2,000 municipal landing sites (E. Ocampo pers. comm.). Ports for sampling are selected using a table of random numbers. Sampling did not come from the monthly catch reports of registered operators, but from results of interviews conducted by data enumerators with individual fishers landing their catch at the selected sites (E. Ocampo pers. comm.). We consider this method inadequate, which justifies our step (3) above.

This data collection method also renders difficult the collection of catch from subsistence fishing and even less likely the catch from gleaning. To obtain reliable data on this sector, separate studies were conducted, specifically on gleaning in 3 regions complemented with scattered data available from studies in other regions. The number of gleaners (i.e., women and children in coastal villages) was obtained from national census reports, where available. This enabled estimation of the ratio of the artisanal fishing population that is composed of women and children (aged 10-14 years) by region. Regional estimates of the number of women and children were then multiplied with the set of Philippine-wide average of annual catch per gleaner obtained from the regional studies.

Illegal, unreported and unregistered (IUU) fishing is discussed in some reports outside of government monitoring schemes (see Philippine report in Ganapathiraju *et al.* 2008). Storer (1967) noted that in the 1960s, unreported catches may have been as high as 50 %, though it varied according to the value of the target species. Davies *et al.* (2009) estimated a 31.2 % bycatch of juvenile fishes of the total landed catch by the marine fisheries in 2000-2003 caught by the illegal (as per Fisheries Administrative Order No. 237) small-meshed nets used by the bottom trawl fleet. An informant, who has worked most of his adult life within the fishing industry, observes that, as far as he can remember, in areas where offshore (handline, longline and purse seine) fisheries are predominant, the common practice is to report only 70 % of the catch, most probably leaving out bycatch of large pelagics, like marlins and billfishes, protected under the CITES, e.g., 14 % of the non-tuna catch of Philippine handliners (Gillett 2011). Thus, our sources appear to agree that the level of IUU catches may be around 30 %. The raising factor (average of 10.5 %; see Appendix A for calculations of differences between FAO and national statistics) applied by the national government to adjust landings reported by the industrial fisheries, where illegal fishing (e.g., *muro-ami* or juvenile tuna caught with fish aggregating devices, see Bailey *et al.* 2012), is most likely to have an impact, may already correct for this. Thus, by accepting this raising factor, our estimate of illegal fishing will be that fraction of the catch added by the raising factor applied to industrial catches, plus an additional 20 %, which accounts for the estimated 30 % underreporting.

Table 1. A guide to terms employed in this report and caveats on their use.

Term	Definition	Remarks
Production	1) The elaboration of biomass through anabolic processes (e.g., primary production; fish growth); 2) The sum of fisheries and aquaculture yields.	'Production' should not be used for fisheries catch, as fishing doesn't produce fish; aquaculture may be viewed as 'producing' fish.
Catch(es)	The fish killed by a fishing gear, whether this fish are eventually landed or not.	'Catch' is often used instead of 'landings', but this omits fish that were discarded.
Bycatch	Fish that are caught by a gear without being targeted. Bycatch may be landed or discarded.	The term 'bycatch' should not be used when discards are meant, and vice-versa.
Discards	Fish that are discarded, i.e., that are caught, but not landed.	Discards are not equivalent to 'bycatch'. In fact, some of the targeted fish may be eventually discarded, i.e., at 'high-grading'.
IUU	Illegal, Unreported and Unregulated (fishing or catch).	IUU should not be used as a shorthand formula for 'illegal' fishing. In fact, it is probably *unreported* fishing that generates the highest IUU catches. Fishing conducted using 'prohibited' gear, e.g., dynamite, cyanide, spear fishing, small-meshed nets, etc. maybe reported as 'illegal' within the artisanal sector. Fish obtained by *muro-ami* fishing maybe reported as 'illegal' within the industrial sector.
Landings	The fraction of the catch that is brought to landing places and recorded.	Usually, in reports and databases (including FAO's 'catch' database), it is 'landings' that reported on, not catches.
Fishes	Usually members of the vertebrate class 'Pisces' when fisheries are discussed.	'Fish' can also include aquatic invertebrates such as shrimps and cephalopods but not plants and marine mammals, though these might also be included in the FAO database.
Artisanal	Small-scale fishing conducted in view of selling the catch; fishing effected within municipal waters, i.e., inshore, with gears used typically by the artisanal fleet.	Also referred to as 'municipal'. The definition of artisanal fishing in the Philippines is of the fleet of boats weighing 3 gross tonnes and less. This definition does not account for the fact that boats of 3 t can deploy gears (such as bottom trawls) similar to those deployed by industrial vessels.
Industrial	Fishing by large vessels, whose catch is landed in fishing ports.	Also referred to as 'commercial'. This is here considered to also include boats of 3 t deploying dragged gears such as trawls either within or outside of municipal waters.
Recreational	Fishing conducted mainly for enjoyment (Cisneros-Montemayo and Sumaila 2010)	Includes fish caught by spear (with and without SCUBA) and line fishers (in and out of tournaments).
Subsistence	Fishing effected within municipal waters, and where the bulk of the catch is used for household consumption.	Fishing for fish with or without the use of motored and/or non-motored boats. If the catch is sold at a landing center, e.g., to cover the cost of fishing, is considered artisanal.
Gleaning	Picking of invertebrates for consumption.	Usually, picked invertebrates are consumed and not sold. However, existing fisheries for the shell and sea cucumber industries are considered industrial.
Municipal waters	Within 15 km of the shoreline and/or in waters not more than 13 m deep.	Waters deeper than 13 m, irrespective of their distance from the shoreline are trawlable and may be exempted from this municipal definition; the lifting of this limit is decided on by the governing municipal authority.

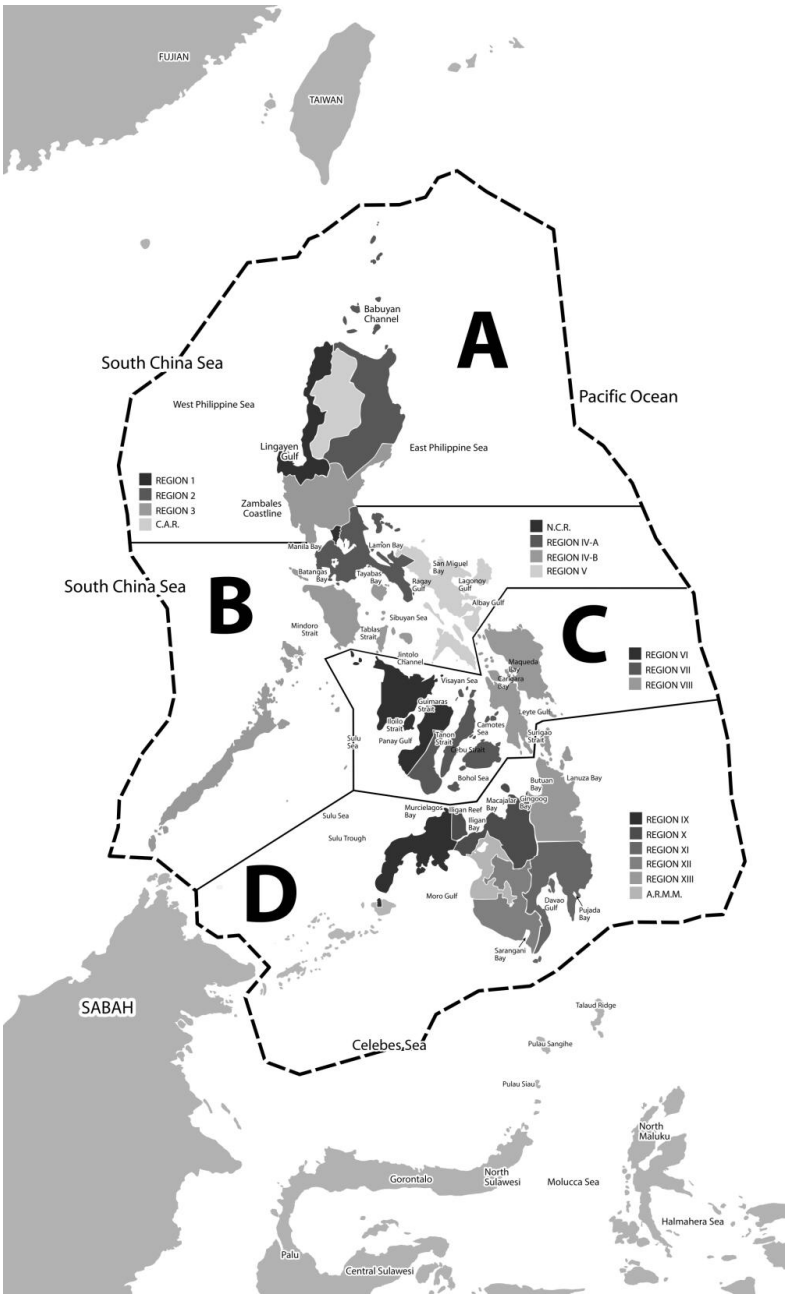

Figure 1. The UNCLOS mandated Philippine Exclusive Economic Zone (EEZ) of the Philippines, showing the four 'subzones' (A-D) to which we have allocated the 15 administrative regions and 84 maritime provinces reporting marine landings to the Bureau of Agricultural Statistics (redrawn by Mr. Mike Yap from a composite of several open source maps).

There are in the Philippines very few instances where discarding is practiced (Kelleher 2009). Matsuoka (2008) estimated the discards in the Philippines to have made up 0.1% of the national catch in 2005. Selorio *et al.* (2008) estimated a 3% discard rate for the stationary lift net fishery in Panay Gulf, which targets sergestid shrimps, sardines and anchovies (notably juvenile fishes; see also Pauly 1996). Anon (1993) reported an average of 1.76% bycatch, with an average of 1.05% tuna discards and 0.38% other

species discards (albacore, blue marlin, kawakawa, mackerel, rainbow runner) by the tuna purse seine fleets for the period 1975-1991. However, most fish bycatch by both artisanal and industrial sectors is used (Anon 2006), either for fish meal production or dried fish processing, fermented fish products (Owens and Mendoza 1985), convenience food (Marfori *et al.* 1991) or, in some offshore industrial fishing operations, given to fishers as their take home in-kind remuneration in addition to their salaries when the catch is a particularly good one (Mr. Pablo Mendoza, an octogenarian and retired fisher from Mabini, Batangas pers. comm.). Thus, it is safe to say that there are practically no discards in Philippine marine capture fisheries, and if there are, they would be composed of non-fish bycatch, i.e., sea turtles (Bagarinao 2011), whales and dolphins (Dolar 1994).

Materials

FAO marine capture fisheries statistics pertaining to the Philippines were downloaded from the FAO website. National statistics were obtained from annual reports issued by the different government agencies, mainly the Bureau of Fisheries and Aquatic Resources (BFAR), which handled the collection of fisheries statistics in the Philippines. Table 2 presents these data sources and indicates the period and sector each data source covered.

Table 2. Sources of official and national statistics on total annual Philippine marine capture fisheries used in this analysis (see Appendix A for detailed national statistics).

Year/Period	Reporting agency	Remarks
1950-2010	Food and Agriculture Organization (UN)	Total marine landings
1951-1979	Bureau of Fisheries and Aquatic Resources	Marine artisanal and industrial fisheries landings
1980-2011	Bureau of Agricultural Statistics	Marine artisanal and industrial fisheries landings

Using regional statistics for the reconstruction of artisanal fisheries catches

In order to reduce the bias created by the (non-) random sampling design mentioned above for artisanal fisheries, and to establish the behavior of and trends in the fisheries of each region, the catch statistics specific to the 15 Philippine regions were grouped into the four subzones of Figure 1, as shown in Table 3. These subzones basically represent northern Luzon (A), southern Luzon including Palawan and its associated islands (B), the Visayas group of islands (C) and Mindanao, including the small island group of Tawi-Tawi (D). The fisheries of each subzone vary according to the resources and the topography of the coast. Thus, descriptions of the regions included in each subzone form parts of the four chapters dealing with the artisanal catch reconstructions. This is complemented by 2 chapters dealing with gleaning and one devoted to recreational fishing, which are followed by a synthesis chapter which also discusses the industrial fisheries.

Using independent estimates of annual catch per fisher

Pauly (2000), based on data in *Censo de las Islas Filipinas* (1905), calculated that in 1900, the average annual catch per fisher (c/f) was 4.2 t, given a countrywide catch of 500,000 t, and a number of fishers estimated at 119,000. This 1900 estimate was used as the baseline for the annual c/f for the Philippines as a whole, for artisanal fisheries.

Estimates of annual catch and number of fishers were obtained from the scientific literature, e.g., of distinct fisheries (Pauly 1982; Campos *et al.* 1994). Annual catch per unit effort from different studies,

when available, were used to estimate c/f. These were averaged if multiple studies were available for a year, or in blocks of 3-5 years. These estimates were obtained using one of the following steps:

- Stable estimates of catch per day were obtained and multiplied with the number of days fished by artisanal fishers per year;
- Total annual municipal catch in a given area (without the number of fishers) was obtained and divided by the number of fishers in that small area;
- Gross income of small-scale fishers in a given area was divided by the average ex-vessel price of fish, to infer the average c/f.

Table 3. Philippine administrative regions and the size of their constituencies measured in the number of provinces, cities, municipalities and inhabitants. These 15 regions represent 80 provinces, 140 cities and 1494 municipalities. Note the importance of subzones B and C (with large 'inland seas') in terms of number of municipalities, and thus number of potential fishers. Data from the National Statistical Coordination Board (www.nscb.gov.ph), with population data for 1 May 2010.

Region	Name	Zone	Provinces	Cities	Municipalities	Population (millions)
I	Ilocos	A	4	9	116	4.75
II	Cagayan Valley	A	5	3	90	3.23
III	Central Luzon	A	7	13	117	10.1
IV-A	CALABARZON	B	5	16	126	12.6
IB-B	MIMAROPA	B	5	2	71	2.74
V	Bicol	B	6	7	107	5.42
NCR	National Capital Region	B	0	16	1	11.9
VI	Western Visayas	C	6	16	117	7.10
VII	Central Visayas	C	4	16	116	6.80
VIII	Eastern Visayas	C	6	7	136	4.10
IX	Zamboanga Peninsula	D	3	5	67	3.41
X	Northern Mindanao	D	5	9	84	4.30
XI	Davao	D	4	6	43	4.47
XII	Soccsksargen	D	4	5	45	4.11
XIII	Caraga	D	5	6	67	2.43
ARMM	Autonomous Region in Muslim Mindanao	D	5	2	116	3.26

Linear regression analyses of c/f versus year were performed in cases where at least 10 independent c/f estimates were available per area. In cases where the c/f estimates varied widely, a line was drawn which linked the geometric mean of the available, more recent estimates and the 1900 base value. The resulting empirical equations were used to predict annual c/f values for 1950-2010, the period equivalent to available FAO and national statistics data. In cases where only 2-3 c/f estimates were available, interpolations between available estimates were obtained using the slope of two values, i.e., $Catch_{year2} - Catch_{year1}$ / $Year_2$-$Year_1$, in order to fill in gaps within the 1950-2010 period.

In cases where estimates of annual c/f were not available for a given area, values between adjacent subzones within a group were interpolated. However, this rule was not followed for c/f estimates between the four subzones because the fleet and target species between non-adjacent areas are assumed to differ. Thus, it was imperative that at least one region in each subzone had a good c/f estimate, representative of, or typical of, the fishery in that region.

This methodology was also applied to subsistence catch, with Palomares *et al.* (this vol.) and Cabanban *et al.* (this vol.) included, for their respective subzones, as independent estimates of catch per gleaner. The

estimate of 5.2 $kg \cdot gleaner^{-1} \cdot day^{-1}$ obtained by Palomares *et al.* (this vol.) was used as the baseline, i.e., the highest catch (made up of a variety of fish and invertebrates) estimated for Subzone B for 1950, for subsistence catch.

Using demographics data to estimate annual number of artisanal and subsistence fishers

Provincial population and household reports published by the National Statistics Office (NSO) of the Philippines for 1970, 1980, and 1995 were used to obtain fisher population estimates. The number of urban and rural fishers were disaggregated into fishers (both female and male) 10-14 years of age, female >=15 years old and male >=15 years old. In addition, Census of Agriculture and Fisheries (CAF[22]) reports from the NSO for 1970 and 1980 were consulted to obtain the number of fishing operators and their household members by region. The CAF reports identified fishers according to the sector, age group and gender, and amount of time spent fishing. In 2012, the National Statistics Office launched the Registry System in Basic Sectors in Agriculture (RSBSA), a system that "*aims to list and register farmers, farm labourers and fisherfolk nationwide and gather basic information on them*"[23]. The NSO via Mrs. Carmelita N. Ericta (Administrator) kindly provided us with the 2012 RSBSA results of the number of registered fishers for a preliminary batch of 20 provinces (see Appendix B). Finally, independent estimates of the total number of fishers in the Philippines by the FAO (Villareal *et al.* 2004) and SEAFDEC (2012) permitted comparison with those obtained from the NSO reports.

These data sets were assembled (Appendix B) and used to estimate the average proportion of artisanal and industrial fishers as well as the average proportion of women and children in fisher communities per region. Several assumptions were made, viz.:

- Children 10-14 years of age were most likely gleaning with their mothers; thus, unless explicitly categorized, e.g., children employed in *muro-ami* operations, both groups were included in the subsistence fishers group;
- Male rural fishers ages >15 years, if not explicitly categorized in a sector, were included in the artisanal fishers group; fishers employed in major urban areas were assumed to be employed by the industrial fishing sector; this classification was applied to number of fishers data from the Census of Population and Housing reports of the NSO;
- Full-time (or permanent) fishers were assumed to work all-year round in the fishery and thus given a weight of 1; part-time fishers were assumed to work only half of the year and thus given a weight of 0.5; occasional (or peak season) fishers are assumed to be employed only during the peak periods (about 3 months of the year) and thus given a weight of 0.25; this weighting system was applied to number of fishers data from the Census of Fisheries reports of the NSO;
- The crew of vessels <3 gross tons (GT), non-motorized vessels or those fishing without vessels and selling their catch were classified as artisanal fishers, while those who report that they fish for their own consumption were classified as subsistence fishers;
- The crew of vessels =3GT were divided into 2, one half was added to the number of artisanal fishers and the other half to the number of industrial fishers, because these fishers do not board industrial fishing vessels the whole year and tend to join the artisanal fishing fleet when small industrial vessels are grounded during the monsoon season. Note, however, that the catch of such vessels (e.g., 'baby trawlers') are considered only as industrial catch;
- The crew of vessels >=3GT were classified as industrial fishers; the vessel crew classification system was applied to number of fishers data from the Census of Fisheries reports of the NSO.

[22] See http://www.census.gov.ph/content/census-agriculture-and-fisheries-caf for more details on this census.
[23] See http://www.pia.gov.ph/news/index.php?article=2261347935359 for more details on this system.

The resulting annual number of fishers/sector/zone (Table 4) were analyzed to obtain the various estimates. The rate of change in the total number of fishers extracted from NSO reports for 1970 and 1995 ($Nfishers_{1995}$-$Nfishers_{1970}$ / 1995-1970) was used to back-calculate to 1950, interpolate between 1970 and 1995 and forward calculate to 2010. The rate of change of the proportions of artisanal, subsistence and industrial fishers in the total fishing population from the NSO reports estimated for 1970 and 2012 were used to interpolate between 1970 and 2012 and to extrapolate to 1950. Finally, the numbers of fishers obtained from the previous interpolations were multiplied with the interpolated proportions to obtain the number of artisanal, subsistence and industrial fishers.

Table 4. Annual number of fishers/sector/zone estimated from data extracted from reports of the National Statistics Office (details in Appendix B) and total number of fishers in the Philippines from different sources with proportion of artisanal, subsistence and industrial fishers in % of total.

Subzone	Year	Total (10^3)	Artisanal (%)	Subsistence (%)	Industrial (%)
A	1970	50.2[a]	66.3	5.99	27.8
	1980	125.8[a]	53.5	44.8	1.63
	1995	101.4[a]	–	–	–
	2012	21.7[b]	47.7	52.1	0.196
B	1970	130.9[a]	61.3	4.44	34.2
	1980	152.9[a]	38.2	53.2	8.53
	1995	291.9[a]	–	–	–
	2012	114.1[b]	42.6	26.6	30.8
C	1970	162.0[a]	71.4	6.63	22.0
	1980	189.0[a]	46.4	49.2	4.34
	1995	297.9[a]	–	–	–
	2012	109.9[b]	36.6	36.3	27.1
D	1970	109.7[a]	68.1	9.48	22.4
	1980	168.5[a]	40.0	55.9	4.14
	1995	254.5[a]	–	–	–
	2012	129.1[b]	49.4	17.4	33.3
Philippines	1970	452.7[a]	67.1	6.61	26.3
	1970	399.9[c]	–	–	–
	1977	671.9[d]	–	–	–
	1978	427.1[d]	–	–	–
	1980	636.1[a]	44.2	51.1	4.76
	1980	431.4[d]	–	–	–
	1980	904.0[c]	–	–	–
	1983	638.3[d]	–	–	–
	1984	628.8[d]	–	–	–
	1985	615.8[d]	–	–	–
	1986	638.0[d]	–	–	–
	1990	958.2[c]	–	–	–
	1995	945.6[a]	–	–	–
	2012	374.8[b]	43.5	27.8	28.8

[a]Estimates from reports of the National Statistics Office. [b]Estimates from RSBSA, represent only 25% of the coastal provinces and were thus not used in the interpolation process for annual number of fishers. [c]Estimates of total number of municipal fishers from Villareal *et al.* (2004). [d]Estimates of total number of fishers from SEAFDEC (2012).

Figure 2 summarizes the results of this analysis, which were in turn used as multiplier to the predicted c/f/year/subzone obtained from individual estimates of c/f as discussed above, to reconstruct annual catches per subzone. Subzone A (covering the northern half of the island of Luzon) shows the least number of fishers (average of 14% of the total) in the Philippines among the four zones. Zones B-D represent, at an average, 28, 32 and 26%, respectively. These results are concurrent with population estimates of coastal municipalities for 1995 and 2000 from Rivera *et al.* (2002), summarized in Table 5.

Table 5. Percent distribution of Philippine coastal municipality populations summarized from Appendix 6 of Rivera *et al.* (2002, p. 110-125).

Region	Subzone	1995	2000
1	A	7.90	6.93
2	A	0.27	NA
3	A	4.64	3.84
Subtotal		12.8	10.8
4	B	17.7	19.0
5	B	11.9	11.2
NCR	B	0.99	1.03
Subtotal		30.6	31.3
6	C	9.74	11.0
7	C	12.0	14.1
8	C	10.1	5.99
Subtotal		31.9	31.0
9	D	6.05	5.28
10	D	3.14	3.58
11	D	5.24	6.01
12	D	2.47	2.72
13	D	3.40	3.83
ARMM	D	4.46	5.45
Subtotal		24.8	26.8
Total number of fishers		23,205,458	22,327,156

Disaggregating total annual catches to species groups

The annual catches resulting from the reconstruction process were disaggregated taxonomically; therein, we assumed that the catch composition of the original national statistics data applies. Thus, our reconstructed catch composition reflects the changes made in the taxonomic detail according to the national statistics collection scheme, which tended to change every decade. However, to standardize the taxonomic groups across collection schemes, we categorized earlier taxonomic groupings to fit current ISCAAP groups through their English common names. Percent catch composition values were averaged by decade and used to disaggregate the annual total catches.

Exceptions to the rules

Annual catch per fisher estimates from studies conducted in marine protected areas (MPA) are not included in the artisanal catch. However, annual estimates of catch per fisher before the creation of an MPA were used and added to the total catch of the region where the MPA is located.

Aquarium fisheries are completely excluded from this analysis though their catch might be mentioned in the text of the various contributions in this report. Finally, marine mammals, reptiles and marine plants were excluded from the analysis.

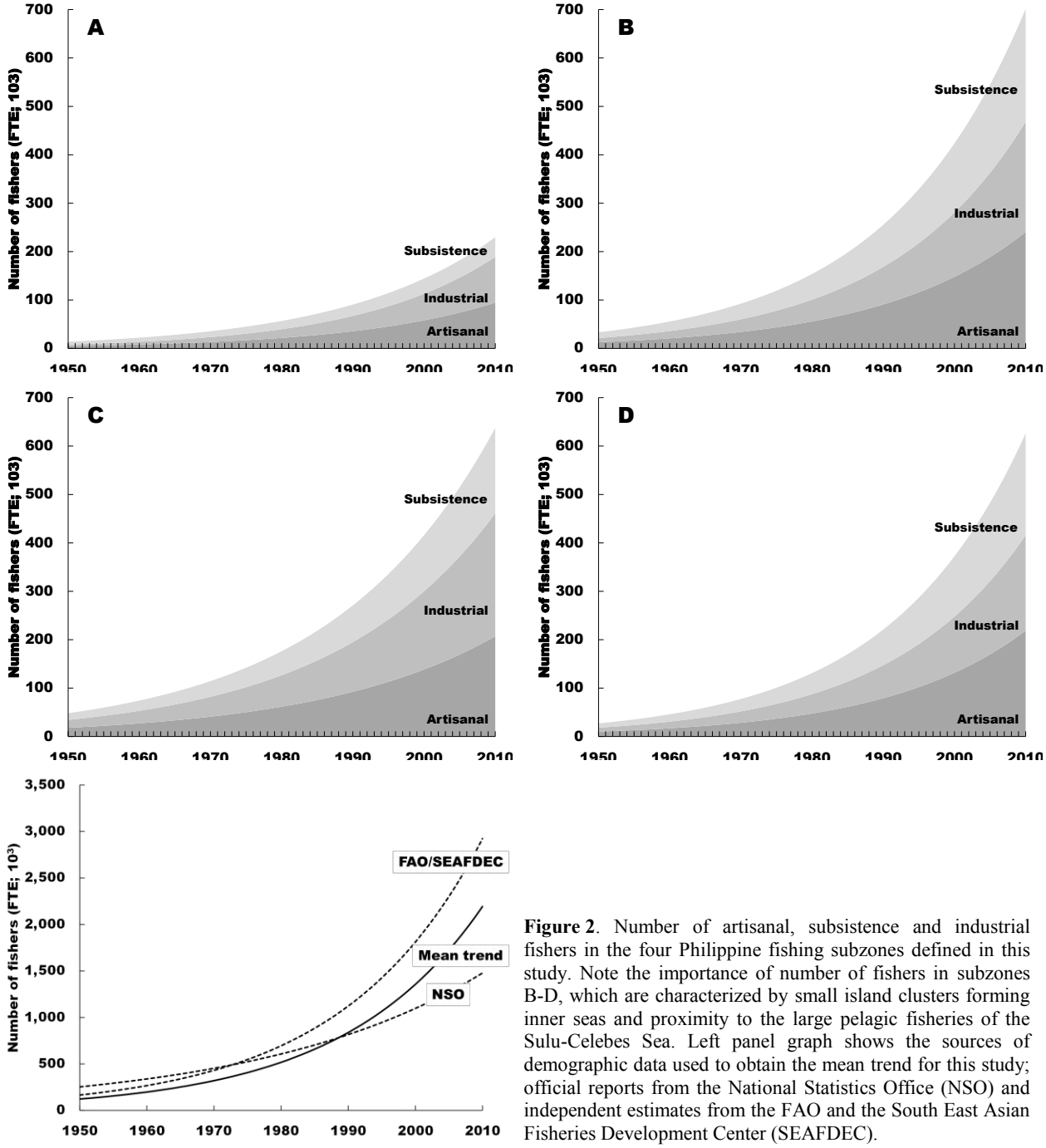

Figure 2. Number of artisanal, subsistence and industrial fishers in the four Philippine fishing subzones defined in this study. Note the importance of number of fishers in subzones B-D, which are characterized by small island clusters forming inner seas and proximity to the large pelagic fisheries of the Sulu-Celebes Sea. Left panel graph shows the sources of demographic data used to obtain the mean trend for this study; official reports from the National Statistics Office (NSO) and independent estimates from the FAO and the South East Asian Fisheries Development Center (SEAFDEC).

Summary

Given that catch statistics for the Philippine artisanal marine capture fisheries are considered defficient, alternative data sets were reconstructed based on two types of data, i.e., (i) empirical trends of estimates of annual catch/fisher for the different fisheries within a subzone, and which are independent of government mandated statistics; and (ii) the number of fishers/sector/subzone from national demographic censuses. The national statistics for the industrial marine capture fisheries sector was accepted as baseline estimates, topped up by 30% for the period 1950-1960 and by 20% for the period 1970-2010 to account for unreported catches. Disaggregation to target species or groups of species followed ISCAAP groupings, expressed as average proportions of these species/groups in the total landings by decade, i.e., 1960s, 1970s, 1980s, 1990s, 2000s. The catch composition obtained for 1960 was used for the 1950s.

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Marine artisanal fisheries of the Philippines, Subzone A – northern Luzon (Regions I, II and III)[24]

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Abstract

Independent estimates of daily catch per fisher from La Union (Region I), Pangasinan (Region I) and Zambales (Region III) were obtained from 12 published sources. The artisanal fisheries were classified into non-tuna and tuna fisheries and subsistence catch distinguished from the artisanal catch. These data indicated a breadth of non-tuna catches from 0.16 $kg \cdot day^{-1} \cdot fisher^{-1}$ to 8.54 $kg \cdot day^{-1} \cdot fisher^{-1}$ (n=17, s.e.=2.52, covering 1980-2010) and tuna catches from 0.15 $kg \cdot day^{-1} \cdot fisher^{-1}$ to 12 $kg \cdot day^{-1} \cdot fisher^{-1}$ (n=13, s.e.=3.90, covering 1998-2010). These data sets were compared, using log-transformed regression analyses, to the 1900 estimates of 19.7 $kg \cdot day^{-1}$ $fisher^{-1}$ (standardized to 213 fishing days as currently practiced in the region) for the non-tuna, and 25 $kg \cdot day^{-1}$ $fisher^{-1}$ (standardized to 166 fishing days) for the tuna fisheries. Results indicate decreasing trends in daily catches per fisher from 1950 to 2010, with rates of change at 76 % for non-tuna and 80 % for tuna fisheries. Only two estimates of subsistence catch were obtained, which when compared to the baseline of 5.2 $kg \cdot day^{-1} \cdot fisher^{-1}$ in a log-transformed regression analysis, gave subsistence catch estimates of 10,043 t (1950) to 13,640 t (2010). Total artisanal catch for the subzone estimated as the product of predicted daily catch per fisher, number of fishers and average number of fishing days in a year resulted in a reconstructed time series with catches from 8,656 $t \cdot year^{-1}$ (1950) to 38,438 $t \cdot year^{-1}$ (2010) and an average 28 % increase per decade. The reconstructed total catch was then separated into species components using the percent species composition of reported artisanal fisheries statistics for the subzone. This data suggests that yellowfin tuna is the most important exploited species in the subzone over the three decades for which this data was collected (1980s to 2000s). Slipmouths, included among the seven taxa making up 90 % of the catch in the 1980s slipped from 5th (1980s) to 19th (2000s) most important taxon in the catch, while anchovies, *Acetes*, round scads, hardtails and skipjack tuna are consistently among the groups contributing 90 % of the catch.

Introduction

Northern Luzon, hereafter referred to as Subzone A (see Figure 1), is subdivided into three administrative regions (I, II and III) covering the northern tip of the island of Luzon . For the purposes of this study, we exclude the Cordillera Administrative Region (CAR), a landlocked area of the Cordillera Mountains.

Region I, the Ilocos region, was created in 1972 by then President Ferdinand E. Marcos under Presidential Decree No. 1.[25] The four provinces making up this region, i.e., Ilocos Norte, Ilocos Sur, La Union, and Pangasinan, covers a total land area of 12,840 km^2 – about 4.3 % of the country's total land area – with

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[25] Regional profile: Ilocos. Bureau of Agricultural Statistics accessed on 12/08/13 from http://countrystat.bas.gov.ph/?cont=16&r=1.

Pangasinan as the widest and La Union as the narrowest.[26] The coastal region is bounded by the South China Sea in the west, Cagayan region in the north, the Cordillera mountain range in the east, and Central Luzon in the south. In 2011, fisheries contributed 17 % to the gross output of the region's Agriculture, Forestry and Fisheries subsector, which represents 25 % of the regional economy.[27]

Region II, the Cagayan Valley is composed of five provinces, i.e., Batanes, Cagayan, Isabela, Nueva Vizcaya, Quirino, and the city of Santiago. The second largest region in the country, Cagayan Valley has a total land area of 26,860 km^2, and is bounded by the Pacific Ocean in the east, Central Luzon in the south, the Cordillera mountain range in the west, and Babuyan Channel in the north. With rich fishing grounds, fishing is among the major occupations in the region.[28]

Finally, Region III, Central Luzon, with the largest contiguous plains in the whole Philippine Archipelago, includes seven provinces, i.e., Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, Zambales, and two large cities, i.e., Angeles and Olongapo. With a total land area of 21,470 km^2,[29] it represents 7.1 % of the country's total land area and is bounded by the CAR and Cagayan Valley in the north, the South China Sea in the west, Manila Bay in the south, and the Philippine Sea in the east.[30]
Most of the subzone's coast has a small tidal range. In most areas, the 200 m isobath hugs the coastline, e.g., along Zambales in the west facing the South China Sea and most of the eastern coastline facing the Pacific Ocean (see bathymetry in Centurioni *et al.* 2004, Figure 1, p. 114). The few shallow areas include the stretch of coast between Claveria (Region I) and Paluai Island (Region II) in the north facing the Babuyan Channel and Barit and Fuga Islands of the Babuyan Island Group, with 50-100 m depths from the mainland to the islands. In the western coast, the exception is Lingayen Gulf, with an average depth of 46 m and the 200 m isobath along its northern border just beyond the Gulf's mouth (McManus *et al.* 1990).

In an overview of the capture fisheries of Lingayen Gulf, Silvestre and Palma (1990) described it as a "*traditional fishing ground for trawlers*" since before the Second World War, when 15 beam trawlers plied the area. In addition to this industrial trawling fleet (which also includes large, medium and 'baby' trawlers), a number of artisanal gears are employed in Lingayen Gulf, which can be extrapolated to the other regions of Subzone A. These include (i) hand/pole lines and their derivatives; (ii) gillnets; (iii) seine nets; (iv) various other nets (bag, lift, lever, cast, push, filter, scoop); (v) dredge, fish corral, fish and crab pots, jigger, and spear gun/harpoon (Umali 1950; Mines 1986; Silvestre and Palma 1990; Vincent Hilomen, Professor, Institute of Biological Sciences, University of the Philippines in Los Baños pers. comm.). Additionally, illegal gears such as *muro-ami* and blast fishing were used, apparently widely in the mid 1970s (Bailen 1978). In the early 2000s, 33 fishing gears were in operation within the region (V. Hilomen, UPLB, IBS pers. comm.), i.e., 2.4 times more than that of Mines' (1986) mid-1980s estimate. Of these gears, the round haul seine, baby trawl, drift and bottom gill nets contributed 70 % of the catch in the mid-1980s (Mines 1986), while gillnets, hook and line, and 'baby trawlers' contributed 73 % of the catch in the early 2000s (V. Hilomen pers. comm.). The primary target species include mackerels, tunas and bonitos (e.g., *Auxis thazard*, *Euthynnus affinis*, *Decapterus* spp., *Rastrelliger* spp.), an array of reef-

[26] Regional office I profile. National Nutrition Council accessed on 12/08/2013 from http://www.nnc.gov.ph/component/k2/itemlist/category/117.
[27] Regional profile: Ilocos. Bureau of Agricultural Statistics accessed on 10/10/13 from http://countrystat.bas.gov.ph/?cont=16&r=1.
[28] Cagayan Valley Region. Department of Tourism accessed on 12/08/13 from http://www.dotregion2.com.ph/welcome/index.php/78-frontpage/101-an-introduction-to-cagayan-valley-region.
[29] Regional profile. Department of Environment and Natural Resources accessed on 12/08/13 from http://r3.denr.gov.ph/index.php/about-us/regional-profile.
[30] Central Luzon. National Nutrition Council accessed on 12/08/13 from http://www.nnc.gov.ph/component/k2/item/278-central-luzon?tmpl=component&print=1.

associated fishes (e.g., *Mugil*, *Leiognathus*, *Ephinephelus*, *Siganus*, *Upeneus* spp.) and invertebrates such as crabs (*Portunus*), shrimps (*Metapeneus*, *Peneus*), and cephalopods (*Loligo*).
Because of these conditions, and the setting-up of the Marine Science Institute Laboratory (University of the Philippines) in Bolinao, Lingayen Gulf tends to be the most studied fisheries in this subzone (see, e.g., Pauly *et al.* 1989).

Daily catch per fisher data

The sections below present the catch and/or landing and data on number of fishers, obtained from sources independent of Philippine government institutions involved in the assembly of fisheries statistics. Artisanal fisheries are reported as non-tuna and tuna catches, because tuna is an important albeit seasonal fishery, which can distort trends in artisanal catches. Finally, subsistence catch consumed by the fishers (as opposed to sold at local markets), but effected in 'municipal' waters by artisanal gears is estimated.

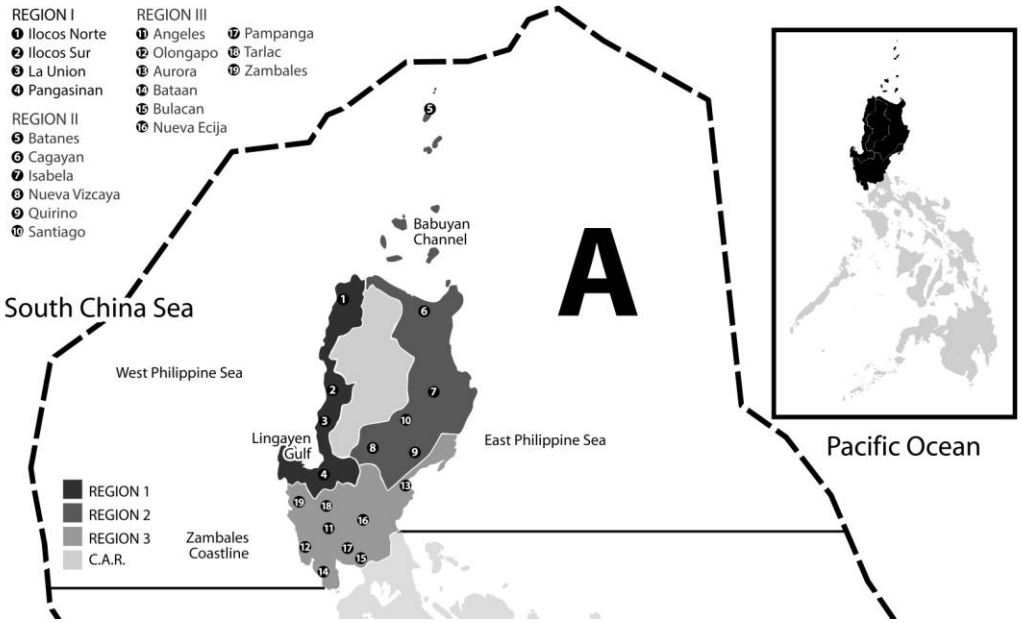

Figure 1. Subzone A, Northern Luzon, Philippines, showing the administrative regions (Regions I, II and III; CAR included here), provinces, fishing grounds, and its surrounding waters (from Smith *et al.* 1980); the insert shows this subzone (dark) relative to the Philippine EEZ (Redrawn by Mr. M.A. Yap from Figure 1 of Palomares and Pauly (this vol.) and a composite of open source maps).

Artisanal non-tuna fishery

The reconstructed non-tuna artisanal catch of the subzone were based on 17 independent estimates of catch per fisher per day from 8 sources (Table 1). The majority were from studies made along the coasts of La Union, Pangasinan, and Zambales, where two of the major fishing grounds in the country occur, i.e., Lingayen Gulf and the South China Sea. We did not find any applicable catch per fisher data to represent catch rates from fishing grounds surrounding the Cagayan region, i.e., the Babuyan Channel and the Eastern Philippine Sea. Different gears are employed in the two fishing grounds represented by data in Table 1, principally of the following types: hook and line, nets (bottom-set and drive-in gillnets, lift net, push net), spear and traps (beach seine, round haul seine). Other gears used were crab pots, fish corrals,

and jiggers. The catch of these gears are composed mostly of demersal fish species (e.g., emperors, groupers, and snappers) and may often include small pelagic fish species (e.g., anchovy and sardines).

The daily catch per fisher of non-tuna species ranging from 0.16 kg to 8.54 kg were obtained from different data types, viz.: (1) direct estimates of daily catch per fisher; (2) total daily/monthly/annual catch by a certain number of fishers; (3) catch per hour; and (4) catch per gear. Monthly and annual catch rates were divided by the number of fishing days; the average number of fishing days per year (213 days) obtained from data for the region from Muallil *et al.* (2012, Table 1, p. 3) was used in cases where this parameter was not specified, e.g., annual catch data from Calud *et al.* (1989). For data type (3), the average number of fishing hours per day per fisher was necessary in order to get the average catch per day. Cases with data type (4) used an average of the daily catch rates across gear types. In cases where different daily catch rates were supplied, e.g., daily catch rates by gear by month from Campos *et al.* (1994), the average daily catch rates were calculated and presented in Table 1. In cases where the data reported included either a) tuna as target species; or b) gear targeting only tuna species, catch rates were recalculated in order to separate the catch of tuna from non-tuna species and/or gears by getting the % contribution of tuna to the daily catch or to the number of gears employed. Note also that we made a distinction between full- and part-time fishers, counting full-time fishers with a weight of 1.0 and part-time fishers (assumed to take part in fishing only half of time) with 0.5. These data points were then compared to the estimate in Pauly (2000) of 4.2 $t \cdot year^{-1} \cdot fisher^{-1}$, standardized to 19.7 $kg \cdot day^{-1} \cdot fisher^{-1}$, assuming that the number of fishing days per year then was also equivalent to 213 days.

Tuna artisanal fishery

The reconstructed artisanal tuna catch of Subzone A was based on 11 independent estimates of daily catch per fisher from 4 sources (Table 1). Catch rates were mostly from the coast of Zambales, directly facing the South China Sea – an important tuna spawning ground (Wade 1951; Barut 2007). The catch rate from Lingayen Gulf was low, but is still included in the analysis. Unfortunately, data points were obtained only from the late 1990s to the present; data from previous decades were not available, at least from the literature we had access to. The following gears primarily used by tuna fishers are: gillnet, *lambaklad* (Calud *et al.* 1989, defined it as a modified fish corral made of bamboo and netting material), deep sea hook and line, longline, etc. Yellowfin tuna, big eye tuna, frigate tuna, mackerel, scad, and skipjack make up the bulk of the catch, but the fishery is not restricted to these species. According to Muallil *et al.* (2012), pelagic species (the bulk of which is composed of tuna and tuna-likes) contribute to 73 % of the catch, while the rest were demersal fish such as parrotfish, emperors, snappers, and groupers. The minimum and maximum landed catch per fisher of tuna were recorded at 0.15 kg and 12 kg, respectively. Daily catch per fisher rates were of the same data types as those discussed for the non-tuna artisanal fishery. The same treatment of full- and part-time fishers as discussed for the non-tuna fishery was used in cases where the number of fishers included such data. The 1900 catch per fisher estimate (Pauly 2000) was used here, standardized to 25 $kg \cdot day^{-1} \cdot fisher^{-1}$, assuming that the number of fishing days then was equivalent to 166 days (average tuna fishing days for Masinloc, Zambales, from Muallil *et al.* 2012).

Subsistence fishery

The reconstructed subsistence catch of the subzone were based only on 2 independent estimates of daily catch per fisher (Table 1). Both recorded catch rates were from Bolinao, Pangasinan, along the coast of Lingayen Gulf; one is from a gleaning study and the other from an artisanal fishery study. Note that there is usually a small percentage of catch by the artisanal fisheries that is used as take-home pay to fishers that they can either use for household consumption or for bartering/selling. Campos *et al.* (1994) reported that 20 % of the artisanal catch is brought home by fishers. Pet-Soede (2000), on the other hand, reports gleaning catches by subsistence fishers from the Gulf, one of the few studies on gleaning in the region.

These values were compared with the 1950 estimate of a purely subsistence catch in Palomares *et al.* (this vol.) of 5.2 $kg \cdot day^{-1} \cdot fisher^{-1}$.

Catch composition data

The available national marine fisheries landing statistics (see Appendix C) were used in determining the species composition of the catch. The data available to us covers a 20-year reporting period, from 1981 to 2006. Changes in the reporting platforms (discussed in Palomares *et al.* this vol.) are evident in the 'empty' cells for certain species groups in the 1980s and 1990s and the rather large contribution of a group named 'Others' in the 2000s. However, for reasons already discussed in Palomares *et al.* (this vol.) and in Palomares and Pauly (this vol.), recent reporting (2000s) of national marine fisheries landing statistics is specific only for the 30 most important species which together make up 60-70 % of the catch and the rest are reported as aggregates.

Thus, before the official statistics could be used in obtaining the species composition of the catch by decade, the following corrections had to be made: (1) taxon names were standardized, thus consolidating 'doubled' or 'tripled' taxon groups, e.g., 'fusilier (dalagang-bukid)' used in the 1980s and '*Caesio* (dalagang-bukid)' used in the 2000s reporting were combined (catches summed) to 'fusiliers (*Caesio*, dalagang-bukid)'; (2) grouped taxa were split into individual species, e.g., species in the taxon group yellowfin/bigeye tuna in the 1980s-1990s were reported separately in the 2000s; by using the % distribution of each species in the 2000s data set, the 1980s and 1990s data were split into yellowfin and bigeye tuna; (3) remaining miscellaneous groupings were standardized, e.g., ornamental shells, other shells and assorted shells, were consolidated as 'Shells nei'; (4) taxa with less than 1 t of reported catch were grouped with miscellaneous groups in (3); and (5) marine mammals, sea turtles and marine plants were grouped under 'Miscellaneous marine species', i.e., a group of animals that this reconstruction does not cover.

The official statistics, corrected as described above, were then used to get the annual % composition of each taxon. Missing data for a taxon (e.g., for 1950-1980, 1983, 1985-1987, and 2007-2010) were inter/extrapolated using the following rules: 1) if % catch data is interpolated between Y_1 and Y_2, corresponding to years X_1 and X_2, then $Y_{i+1} = Y_i+[(Y_1-Y_2)/(X_1-X_2)]$, where Y_{i+1} is the missing % catch data; 2) if % catch data is (forward or backward) extrapolated from Y_i corresponding to year X_i, then $Y_{i+1} = (\sum Y_i \ldots Y_{i+3})/3$ or $Y_{i-1} = (\sum Y_i \ldots Y_{i-3})/3$.

The most important species in the catch were obtained from the sums of the catch for all years with official landing statistics using rank and percentile analysis. This list was then used to graph the species or taxon groups that represent 70% of the catch.

Results

Non-tuna artisanal fishery

The cloud of 17 data-pairs ($kg \cdot day^{-1} \cdot fisher^{-1}$ *vs*. year; standard error of X/Y pairs at 2.52) for this sector compared with the standardized 1900 value from Pauly (2000) resulted in a logarithmic linear relationship with a relatively low fit (r^2=0.24). This is because the 2006-2010 data points broke the downward trend of the 1980s and the 1990s (Figure 2A). Excluding these 5 points would result in an r^2 value of 0.52, which, given n=13 (including Pauly 2000), is still rather low. Disregarding these points will bias our analysis, thus, we opted for a geometric mean analysis; with the geometric mean of the daily catch per fisher for n=17 (excluding the 1900 baseline) at 1.9 kg in 1997, and with the 1900 baseline resulting in the log-log relationship presented in Equation (1):

$$\textbf{Non-tuna catch (kg·day}^{-1}\textbf{·fisher}^{-1}\textbf{; log}_{10}\textbf{) = 156.13 - 47.223·log}_{10}\textbf{(Year)} \quad \text{… (1)}$$

Note that the geometric mean of the first and second cloud of points in Figure 2A is 1.4 kg in 1992 or a decrease of almost 25% from the 1997 mean, while the geometric mean of the third cloud of points is at 3.7 t or an increase of almost 160% from the 1992 mean. This high variability, inherent in the nature of the data points themselves (i.e., different target species, gears, and methodologies), is reduced by taking the geometric mean as represented by Equation (1).

Equation (1) was then used to reconstruct the daily catch of non-tuna species by artisanal fishers from 1950-2010, then multiplied by the average number of fishing days (213 days; see above), and then multiplied by the number of artisanal fishers estimated for this subzone in Palomares and Pauly (this vol., Figure 2A, p. 24). The resulting annual catch of non-tuna species per fisher is presented in Figure 2D, with a range of 6,030 t in 1950 to 28,015 t in 2010, or a 29 % increase per decade.

Tuna artisanal fishery

The cloud of 11 points (standard error = 3.90) for this sector was used to obtain a geometric mean daily catch per fisher of 1.6 kg in 2004 (see Figure 2B). This was plotted with the standardized baseline of 25.3 kg for 1900. The resulting relationship is presented in Equation (2):

$$\textbf{Tuna catch (kg·day}^{-1}\textbf{·fisher}^{-1}\textbf{; log}_{10}\textbf{) = 173.27-52.418·log}_{10}\textbf{(Year)} \quad \text{… (2)}$$

The tuna fishery is seasonal throughout the Philippines, i.e., the prevalence of typhoons may prevent boats from sailing and may hamper the setting of fish aggregating devices (Barut 2007); thus, the 166 tuna fishing days average from data in Muallil *et al.* (2012) is an acceptable assumption. In addition, not all artisanal fishers in the region will go tuna fishing, though half of them may (e.g., from the western regions). The calculated daily tuna catch from Equation (2) were thus multiplied by 166 fishing days and then by [0.5*number of fishers] estimated in Palomares and Pauly (this vol.) for Subzone A. The resulting annual tuna catches ranged from 2,626 t (1950) to 10,423 t (2010), with a 26 % increase per decade (see Figure 2D).

Subsistence fishery

The two data points (see Figure 2C) we were able to assemble for this area on subsistence fishing gave an average daily catch per fisher of 1.15 kg in 1992. As we cannot relate this to the 1900 estimate of average artisanal catch from Pauly (2000), we took instead the estimate of 5.20 kg for 1950 obtained in Palomares *et al.* (this vol.) for Mabini, Batangas (Region IV-a), the highest estimate of subsistence fishing that was available to us. As this study was of a coastal community that survived mostly on gleaning in the 1940s until the 1950s, its use as a baseline for subsistence catch can be justified. In addition, the geometric mean of just over 1 kg per fisher in the early 1990s resembles the results reported in Palomares *et al.* (this vol.) and Cabanban *et al.* (this vol.) for other areas in the Philippines. The log-log plot resulting from the use of the geometric mean and the baseline is presented in Equation (3):

$$\textbf{Subsistence catch (kg·day}^{-1}\textbf{·fisher}^{-1}\textbf{; log}_{10}\textbf{) = 231.58 – 70.172·log}_{10}\textbf{(Year)} \quad \text{… (3)}$$

The daily catch per fisher estimated from Equation (3) was multiplied with an average of 227 fishing days usually practiced in Bolinao, Pangasinan based on Muallil *et al.* (2012). Assuming that a certain proportion of artisanal (50%) and industrial fishers (10%) take a proportion of their catch home for consumption, reconstructed total subsistence catch as:

$$\textbf{Reconstructed subsistence catch (t) = Catch (t·year}^{-1}\textbf{·fisher}^{-1}\textbf{)* [Subs. + (Art.*0.5)} \quad \text{… (4)}$$

+ (Ind.*.10)]

The resulting annual subsistence catches ranged from 10,043 t (1950) to 13,543 t (2010), with a 5 % increase per decade (see Figure 2D).

Table 1. Catch of artisanal (tuna and non-tuna fisheries) and subsistence fishers in Subzone A (Regions I, II and III) assembled from independent sources and used in this analysis.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal	**Non-tuna species**		
1980	2.25	Not specified	Not specified	Lingayen Gulf (I)	0.48 $t \cdot year^{-1}$ (Calud *et al.* 1989, p. 4) for 213 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3).
1984	3.29	Not specified	Not specified	Lingayen Gulf (I)	0.7 $t \cdot year^{-1}$ (Calud *et al.* 1989, p. 4) for 213 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3).
1986	7.99	spear, hook and line	Serranidae, Lethrinidae, Mullidae, Labridae, Scaridae, Gobiidae, Siganidae, others	Cape Bolinao, Lingayen Gulf, Pangasinan (I)	Averaged from daily catch rates by gear for Jun-Dec 1986 (Acosta *et al.* 1988, Appendix Tables 4 and 5, p. 24-25).
1987	3.79	spear, trap fish, fish corral, bottom-set and drive-in gillnets	Siganidae, Labridae, Scaridae, Gobiidae, Muraenidae, Terapontidae, Gerreidae, Serranidae, Pinguipedidae, Pomacentridae, Mullidae, Lethrinidae, Lutjanidae, Apogonidae, others	Cape Bolinao, Lingayen Gulf, Pangasinan (I)	Averaged from daily catch rates by gear for May-Dec 1987 (Campos *et al.* 1994; Tables 1-4, p. 84-86).
1987	3.94	Not specified	Not specified	Lingayen Gulf, Pangasinan and La Union (I)	0.84 $t \cdot year^{-1}$ (Silvestre *et al.* 1991; p. 29) for 213 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3).
1988	3.96	spear, trap fish, fish corral, bottom-set and drive-in gillnets	Siganidae, Labridae, Scaridae, Gobiidae, Muraenidae, Terapontidae, Gerreidae, Serranidae, Pinguipedidae, Pomacentridae, Mullidae, Lethrinidae, Lutjanidae, Apogonidae, others	Cape Bolinao, Lingayen Gulf, Pangasinan (I)	Averaged from daily catch rates by gear for Jan-Apr 1988 (Campos *et al.* 1994; Tables 1-4, p. 84-86).
1998	0.37	lamp net, parisris, compressor, shell compressor, triplet, fixed trap, gleaning, gillnet, hook and line, crab pot, spear gun	Not specified	Bolinao, Pangasinan (I)	Daily catch rates by gear (Pet-Soede 2000; Table 2, p. 37) were used to obtain the % contribution of non-tuna gears in the total catch of 7 villages (71% of 1,645 kg). This was divided by the sum of the number of fishers (n=3154 from Pet-Soede 2000; Table 1, p. 37) from the 7 villages.

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Non-tuna species (continued)**		
1998	0.87	longline, squid jigger, spear gun, push net, troll line, lift net, trap, beach seine, round haul seine	Carangidae, Holocentridae, Siganidae, Mullidae, Scaridae, Acanthuridae, Priacanthidae, Nemipteridae, others	northern Zambales coast (III)	Averaged daily catch rates for non-tuna gears (Rueca *et al.* 2009, Table 9, p. 14) divided by a reconstructed number of fishers in Northern Zambales. Number of fishers was obtained using the % distribution of gears by municipality (Rueca *et al.* 2009, Table 4, p. 9) multiplied by the number of fishers (Rueca *et al.* 2009, Table 3, p. 8) where full-time fishers were given a weight of 1 and part-time fishers a weight of 0.5.
1999	0.79	longline, squid jigger, spear gun, push net, troll line, lift net, trap, beach seine, round haul seine	Carangidae, Holocentridae, Siganidae, Mullidae, Scaridae, Acanthuridae, Priacanthidae, Nemipteridae, others	northern Zambales coast (III)	Idem
2000	0.70	longline, squid jigger, spear gun, push net, troll line, lift net, trap, beach seine, round haul seine	Carangidae, Holocentridae, Siganidae, Mullidae, Scaridae, Acanthuridae, Priacanthidae, Nemipteridae, others	northern Zambales coast (III)	Idem
2001	0.16	longline, squid jigger, spear gun, push net, troll line, lift net, trap, beach seine, round haul seine	Carangidae, Holocentridae, Siganidae, Mullidae, Scaridae, Acanthuridae, Priacanthidae, Nemipteridae, others	northern Zambales coast (III)	Idem
2002	0.58	longline, squid jigger, spear gun, push net, troll line, lift net, trap, beach seine, round haul seine	Carangidae, Holocentridae, Siganidae, Mullidae, Scaridae, Acanthuridae, Priacanthidae, Nemipteridae, others	northern Zambales coast (III)	Idem
2006	8.54	*lambaklad*	caranx, swordfish, Spanish mackerel, sailfish, dolphinfish, garfish, big-eyed crevally, shark, stingray, sardines	Ilocos Sur (I)	A total daily landed non-tuna catch of 1,743 kg by 204 fishers (Sanidad *et al.* 2006, Tables 4 and 5, p. 12).
2010	2.18	Not specified	91 % demersal (such as parrotfishes, emperors, snappers, groupers), 9 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Alaminos, Pangasinan (I)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.91 for non-tuna catch.
2010	3.37	Not specified	91 % demersal (such as parrotfishes, emperors, snappers, groupers), 9 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Bolinao, Pangasinan (I)	Idem
2010	4.46	Not specified	27 % demersal (such as parrotfishes, emperors, snappers, groupers), 73 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Masinloc, Zambales (III)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.27 for non-tuna catch.

Table 1. Continued.

		Artisanal	**Tuna species**		
2010	2.33	Not specified	63 % demersal (such as parrotfishes, emperors, snappers, groupers), 37 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Subic, Zambales (III)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.63 for non-tuna catch.
1998	3.82	gillnet, handline, multiple hook and line, baby bagnet, trammel line, baby trawl	yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), big-eyed tuna (*Thunnus obesus*), frigate tuna (*Auxis thazard thazard)*, bullet tuna (*Auxis rochei rochei*), mackerel tuna (*Euthynnus affinis*)	northern Zambales coast (III)	Averaged daily catch rates for tuna catching gears (Rueca *et al.* 2009, Table 9, p. 14) divided by a reconstructed number of fishers in Northern Zambales. Number of fishers was obtained using the % distribution of gears by municipality (Rueca *et al.* 2009, Table 4, p. 9) multiplied by the number of fishers (Rueca *et al.* 2009, Table 3, p. 8) where full-time fishers were given a weight of 1 and part-time fishers a weight of 0.5.
1998	0.15	deep sea hook and line	tuna, mackerel	Bolinao, Pangasinan (I)	Averaged from total landed catch divided by number of fishers (Pet-Soede 2000, Table 1, p. 37) multiplied by % tuna catch distribution from catch rates by gear (Pet-Soede 2000, Table 2, p. 37).
1999	3.42	gillnet, handline, multiple hook and line, baby bagnet, trammel line, baby trawl	yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), big-eyed tuna (*Thunnus obesus*), frigate tuna (*Auxis thazard thazard)*, bullet tuna (*Auxis rochei rochei*), mackerel tuna (*Euthynnus affinis*)	northern Zambales coast (III)	Idem
2000	3.06	gillnet, handline, multiple hook and line, baby bagnet, trammel line, baby trawl	yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), big-eyed tuna (*Thunnus obesus*), frigate tuna (*Auxis thazard thazard)*, bullet tuna (*Auxis rochei rochei*), mackerel tuna (*Euthynnus affinis*)	northern Zambales coast (III)	Idem
2001	0.78	gillnet, handline, multiple hook and line, baby bagnet, trammel line, baby trawl	yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), big-eyed tuna (*Thunnus obesus*), frigate tuna (*Auxis thazard thazard)*, bullet tuna (*Auxis rochei rochei*), mackerel tuna (*Euthynnus affinis*)	northern Zambales coast (III)	Idem
2002	2.56	gillnet, handline, multiple hook and line, baby bagnet, trammel line, baby trawl	yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), big-eyed tuna (*Thunnus obesus*), frigate tuna (*Auxis thazard thazard)*, bullet tuna (*Auxis rochei rochei*), mackerel tuna (*Euthynnus affinis*)	northern Zambales coast (III)	Idem

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Tuna species (continued)**		
2006	8.53	*lambaklad*	yellowfin, frigate, skipjack	Ilocos Sur (I)	A total daily landed tuna catch of 1,740 kg by 204 fishers (Sanidad *et al.* 2006, Tables 4 and 5, p. 12).
2010	0.22	Not specified	91 % demersal (such as parrotfishes, emperors, snappers, groupers), 9 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Alaminos, Pangasinan (I)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.09 for non-tuna catch.
2010	0.33	Not specified	91 % demersal (such as parrotfishes, emperors, snappers, groupers), 9 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Bolinao, Pangasinan (I)	Idem
2010	12.05	Not specified	27 % demersal (such as parrotfishes, emperors, snappers, groupers), 73 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Masinloc, Zambales (III)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.73 for non-tuna catch.
2010	1.37	Not specified	63 % demersal (such as parrotfishes, emperors, snappers, groupers), 37 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Subic, Zambales (III)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.37 for non-tuna catch.
		Subsistence	**Mixed**		
1987	0.75	spear fishing, trap fishing, fish corral, gill net	*Signus fuscescens, Choerodon anchorago, Scarus ghobban, Calotomus japonicus, Scarus rhodurepterus, Acentrogobius puntang, Signus spinus, Cheilinus trilobatus, Gymnothorax pictus, Pelates quadrilineatus, Gerres oyena, Epinephelus merra, Leptoscarus vaigiensis, Parapercis cylindrica, Dischistodus chrysopoecilus, Parupeneus barberinus, Lethrinus harak, Lethrinus ornatus, Siganus virgatus, Mulloidichthys flavolineatus, Siganus guttatus, Siganus argenteus, Lutjanus fulviflamma, Lethrinus lentjan, Cheilodipterus quinquilineatus*, others	Cape Bolinao, Lingayen Gulf, Pangasinan (I)	Averaged from 20 % of daily catch rates by gear for Jan-Apr 1988 (Campos *et al.* 1994; Tables 1-4, p. 84-86).
1998	1.75	gleaning	shells	Bolinao, Pangasinan (I)	Average daily catch per fisher by 3-6 gleaners (Pet-Soede 2000, Table 2, p. 37).

Table 2. Results of the rank and percentile analysis of marine artisanal landings for northern Luzon (representing Regions I-III, or Subzone A) from 1981 to 2006 reported by the Philippine Bureau of Agricultural Statistics.

Rank	Percentile	English name	Scientific name
1	100	Yellowfin tuna	*Thunnus obesus*
2	98	Anchovy	*Enchrasicolina* spp.
3	97	Acetes	*Acetes* spp.
4	95	Round scad	*Decapterus macrosoma*
5	94	Skipjack	*Katsuwonus pelamis*
6	92	Hardtail	*Megalaspis cordyla*
7	90	White shrimps	*Fenneropenae* spp.
8	89	Threadfin bream	*Nemipterus virgatus*
9	87	Siganid	*Siganus* spp.
10	85	Squid	*Loligo* spp.
11	84	Slipmouth	*Leiognathus* spp.
12	82	Flying fish	*Cypselurus poelicopter*
13	81	Frigate tuna	*Auxis* spp.
14	79	Blue crab	*Portunus pelagicus*
15	77	Spanish mackerel	*Acanthocybium solandri*
16	76	Leather jacket	*Scomberoides* spp.
17	74	Snapper	*Pristipomoides filamentosus*
18	73	Big-eyed scad	*Selar crumenophthalmus*
19	71	Indo-Pacific mackerel	*Rastrelliger brachysoma*
20	69	Endeavor prawn	*Metapenaeus* spp.

Catch composition

The rank and percentile analysis resulted in a list of 20 taxa making up 70 % of the catch, the most important of which is yellowfin tuna (see Table 2 and Figure 2E). In the 1980s, 90% of the total catch consisted of the following species, arranged in decreasing order: yellowfin tuna, *Acetes*, anchovy, skipjack tuna and slipmouths. In the 1990s, this configuration slightly changed to yellowfin tuna, anchovy, *Acetes*, round scads and hardtails. Finally in the 2000s, catch was primarily composed of yellowfin tuna, anchovy, hardtails, round scads and skipjack tuna. In all three decades, tuna species dominated the catch, with small pelagic fish species such as anchovy consistently being on top, followed by *Acetes* and round scads. Demersal species like threadfin breams, siganids, slipmouths, and snappers and some pelagic species usually targeted by the industrial fleet, e.g., frigate tuna and mackerel, and commercially important macroinvertebrates such as shrimps, squids, and crabs made up the rest of the upper 70 %. We present in Figure 2E only the most important species for clarity of the graph, as there are more than 100 species caught by the artisanal fisheries in this subzone.

Discussion

In the 1980s, 75 % of the total landings from Lingayen Gulf came from the artisanal sector (Silvestre *et al.* 1991). In the early 1990s, total marine landings from Regions I and III provided by BAS suggested a higher share from the South China Sea, roughly 79 % of the total landings (Barut 2007). The contributions of the fisheries sector for Regions I-III to agricultural production in recent years are 17.4 %, 5.9 %, and 20.6 %, respectively (BAS 2006-2013 CountrySTAT Philippines)[31]. These estimates illustrate the importance of these two major fishing grounds in the overall exploitation of marine resources in northern Luzon (Calud *et al.* 1991; Geronimo *et al.* 2007; Lopez 1986; Cortes-Zaragoza *et al.* 1989; McManus *et al.* 1990; Rueca *et al.* 2009; Silvestre *et al.* 1991; Silvestre and Hilomen 2004). This

[31] http://countrystat.bas.gov.ph/?cont=16&r=1; http://countrystat.bas.gov.ph/?cont=16&r=2; http://countrystat.bas.gov.ph/?cont=16&r=3

apparent high productivity may be related to several unique geographical and oceanographic traits of the subzone. The patches of shallow coastal waters (e.g., Lingayen Gulf and Babuyan Channel) that were predominantly mangrove habitats (acting as nursery to many small pelagic and demersal species) are exposed to upwelling conditions brought seasonally by the predominant oceanic currents. The seasonal North Equatorial Current comes from the east and bifurcates into the Mindanao Current flowing south and the Kuroshio Current flowing north (Toole *et al.* 1990). The Kuroshio Current from the Philippine Sea off the coast of Region II flows into the South China Sea through the Luzon Strait in colder months (Centurioni and Niiler 2004). Tang *et al.* (1999) hypothesize that the seasonal intrusions of colder water from the north through the Luzon Strait that encounter the warm Kuroshio Current may generate upwelling conditions, and thus may bring nutrients that favor phytoplankton blooms in an area of otherwise low primary productivity (primary productivity measured at 0.10-1.53 $gC \cdot m^{-2} \cdot d^{-1}$; see Furio and Borja 2000). The South China Sea, on the other hand, is influenced by north-easterly monsoon winds which create a westward Ekman drift in winter that is reversed in summer, with the deep trenches off the western coast of Luzon contributing to the formation of the West Luzon Eddy (Hu *et al.* 2000; Qu 2000), which favor the transport of larvae from the rich coral reefs of, e.g. Palawan and the Sulu Sea, and may thus favor the tuna spawning grounds found off western Luzon (Wade 1951;Barut 2007, Figure 8, p. 15). In addition, with its narrow coastline directly facing the South China Sea – characteristic of shallow reefs, coves and bays – the Zambales coast is also an important fishing ground not only of demersal but also of pelagic species (Rueca *et al.* 2009). Contrary to the western coast, however, the deep waters of the eastern coast (Region II), facing some of the deepest trenches of the western Pacific Ocean, may be difficult to access by small artisanal vessels and may thus not contribute greatly to the artisanal catch of this subzone.

The multigear and multispecies fishery of Regions I and III account for the large landed artisanal catch (Calud *et al.* 1989; Calud *et al.* 1991; McManus *et al.* 1990; Silvestre and Hilomen 2004). Among the listed gear types used in Lingayen Gulf, for instance, the catch of gillnet (generally employed by the siganid fishery) made up 50 % of the landings, (Luna *et al.* 1990; Aragones *et al.* 1993; Calud *et al.* 1991; Campos *et al.* 1994; Gaerlan *et al.* 2002; McManus *et al.* 1990). Other demersal species caught belong to the following families: Acanthuridae, Apogonidae, Carangidae, Gobiidae, Labridae, Lethrinidae, Lutjanidae, Mullidae, Nemipteridae, Priacanthidae, Pomacentridae, Scaridae, Serranidae, etc. (Acosta *et al.* 1988; Campos *et al.* 1994; Sanidad *et al.* 2006). Small pelagics of the family Engraulidae and Scombridae, are also caught from the subzone's coastal areas (Gaerlan *et al.* 2002; Martosubroto 1998; Pet-Soede 2000; Rueca *et al.* 2009).

The tuna fishery (i.e, yellowfin tuna, skipjack, big-eyed tuna, eastern little tuna, frigate tuna), developed in the late 1970s and by the 1980s, was one of the main contributors to total fish landings from the South China Sea (Martosubroto 1998). The artisanal sector, in Zambales for instance, contributes 61 % of the region's total tuna catch (the rest is from the industrial fishery; see Rueca *et al.* 2009). Gears commonly used by tuna fishers along the coast of Lingayen Gulf were surface and drift gillnets, which allowed fishing as far as the Ilocos coast (Calud *et al.* 1989). Yellowfin tuna is the major contributor to the total artisanal landed catch since the 1980s (Martosubroto 1998) followed by anchovy and *Acetes*, the latter is used in shrimp paste making – an important market (Calud *et al.* 1989). Yellowfin tuna and skipjack, considerably larger species, contribute more in weight, but anchovy dominate in number, as with other coastal pelagic species, e.g., sardines, mackerels, and round scads (McManus *et al.* 1990). Other commercially important macroinvertebrates (i.e., squid, blue crab and prawns) were also important in the catch since 1976, especially squids and shrimps caught along the Ilocos coast down to Lingayen Gulf (Lopez 1986; Hernando 1981).

In spite of the large landings reported for this subzone, recent studies report a decreasing trend in catch per unit effort (Barut 2007; Cruz-Trinidad *et al.* 2011; DENR 2010b; Gaerlan *et al.* 2002; Pauly 2000; Pet-Soede 2000; Rueca *et al.* 2009), which may be attributed to the following conditions: (i) increase in the number of fishers; (ii) increased fishing capacity (related to improved fishing technology); (iii) illegal

fishing practices; and (iv) failed recruitment of target species (Ferrer *et al.* 1994; Gaerlan *et al.* 2002; Martosubroto 1998). Tuna, being increasingly valued more than demersal species, artisanal fishers expanded their reach further offshore, and thus conflicted with the industrial tuna fishery (Calud *et al.* 1991; McManus *et al.* 1990). Calud *et al.* (1991) showed that 85 % of the 118 species caught by gillnets were also exploited by trawlers, and the non-compliance of industrial trawlers ('baby trawlers') with the 7 km 'trawler-free' inshore waters led to the tremendous overlap between the two sectors. As such, juvenile tuna dominated in the overall catch from "municipal waters" since the 1980s, and of the 6 commercially important species caught in these waters, the big-eyed tuna (*Thunnus obesus*) is now listed as vulnerable[32] by the IUCN (Barut 2007). The continuous pressure on these species identifies Lingayen Gulf as one of the most overexploited fishing grounds in the country (Calud *et al.* 1989; Calud *et al.* 1991; McManus *et al.* 1990; Pauly 2000). The mariculture of economically important fish and shellfish was initiated in response to this problem. Mariculture requires a large amount of small to medium pelagic forage species (e.g., anchovies, sardines, mackerels), which form large dense schools that are easy to catch (Alder *et al.* 2008). Tuna feed on forage fish, and possibly as a consequence of forage fish extraction, tuna catches declined[33] while forage fish in total catch landings increased alongside the doubled production from marine aquaculture in recent years (Tacon *et al.* 2009). The various economic and anthropological factors (see Gaerlan *et al.* 2002) leading to increased effort by a growing number of fishers coupled with destructive fishing practices (see Pauly *et al.* 1989) and other natural factors, such as climate change, disturbed the recruitment patterns of fish populations in the region, which led to a notable decrease in the demersal fish biomass of 15-30% (Silvestre and Palma 1990; Gaerlan *et al.* 2002; DENR 2010b; Estepa *et al.* 2001b; Ferrer *et al.* 1994).

The results shown as Figures 2A and 2B corroborate this decreasing trend in catch per unit of effort. Furthermore, the reconstructed total catches by the non-tuna and tuna artisanal fisheries presented in Figure 2D and the composition of the catch in Figure 2E matches the behaviour of these fisheries as discussed above. We thus feel that our reconstructions represent a reasonable picture of the evolution of artisanal fisheries of northern Luzon.

Subsistence fishery

The marine invertebrate catch from Lingayen Gulf alone consists of at least 120 species (cephalopods, crabs, echinoderms, lobsters, molluscs, shrimps) of low economic value, 52 % are hand-gathered while 46 % are those caught by artisanal gears (Estepa *et al.* 2001a; Lopez 1986; Luna *et al.* 1990; McManus *et al.* 1990). Hand-gathering, or simply gleaning, is a common reef activity performed by women and children along shallow areas during low tide (Estepa *et al.* 2001a; Ferrer *et al.* 1994; Luna *et al.* 1990; McManus *et al.* 1990; Pet-Soede 2000). It lasts for at least 3 hours a day and catch ranged from 1-3 kg (Pet-Soede 2000). Catch usually targeted shells only, especially of commercial importance, i.e. food and ornament (Estepa *et al.* 2001a; Ferrer *et al.* 1994; Luna *et al.* 1990; McManus *et al.* 1990). Small shells (such as species of the genus *Strombus* and *Cypraea*), sea urchins and sea cucumbers (used in Chinese cuisine), and edible seaweeds were sold (McManus 1989). Other species were caught either by spear gun, such as cuttlefish, lobster and octopus, or by fish corral, gillnet, traps and others, together with reef fishes (Christie *et al.* 2003; Ferrer *et al.* 1994; Lopez 1986; Luna *et al.* 1990, McManus *et al.* 1990). Since fishing is seasonal (i.e., monsoon dependent), some fishers, together with their household members, revert to gleaning as an alternative way to earn money (McManus 1989). The bulk of the catch is sold in the

[32] *Thunnus obesus*. International Union for Conservation of Nature accesses on 11/11/13 from http://discover.iucnredlist.org/species/21859

[33] Little fish, big deal: for a healthy ocean, albacore tuna need forage fish. PEW accessed on 11/11/13 from http://www.pewenvironment.org/news-room/fact-sheets/little-fish-big-deal-for-a-healthy-ocean-albacore-tuna-need-forage-fish-85899505866

market and only a minute portion is allotted for household consumption (Christie *et al.* 2003; Estepa *et al.* 2001a; Ferrer *et al.* 1994). Likewise, some 0.5-1 kg from the artisanal catch stated above is kept (Campos

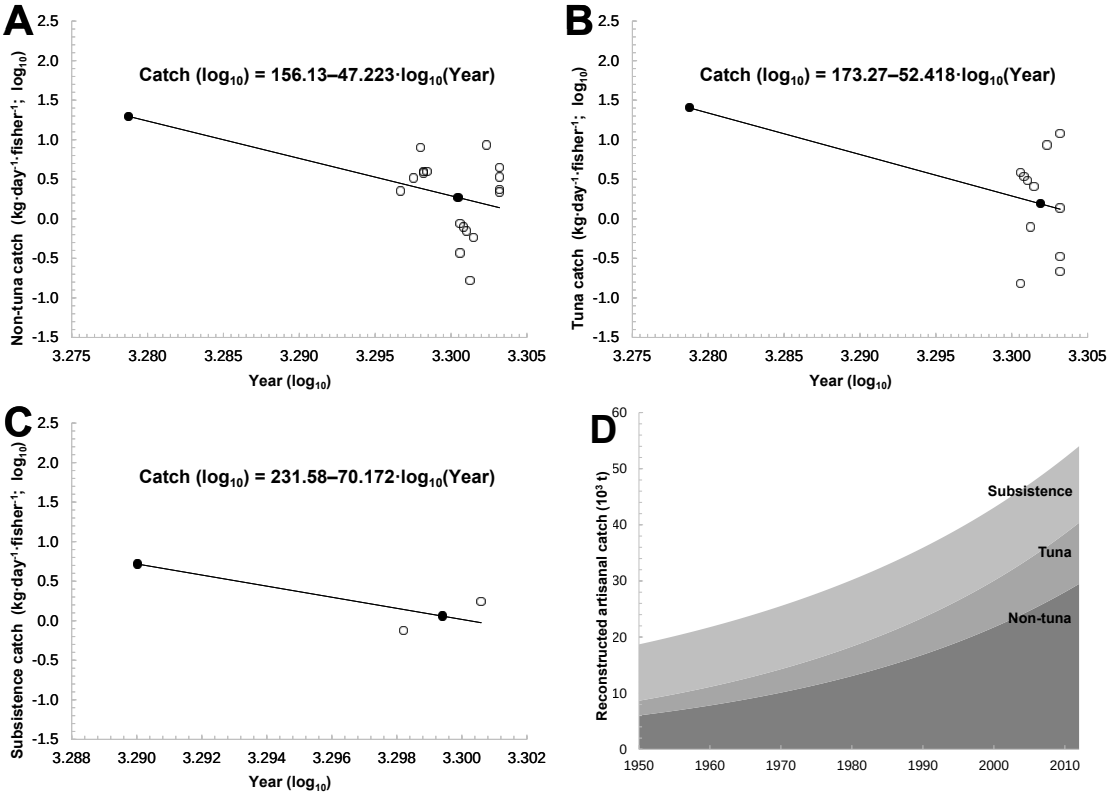

Figure 2. Catch per artisanal fisher per day (t; $\log_{10}$) based on independent estimates of catch data assembled in Table 1 used with demographics presented in Palomares and Pauly (this vol., Figure 2A, p. 24) and assumptions quoted in Table 1). **A**: Catch of non-tuna species by artisanal gears using the 1900 value of 4.2 t·year^{-1}·fisher^{-1} of Pauly (2000) standardized to 19.7 kg·day^{-1}·fisher^{-1} and the geometric mean of 1.86 kg·day^{-1}·fisher^{-1} for 1997 from 17 data points with s.e.=2.524. **B**: Catch of tuna species by artisanal gears using the 1900 value standardized to 25 kg·day^{-1}·fisher^{-1} and the geometric mean of 1.55 kg·day^{-1}·fisher^{-1} for 2004 from 11 data points with s.e.=3.903. **C**: Catch of subsistence fishers using the 1950 value estimated in Palomares *et al.* (this vol.) of 5.2 kg·fisher^{-1}·day^{-1} and the geometric mean of 1.15 kg·day^{-1}·fisher^{-1} for 1992 from 2 data points. **D**: Reconstructed catches assuming: (i) an average of 213 fishing days in a year (Muallil *et al.* 2012 for landing areas within Subzone A) for non-tuna artisanal fishers; (ii) 166 fishing days for tuna artisanal fishers based on the average established for Masinloc, Zambales, i.e., landing site of most tuna fishers from the region (Muallil *et al.* 2012); (iii) only half of the fishers from this region engage in tuna fishing; and (iv) coastal gleaners spend 227 days in a year on subsistence fishing based on the average established for Bolinao, Pangasinan (Muallil *et al.* 2012). **E**: Composition of the catch based on percentage distribution of species from available national statistics (Appendix A) and reconstructed catches in (D) showing top 5 non-tuna and all 5 tuna species caught in Subzone A.

et al. 1994; Christie *et al.* 2003). Decreased catch rates were observed by coastal fishers; for instance, in the 1980s, it took only an hour to fill a full basket of gleaned shells, while in the 1990s, a full basket was obtained only after a full day of gleaning (Estepa *et al.* 2001a; Ferrer *et al.* 1994). These studies are similar to the results in Figure 2C and suggest that the reconstruction presented in Figure 2D, the first of its kind, may well be a good representation of the evolution of subsistence catch in northern Luzon.

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Marine artisanal fisheries of the Philippines, Subzone B – southern Luzon (Regions IV, V and NCR)[34]

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Abstract

Independent estimates of daily catch per fisher (n=41) from Batangas, Mindoro, Palawan (Region IV) and Bicol (Region V) were obtained from 10 published sources; no applicable data was found to represent the fishing ground directly surrounding the NCR region, i.e., Manila Bay. These indicated a breadth of non-tuna catches from 0.15 $kg \cdot day^{-1} \cdot fisher^{-1}$ to 7.8 $kg \cdot day^{-1} \cdot fisher^{-1}$ (n=16, s.e.=0.00167, covering 1972-2010) and tuna catches from 0.28 $kg \cdot day^{-1} \cdot fisher^{-1}$ to 4.7 $kg \cdot day^{-1} \cdot fisher^{-1}$ (n=18, s.e.=0.00138, covering 1980-2010). These data sets were compared, using log-transformed regression analyses, to the 1900 estimates of 19.4 $kg \cdot day^{-1}$ $fisher^{-1}$ (standardized to 216 fishing days as practiced in the region) for the non-tuna, and 18 $kg \cdot day^{-1}$ $fisher^{-1}$ (standardized to 233 fishing days) for the tuna fisheries. Results indicate decreasing trends in daily catches per fisher from the 1950s to the 2000s, with average rates of 74 % for non-tuna and 76 % for tuna fisheries. Estimates of subsistence catch obtained from Batangas (Region IV) and Lagonoy Gulf (Region IV) ranging 5.2-0.75 $kg \cdot day^{-1}$ $fisher^{-1}$ (n=7; s.e.=0.000913; covering 1955-2010) were compared to the baseline of 5.2 $kg \cdot day^{-1} \cdot fisher^{-1}$ in a log-transformed regression analysis. Results indicate an average decline in daily subsistence catch per fisher of 81 % over a 50-year period. Total artisanal catch for the subzone estimated as the product of predicted daily catch per fisher, number of fishers and average number of fishing days in a year resulted in a reconstructed time series with catches of 28,410 $t \cdot year^{-1}$ (1950) to 141,764 $t \cdot year^{-1}$ (2010) and an average increase of 30 % per decade. The reconstructed total catch separated into species components, using the percent species composition of reported artisanal fisheries statistics for the subzone, suggests that round scads (*Decapterus macrosoma*) is the most important exploited species in the subzone over the three decades for which this data was collected (1970s to 2000s), while small pelagic fishes (e.g., anchovies), frigate, yellowfin and skipjack tuna are consistently represented in the upper 80 % of the catch.

Introduction

Southern Luzon, hereafter referred to as Subzone B (see Figure 1) includes four administrative regions (IV-A, IV-B, V and NCR) of the southern half of the island of Luzon, bounded by the Province of Quezon in the northeastern border, south to Bicol (including the island of Masbate), west to the islands of Romblon, Mindoro (including the island of Marinduque), and Palawan (and its islands) and north along the eastern border of the South China Sea to the coasts of Batangas, Cavite, Rizal and the Metro Manila area i.e., the National Capital Region (NCR). This rather important subzone is home to 31% of the more than 22 million Filipinos inhabiting coastal areas (2000 estimate).

[34] Cite as: Palomares, M.L.D., Parducho, V.A. (2014) Marine artisanal fisheries of the Philippines, Subzone B – southern Luzon (Regions IV, V and NCR). In: Palomares, M.L.D., Pauly, D. (eds.), *Philippine Marine Fisheries Catches: A Bottom-up Reconstruction, 1950 to 2010*, p. 45-61. Fisheries Centre Research Report 22(1). Fisheries Centre, University of British Columbia, Vancouver, Canada.

Metro Manila (NCR) was created under Presidential Decree No. 824 issued by the late President Ferdinand E. Marcos, shifting the country's capital city from Pasig to Manila.[35] One of the 20 most populated metropolitan areas worldwide, it has a population of 12 million on a land area of 636 km^2 composed of 17 local government units with 16 cities and 1 municipality (Pateros)[36]. It is bounded by Bulacan in the north, Rizal in the east, Laguna in the south, and Manila Bay in the west. In 2009, it contributed almost 3 % to the country's total marine production.[37]

Region IV-A was created by Executive Order No. 103 in 2002[38], by dividing the Southern Tagalog region into two. This region includes the provinces of Cavite, Laguna, Batangas, Rizal, and Quezon (also known as CALABARZON) – occupying a total land area of 16,560 km^2, with Quezon as the widest and Rizal as the narrowest.[39] The region is bounded by the South China Sea in the west, Cordillera and Cagayan regions in the north, Pacific Ocean in the east, and the second division of the Southern Tagalog region in the south. In 2010, the region ranked 5th in terms of percent contribution to nominal fisheries landings, with the largest contribution from Quezon (37 %).[40]

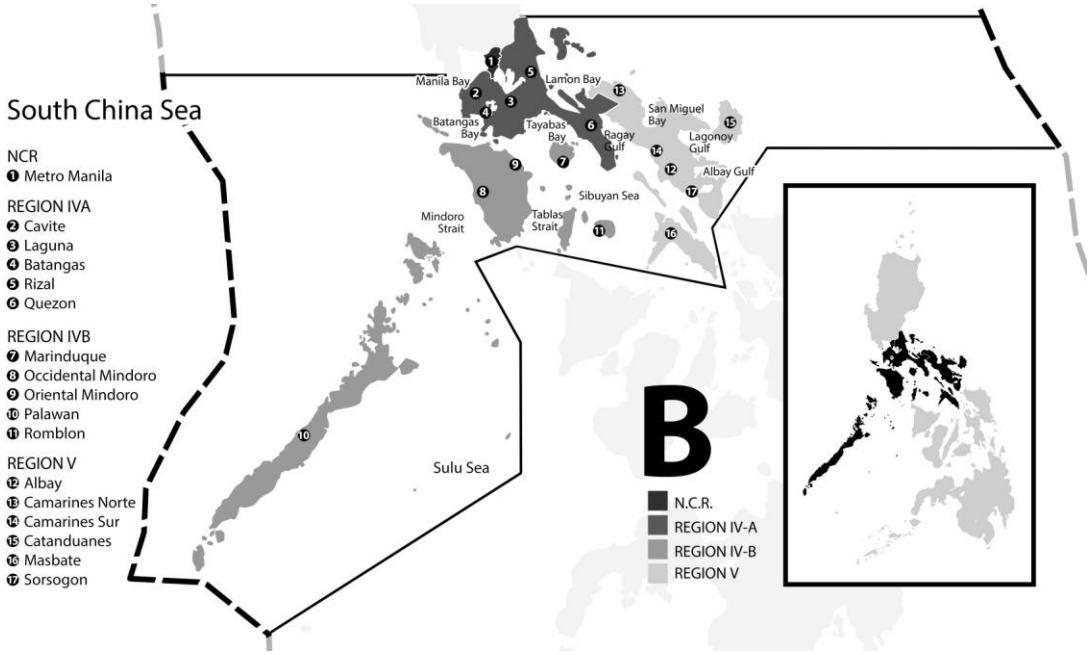

Figure 1. Subzone B, Southern Luzon, Philippines, showing its four administrative regions (Regions IV-V and NCR), provinces, fishing grounds, and its surrounding waters; the insert shows this subzone (dark) relative to the Philippine EEZ (Redrawn by Mr. M.A. Yap from Figure 1 of Palomares and Pauly (this vol.) and a composite of open source maps).

[35] NCR National Capital Region regional profile. Department of Tourism accessed on 15/11/13 from http://www.visitmyphilippines.com/index.php?title=Regional%20Profile&func=all&pid=388&tbl=0

[36] NCR profile. National Nutrition Council accessed on 09/11/13 from http://www.nnc.gov.ph/component/k2/itemlist/category/89

[37] Fisheries subsector statistics. Bureau of Fisheries and Aquatic Resources accessed on 15/11/13 from http://www.bfar.da.gov.ph/pages/statistics/table1.htm

[38] Regional profile CALABARZON. Department of Agriculture accessed on 15/11/13 from http://www.calabarzon.da.gov.ph/profile_CALABARZON.html

[39] Region 4A-CALABARZON physical and socio-economic profile. Department of Environment and Natural Resources accessed on 15/11/13 from http://calabarzon.denr.gov.ph/index.php/about-us/regional-profile/reg-profile-physical-socio-eco

[40] CALABARZON profile. Bureau of Fisheries and Aquatic Resources accessed on 15/11/13 from http://region4a.bfar.da.gov.ph/pages_all/heading/about_us/CALABARZON_Profile/CALABARZON_Profile.html

Region IV-B include the islands separated from the mainland of the Southern Tagalog region; these are: Mindoro (Occidental and Oriental), Marinduque, Romblon, and Palawan (also known as MIMAROPA) – covering a total land area of 2,750 km^2, with Palawan as the widest and Marinduque as the narrowest.[41] It is bounded by the South China Sea in the west, CALABARZON in the north, Sibuyan Sea on the east, and the Visayas region in the south. Its economy is greatly dependent on fisheries and ecotourism.[42] It contributed 14 % to the country's nominal fish landings in 2002-2004, thus ranked as 2nd nationwide.[43]

At the southernmost tip of Luzon lies Region V, also known as the Bicol region. Region V includes the provinces of Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, and Sorsogon – encompassing a total land area of 17,632 km^2, 6 % of the country's total land area.[44] It is bounded by the Southern Tagalog in the west, Quezon province in the north, the Pacific Ocean in the east, and the Visayan seas in the south. The economy of Region V is dependent not only on agriculture, but also on fisheries, as the region is surrounded by important fishing grounds (i.e, Albay Gulf, Asid Gulf, Lagonoy Gulf, Lamon Bay, Ragay Gulf, San Miguel Bay, Sibuyan Sea, and Sorsogon Bay).[45]

The majority of Luzon's traditional fishing grounds are within the boundaries of southern Luzon, and all are heavily exploited (Smith 1979). Two of these, located southwest and east of the region, i.e., the Sulu Sea and San Miguel Bay, respectively, are the most important fishing grounds in Subzone B (Pauly and Mines 1982; Campos *et al.* 2007; Lim *et al.* 1995; Smith 1979). San Miguel Bay, an 840 km^2 shallow body of water located southeast of Luzon is characterized by sandy and muddy substrate, and was exploited uniquely with traditional fishing gears such as gillnet and hook and line until the Second World War; thereafter, trawlers strongly increased in numbers (Pauly 1982a; Pauly *et al.* 1982;, Lim *et al.* 1995; Mines *et al.* 1986; Smith and Pauly 1983; Yater 1982). Sustained fishing from both trawlers and artisanal fishers resulted in the bay's overexploitation as early as in the 1980s (Pauly 1982a; Lim *et al.* 1995; Smith and Pauly 1983; Sunderlin 1994; Bundy and Pauly 2001).

The Sulu Sea, located in the western part of the country, bounded by Palawan and the Visayan islands, is another rich fishing ground in terms of abundance and diversity of species (Campos *et al.* 2007; Itano and Williams 2009). It is one of the top fish producers in terms of annual landings and an important tuna fishing ground (Barut 2007). Gears commonly used by fishers from this region are of the following types: (1) lines, i.e., hook and line and longline; (2) nets, i.e., scissor net, crab liftnet, filternet, beach seine, mini-trawl, drift gillnet, crab gillnet, bottom-set gillnet; and (3) others, i.e., speargun, fish trap, fish weir, stationary tidal weir, fish corral (Garces and Silvestre 2010; Olaño *et al.* 2009; Itano and Williams 2009; Lim *et al.* 1995; Mines *et al.* 1986; Munoz 1991). Of these, hook and line and gillnet contributed 89 % of the total annual landings (Garces and Silvestre 2010; Olaño 2009; Amparado 1993). The catch is mainly composed of the following groups: (1) demersal fish species, i.e., croakers (*Otolithes ruber*), mullet (*Mugil dussumieri*), hairtail or cutlassfish (*Trichiurus lepturus*), slipmouths (Leiognathidae), lizardfish (*Sauridia tumbil*), solefish (*Cynoglossus* sp.), goatfishes (Mullidae), and sea catfish (*Arius thallasinus*); (2) coastal pelagic fish species such as anchovies (*Stolephorus* spp.) and sardines (*Sardinella* spp.); (3) oceanic pelagic fish like tuna (*Katsuwonus pelamis* and *Thunnus albacares*) and mackerel (*Rastrelliger*

[41] Regional profile: MIMAROPA. Bureau of Agricultural Statistics accessed on 15/11/13 from http://countrystat.bas.gov.ph/?cont=16&r=17

[42] Region 4B-MIMAROPA regional profile. Department of Environment and Natural Resources accessed on 15/11/13 from http://mimaropa.denr.gov.ph/index.php/about-us/regional-profile

[43] Region IV-B profile. National Nutrition Council accessed on 15/11/13 from http://www.nnc.gov.ph/component/k2/itemlist/category/101

[44] Overview of Bicol region. Department of Agriculture accessed on 15/11/13 from http://bicol.da.gov.ph/Statistics/regional_profile.html

[45] Region V Bicol regional profile. Department of Tourism accessed on 15/11/13 from http://www.visitmyphilippines.com/index.php?title=RegionalProfile&func=all&pid=170&tbl=0

kanagurta); (4) crustaceans, i.e., small shrimps or *balao* (*Acetes indicus,* penaeid shrimps) and crabs such as the blue or swimming crab (*Portunus pelagicus*), mangrove or mud crab (*Scylla serrata*), and *Charybdis feriata*); (5) cephalopods or squids (*Loligo* spp.), cuttlefish (*Sepia* spp.), and octopus; (6) shelled molluscs, such as the window pane shell (*Placuna placenta*) and abalone (*Haliotis* sp.); and lastly (7) the commercially important sea cucumbers and seaweeds[46] (Pauly 1982b; Mines *et al.* 1986; Lim *et al.* 1995; Olaño *et al.* 2009). The similarity in the gears employed and the catch composition of landings in these two fishing grounds support our assumption that the behaviour of fishing and fishers in the regions within this Subzone are similar, even if it covers a wide range of habitats.

Daily catch per fisher

The sections below present the catch per fisher data per sector obtained from sources other than Philippine government institutions tasked with assembling fisheries statistical data. The sectors were divided into 3: artisanal non-tuna, artisanal tuna and subsistence catches. The reasons for this division are given in Parducho and Palomares (this vol.).

Artisanal non-tuna fishery

The reconstructed non-tuna artisanal catch of the subzone was based on 16 independent estimates of catch per fisher per day from 7 sources (Table 1). Studies were made along the coasts of regions IV and V, i.e., Batangas, Bicol, Mindoro and northern Palawan. No applicable catch per fisher data was found to represent catch rates from the fishing ground directly surrounding the NCR region, i.e., Manila Bay. Different gears employed by the coastal provinces represented by data in Table 1 are of the same types as those in Subzone A (Parducho and Palomares, this vol.). Gillnet and hook and line were the most common gears, based on the boat and gear inventory conducted by BFAR (2003). The catch is composed mostly of demersal fish species (e.g., groupers, slipmouths, snappers, etc.) and small pelagic fish species (i.e., anchovies).

The daily catch per fisher of non-tuna species ranged from 0.15 kg to 7.8 kg obtained from various data types, similar to those specified in Parducho and Palomares (this vol.). Monthly and annual catch rates were divided by the average number of fishing days per year (216) obtained from data for the region from Muallil *et al.* (2012, p. 3), slightly differing from that used for Subzone A (213 days; see Parducho and Palomares, this vol.). This average number of days was used in cases where it was not specified, e.g., for the annual catch data from Smith and Pauly (1983). In cases where different catch rates were supplied, e.g., monthly catch rates by gear from Hamoy-Obusan (2004), the average daily catch rates were calculated using the average number of fishing days also specified in the source. In cases where the data reported included tuna as target species, the procedure followed for Subzone A (Parducho and Palomares, this vol.) was applied. These 16 data points were then compared with the estimate in Pauly (2000) of 4.2 $t \cdot year^{-1} \cdot fisher^{-1}$, standardized to 19.4 $kg \cdot day^{-1} \cdot fisher^{-1}$, assuming that the number of fishing days per year then was also 216.

Artisanal tuna fishery

The reconstructed artisanal tuna catch of Subzone B was based on 18 independent estimates of daily catch per fisher from 6 sources (Table 1). Catch rates were from the coastal provinces of regions IV and V, mostly from the Bicol region, exposed to fishing grounds opening to the Pacific (i.e., San Miguel Bay and Lagonoy Gulf). Almost all data points obtained were from the 2000s to the present and only one each for 1980s and 1990s. The gears primarily used by tuna fishers are gillnet and handlines. Tunas, mackerels, jacks, and scads make up the bulk of the catch alongside a few demersal fish species.

[46] Not included in this study see Palomares and Pauly (this vol.).

The landed values of tuna catch per fisher ranged from 0.28 kg to 4.7 kg. The types of data for which these values were obtained are similar to those used for the non-tuna artisanal fishery. An average of 233 fishing days per year (average tuna fishing days for Tabaco City, Albay; from West *et al.* 2011) was used in cases where only the annual or monthly catch and number of fishers were provided, like the case from Soliman and Dioneda (1997); otherwise, fishing trips per year was used instead, as was the case from Olaño *et al.* (2009). In the case of Yater (1982), where the data may have included both tuna and demersal fish in its catches using only one type of gear (i.e, gillnet), % tuna catch composition for Tinambac, Camarines Sur based on Muallil *et al.* (2012) was used. The 1900 catch per fisher estimate of Pauly (2000) for 1900 was standardized to 18 $kg \cdot day^{-1} \cdot fisher^{-1}$, assuming that the number of fishing days then was 233.

Subsistence fishery

The reconstructed subsistence catch of Subzone B is based on 7 independent estimates of daily catch per fisher from 3 sources (Table 1). Catch rates originated mostly from along the coast of Batangas and one from Lagonoy Gulf, from gleaning and artisanal fishery studies. A small percentage of catch by the artisanal fisheries is usually partitioned as take home by fishers which they use for household consumption; Hamoy-Obusan (2004) reported that 8 % of the artisanal catch is brought home by fishers. On the other hand, Palomares *et al.* (this vol.) and Nieves *et al.* (2010) report gleaning catches by subsistence fishers that were either destined for household consumption or sale. These data points ranged from 0.75 $kg \cdot day^{-1}$ $fisher^{-1}$ to 5.2 $kg \cdot day^{-1}$ $fisher^{-1}$ and were compared with the 1950 estimate of a purely subsistence catch of 5.2 $kg \cdot day^{-1} \cdot fisher^{-1}$ reported in Palomares *et al.* (this vol.).

Catch composition

The most important species in the catch were obtained using rank and percentile analysis (see Parducho and Palomares, this vol., for the methodology) on the available data for regions in this subzone from national statistics. The list in Table 2 was then used to graph the species or taxon groups that represent 80 % of the catch.

Results

Non-tuna artisanal fishery

The cloud of 16 data-pairs ($kg \cdot day^{-1} \cdot fisher^{-1}$ *vs*. year; standard error of X/Y pairs at 1.67) for this sector compared with the 1900 value from Pauly (2000) standardized to 213 fishing days, resulted in a logarithmic linear relationship with a low coefficient of determination (r^2=0.29), mainly because the 2003 data points broke the downward trend from the 1970s to the present (Figure 2A). Excluding these 2 points would result in an r^2 value of 0.66, which, given n=14 (including Pauly 2000), is still rather low. Disregarding these points will bias our analysis; thus, we opted for the use of a geometric mean instead. The geometric mean of the daily catch per fisher for n=16 (excluding the 1900 standardized baseline) was 2 kg in 2002 and compared with the 1900 baseline, resulted in the log-log relationship of Equation (1):

$$\textbf{Non-tuna catch } (kg \cdot day^{-1} \cdot fisher^{-1}; \log_{10}) = 143.67 - 43.427 \cdot \log_{10}(\text{Year}) \quad \ldots (1)$$

Equation (1) was then used to reconstruct the daily catch of non-tuna species by artisanal fishers from 1950-2010, then multiplied by the average number of fishing days (216 days; see above), and then multiplied by the number of artisanal fishers estimated for this subzone in Palomares and Pauly (this vol., Figure 2B, p. 24). The resulting annual catch of non-tuna species per fisher is presented in Figure 2D, with a range of 17,007 t in 1950 to 86,644 t in 2010, or a 31 % increase per decade.

Table 1. Catch of artisanal (tuna and non-tuna fisheries) and subsistence fishers in Subzone B, Southern Luzon, Philippines (Regions IV, V and NCR) assembled from independent sources and used in the analyses presented in Figure 2.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal	**Non-tuna species**		
1972	4.70	gillnet, scissors net, *baklad* (fish corral), *kitang* (hook and line), beach seine, drive-in net, *bocatot* (fish pot), *bintol* (crab lift net), liftnet, hook and line	halfbeak, mullet, sea catfish, goatfish, common whiting, grunt, *Therapon* sp., *Caranx* sp., shrimps, goby, blue crab, flatfish, silver pike eel, grouper, sting ray, slipmouth, crevalle, anchovy, hardtail, snapper, *talakitok* (cavalla)	Sorsogon Bay (V)	Averaged from daily catch rates of non-tuna gears divided by the number of fishers from 4 municipalities surrounding the bay, i.e., Casiguran, Juban, Sorsogon and Castilla (Ordoñes *et al.* 1975; Table 2, p. 186-188).
1980	2.73	drift (*panke*) and bottom-set (*palubog*) gillnets	major species caught: tiger-toothed croaker, whiskered croaker, deep-bodied crevalle, hairtail, mullet, and herring	Castillo, San Miguel Bay (V)	Average daily catch per fisher from total landed catch for 219 fishing days per year (Yater 1982, Table 1, p. 30) multiplied by 0.45 for non-tuna catch (% catch composition for Tinambac, Camarines Sur from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (n=96; Yater 1982, p. 28) .
1981	7.76	non-trawl small-scale gears (e.g., gillnet and scissor net)	*Stolephorus* sp., *Arius thalassinus*, Mugillidae, *Otolithes ruber*, other Sciaenidae, Pomadasyidae, Carangidae, Leiognathidae, Trichiuridae, squids, crabs, penaeid shrimps, others	San Miguel Bay (V)	Average daily catch per fisher from annual landed catch (Smith and Pauly 1983, Table 1, p. 14) for 216 fishing days per year (Muallil *et al.* 2012, Table 1, p. 3) divided by number of fishers (Smith and Pauly 1983, Table 2, p. 15).
1996	3.88	bottom-set gillnet, filter net, hook and line, fish corral, *buli-buli*, pushnet, fish trap, speargun, crab pot, drift gillnet, encircling gillnet, liftnet, stationary liftnet, beach seine, crab liftnet	Not specified	San Miguel Bay (V)	Averaged from annual catch rates of all artisanal gears (Soliman and Dioneda 1997, Table 1, p. 30) for 216 fishing days per year (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.45 for non-tuna catch (% catch composition for Tinambac, Camarines Sur from Muallil *et al.* 2012, Table 1, p. 3) divided by number of fishers (n=5300; Soliman and Dioneda 1997, p. 23).
2001	2.67	multiple hook and line, bottom-set longline, beach seine, stationary/crab liftnet, crab/fish pot/trap, speargun, jigger, fish corral, scoop net, troll line, squid trap, round haul seine	*Selar crumenophthalmus*, *Istiophorus platypterus*, *Rastrelliger faughnii*, *Coryphaena hippurus*, *Stolephorus* sp., *Decapterus russelli, Decapterus macrosoma, Rastrelliger kanagurta, Tylosurus crocodiles, Atule mate, Acanthocybium solandri, Elagatis bipinnulata, Siganus canaliculatus, Lutjanus malabaricus, Makaira mazara, Sardinella longiceps, Lethrinus lentjan, Cheilopogon furcatus, Sepioteuthis lessoniana, Portunus pelagicus, Sepia lycidas, Octopus macropus, Loligo uyii, Sepia pharaonis, Octopus aegina, Portunus sanguinolenthus, Scylla serrata, Charybdis feriata, Sepia recurvirustra*, others	Lagonoy Gulf (V)	Averaged from annual catch rates of all artisanal gears for 208 fishing trips (assumed as days) per year (Olaño *et al.* 2009, Table 1, p. 7) multiplied by 0.48 for non-tuna catch (Olaño *et al.* 2009, Table 2, p. 9) divided by number of fishers (n=8379 from Olaño *et al.* 2009, p. 1).

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Non-tuna species (continued)**		
2003	0.15	hook and line, net types, spear, trap	dominant species: *galunggong, tursilyo, pusit, barak, kambabalo, galunggong, lagidlid, alumahan, manamse, manitis*	Mabini, Batangas (IV)	Averaged from monthly catch rates of all artisanal gears (Hamoy-Obusan 2004, Table 3, p. 9) multiplied by 0.30 for non-tuna catch and divided by the number of fishers (n=704; average for Mabini, Batangas from Muallil *et al.* 2012, Table 1, p. 3).
2003	0.23	hook and line, net types, spear, trap	dominant species: *burak, buluhan, manitis, kanuping, galunggong, tirok, bisugo, kalintigas, kulafu, burak, lapu-lapu, posit, pugita, panos, buglaw, alumahan, samaral, buglaw, palata, dilis, bagis, kanuping*	Tingloy Batangas (IV)	Averaged from monthly catch rates of all artisanal gears (Hamoy-Obusan 2004, Table 4, p. 13) multiplied by 0.45 for non-tuna catch (% catch composition for Batangas from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (n=680; Hamoy-Obusan 2004, p. 4).
2010	3.02	Not specified	72 % demersal (such as parrotfishes, emperors, snappers, groupers), 28 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Bacacay, Albay (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.72 for non-tuna catch.
2010	1.13	Not specified	45 % demersal (such as parrotfishes, emperors, snappers, groupers), 55 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Batangas (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.45 for non-tuna catch.
2010	4.29	Not specified	67 % demersal (such as parrotfishes, emperors, snappers, groupers), 33 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	El Nido, Palawan (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.67 for non-tuna catch.
2010	2.58	Not specified	86 % demersal (such as parrotfishes, emperors, snappers, groupers), 14 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Gubat, Sorsogon (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.86 for non-tuna catch.
2010	4.23	Not specified	83 % demersal (such as parrotfishes, emperors, snappers, groupers), 17 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Looc , Romblon (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.83 for non-tuna catch.
2010	2.11	Not specified	31 % demersal (such as parrotfishes, emperors, snappers, groupers), 69 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Lubang, Mindoro (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.31 for non-tuna catch.
2010	1.53	Not specified	30 % demersal (such as parrotfishes, emperors, snappers, groupers), 70 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Mabini, Batangas (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.30 for non-tuna catch.
2010	1.73	Not specified	36 % demersal (such as parrotfishes, emperors, snappers, groupers), 64 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Puerto Galera, Mindoro (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.36 for non-tuna catch.
2010	2.57	Not specified	45 % demersal (such as parrotfishes, emperors, snappers, groupers), 55 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Tinambac, Camarines Sur (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.45 for non-tuna catch.

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal	**Tuna species**		
1980	3.33	drift (*panke*) and bottom-set (*palubog*) gillnets	tunas and mackerels, jacks and scads, sardines	Castillo, San Miguel Bay (V)	Average daily catch per fisher from total landed catch for 219 fishing days per year (Yater 1982, Table 1, p. 30) multiplied by 0.55 for tuna catch (% catch composition for Tinambac, Camarines Sur from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (n=96; Yater 1982, p. 28) .
1996	4.40	bottom-set gillnet, hook and line, fish corral, bottom-set longline, fish trap, drift gillnet, encircling gillnet, liftnet	tuna, sharks and rays	San Miguel Bay (V)	Averaged from annual catch rates of all artisanal gears (Soliman and Dioneda 1997, Table 1, p. 30) for 216 fishing days per year (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.55 for tuna catch (% catch composition for Tinambac, Camarines Sur from Muallil *et al.* 2012, Table 1, p. 3) divided by number of fishers (n=5300; Soliman and Dioneda 1997, p. 23).
2001	2.99	multiple hook and line, bottom-set longline, drift gillnet, bottom-set gillnet, encircling gillnet, surface gillnet	*Katsuwonus pelamis, Thunnus albacares, Euthynnus affinis, Auxis thazard, Auxis rochei, Thunnus alalunga, Thunnus tonggol, Thunnus obesus*	Lagonoy Gulf (V)	Averaged from annual catch rates of all artisanal gears for 208 fishing trips (assumed as days) per year (Olaño *et al.* 2009, Table 1, p. 7) multiplied by 0.52 for tuna catch (Olaño *et al.* 2009, Table 2, p. 9) divided by number of fishers (n=8379 from Olaño *et al.* 2009, p. 1).
2003	0.34	gillnet and pamo net	major species: *tamban*	Mabini, Batangas (IV)	Averaged from monthly catch rates of all artisanal gears (Hamoy-Obusan 2004, Table 3, p. 9) multiplied by 0.70 for non-tuna catch and divided by the number of fishers (n=704; average for Mabini, Batangas from Muallil *et al.* 2012, Table 1, p. 3).
2003	0.28	hook and line and net types	major species: *tanigue, tambakol, kambabalo*	Tingloy Batangas (IV)	Averaged from monthly catch rates of all artisanal gears (Hamoy-Obusan 2004, Table 4, p. 13) multiplied by 0.55 for non-tuna catch (% catch composition for Batangas from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (n=680; Hamoy-Obusan 2004, p. 4).
2010	1.70	simple handline, jigger	yellowfin tuna, albacore, skipjack, dolphinfish, sailfish, others	Brgy. Sabang, Camarines Sur (V)	Averaged from total monthly landings for 143 sampling days in Sep 2009-Aug 2010 (West *et al.* 2011, Appendix 2, p. 23) divided by the number of fishers (n=201; West *et al.* 2011, Appendix 2, Table 1, p. 10-11).
2010	1.25	simple handline	yellowfin tuna, albacore, skipjack, dolphinfish, sailfish, others	Nato, Camarines Sur (V)	Averaged from monthly landings for 193 days, Sep 2009-Aug 2010 (West *et al.* 2011, p. 22) divided by the number of fishers (n=87; West *et al.* 2011, p. 11).

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Tuna species (continued)**		
2010	0.91	simple handline, multiple hook and line, troll line	yellowfin tuna, albacore, skipjack, dolphinfish, sailfish, others	Sugod, Albay (V)	Averaged from monthly total port landings for 105 sampling days in Sep 2009-Aug 2010 (West *et al.* 2011, Appendix 2, p. 23) divided by the number of fishers (n=988; West *et al.* 2011, Appendix 2, Table 1, p. 11).
2010	1.50	simple handline	yellowfin tuna, albacore, skipjack, dolphinfish, sailfish, others	Tabaco City, Albay (V)	Averaged from monthly total port landings for 233 sampling days in Sep 2009-Aug 2010 (West *et al.* 2011, Appendix 2, p. 23) divided by the number of fishers (n=333; West *et al.* 2011, Appendix 2, Table 1, p. 12).
2010	1.18	Not specified	72 % demersal (such as parrotfishes, emperors, snappers, groupers), 28 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Bacacay, Albay (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.28 for tuna catch.
2010	1.38	Not specified	45 % demersal (such as parrotfishes, emperors, snappers, groupers), 55 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Batangas (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.55 for tuna catch.
2010	2.11	Not specified	67 % demersal (such as parrotfishes, emperors, snappers, groupers), 33 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	El Nido, Palawan (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.33 for tuna catch.
2010	0.42	Not specified	86 % demersal (such as parrotfishes, emperors, snappers, groupers), 14 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Gubat, Sorsogon (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.14 for tuna catch.
2010	0.87	Not specified	83 % demersal (such as parrotfishes, emperors, snappers, groupers), 17 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Looc , Romblon (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.17 for tuna catch.
2010	4.69	Not specified	31 % demersal (such as parrotfishes, emperors, snappers, groupers), 69 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Mabini, Batangas (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.69 for tuna catch.
2010	3.57	Not specified	30 % demersal (such as parrotfishes, emperors, snappers, groupers), 70 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Mabini, Batangas (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.70 for tuna catch.
2010	3.07	Not specified	36 % demersal (such as parrotfishes, emperors, snappers, groupers), 64 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Puerto Galera, Oriental Mindoro (IV)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.64 for tuna catch.
2010	3.14	Not specified	45 % demersal (such as parrotfishes, emperors, snappers, groupers), 55 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Tinambac, Camarines Sur (V)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.55 for tuna catch.

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Subsistence	**Mixed**		
1955	5.20	gleaning	fish and invertebrates	Mabini, Batangas (IV)	Average daily catch per fisher (Palomares *et al.* this volume, Figure 3D).
1965	3.40	gleaning	fish and invertebrates	Mabini, Batangas (IV)	Idem
1975	2.73	gleaning	fish and invertebrates	Mabini, Batangas (IV)	Idem
1985	2.20	gleaning	fish and invertebrates	Mabini, Batangas (IV)	Idem
1995	0.90	gleaning	fish and invertebrates	Mabini, Batangas (IV)	Idem
2003	0.75	artisanal gears	fish	Mabini, Batangas (IV)	Average daily catch per fisher (Hamoy-Obusan 2004, p. 2).
2010	2.28	gleaning	molluscs, echinoderms, crustaceans, brachiopod	Lagonoy Gulf (V)	Averaged from 40 % of the daily catch rates per gleaner from 3 coastal areas along Albay (Nieves *et al.* 2010, Tables 1a-c, p. 31-32).

Tuna artisanal fishery

The cloud of 18 points (standard error of 1.38 kg) for this sector was used to obtain a geometric mean of daily catch per fisher at 1.5 kg in 2006 (see Figure 2B) and plotted with the standardized baseline of 18 kg for 1900. The resulting relationship is presented in Equation (2):

$$\textbf{Tuna catch } (kg \cdot day^{-1} \cdot fisher^{-1};\ \log_{10}) = 149.32 - 45.16 \cdot \log_{10}(\text{Year}) \quad \dots (2)$$

The tuna fishery is seasonal throughout the Philippines, i.e., the prevalence of typhoons may prevent boats from sailing and may hamper the setting of fish aggregating devices (Barut 2007); thus, the 233 tuna fishing days averaged from data in West *et al.* (2011) is still an acceptable assumption. In addition, not all artisanal fishers in the region will go tuna fishing; i.e., we know that there is little, if not no, tuna artisanal fishing in the waters of the NCR (Williams 2002; 2004), there is quite a lot of tuna fishing (assumed at 80 %) in the two Region IV areas (which access the Sulu and South China Sea stocks; see Lewis 2004; Barut 2007) and some (assumed at 50 %) in Region V (which access the Pacific stock; Olaño *et al.* 2009). Thus, we assumed that on the average, 70 % of fishers will fish for tuna in Subzone B. The calculated daily tuna catches from Equation (2) were thus multiplied by 219 fishing days and then by 0.7*number of fishers estimated in Palomares and Pauly (this vol.) for Subzone B. The resulting annual tuna catches ranged from 11,403 t (1950) to 55,119 t (2010), with a 30 % increase per decade (see Figure 2D); this deviates only slightly from the non-tuna catch rate stated above.

Subsistence fishery

The cloud of 7 data points (standard error of 0.9 kg) for this area's subsistence fishing gave an average daily catch per fisher of 2.1 kg in 1984. The values were compared with the 5.2 kg estimate for 1950 obtained in Palomares *et al.* (this vol.) for Mabini, Batangas (Region IV-a). In addition, the geometric mean of just over 2 kg per fisher in the early 1990s is similar to the results reported in Palomares *et al.* (this vol.) and Cabanban *et al.* (this vol.). The log-log plot resulting from the use of the geometric mean and the baseline resulted in Equation (3):

$$\textbf{Subsistence catch } (kg \cdot day^{-1} \cdot fisher^{-1};\ \log_{10}) = 176.37 - 53.389 \cdot \log_{10}(\text{Year}) \quad \dots (3)$$

The daily catch per fisher estimated from Equation (3) was multiplied with an average of 156 fishing days usually practiced along Lagonoy Gulf based on a discussion by Nieves *et al.* (2010). Equation (4) in Parducho and Palomares (this volume) was used with the result of this multiplication to obtain the total subsistence catch for subzone B, which ranged from 15,570 t (1950) to 60,823 t (2012) increasing by 25 % per decade (see Figure 2D).

Catch composition

The rank and percentile analysis resulted in a list of 20 taxa making up 80 % of the catch, the most important of which is the round scad (see Figure 2E). In the 1980s, 90% of the total landed catch consisted of the following taxa in decreasing order: anchovy, round scad, sardine, frigate tuna, *Acetes*, threadfin bream, slipmouth, grouper, Indian mackerel, and cavalla. In the 1990s, this configuration slightly changed to fimbriated sardine, anchovy, frigate tuna, Indian mackerel, blue crab, slipmouth, yellowfin tuna, threadfin bream, skipjack, and round scad. Finally in the 2000s, the catch was primarily composed of round scad, Indian mackerel, yellowfin tuna, Indian sardine, frigate tuna, slipmouth, skipjack, anchovy, crevalle, and threadin bream. In all three decades, only 3 species of tuna (i.e., frigate tuna, yellowfin tuna and skipjack) were consistently part of the first 80 % of the catch. Small pelagic fishes (i.e., anchovy) followed as the second most important; demersal taxa such as slipmouths and threadfin breams, and some pelagic species usually targeted by the industrial fleet, e.g., sardines and mackerels, and the commercially important blue crab, made up the rest of the upper 80 %. We present in Figure 2E only the most important species for clarity of the graph, as there are more than 100 species caught by the artisanal fisheries in Subzone B.

Discussion

The marine ecosystems included in Subzone B vary from sandy/silt/mud substrates (e.g., San Miguel Bay; Mines *et al.* 1986) supporting fisheries for shrimps (Smith and Pauly 1983), to coral reefs supporting demersal fisheries (e.g., southwest Luzon, Mindoro, Palawan; Philreefs 2003; Fabinyi and Dalabanjan 2011), and the deeper waters of the Sulu Sea in the west and the Philippine Sea in the east supporting pelagic fisheries including tuna (Itano *et al.* 2009; West *et al.* 2011). There are several shallow embayments along these coastlines (e.g., Manila, Balayan and Tayabas Bays and Ragay Gulf in the west; Lamon and San Miguel Bays and Albay Gulf in the east), which are important nursery grounds for many fish and invertebrate species (Pauly 1982b; Silvestre *et al.* 1986), and thus, foster high productivity, notably of demersal stocks (Campos 2003).

It is thus logical that these productive areas contribute high percentages to the national landings, notably of demersal stocks. For instance, CALABARZON, MIMAROPA and the Bicol region, remained the top six fishery regions of the country in 2011 despite the decline in rate of fish catches compared from the previous year[47], i.e., 6.0 %, 4.8 % and 0.45 %, respectively (BAS 2006-2013 CountrySTAT Philippines)[48]. A large percentage of the landings, 60 % of the national fish catches in the 2000s, were from the major fishing grounds around Palawan (NEDA 2005), and Batangas' artisanal fishing sector contributed 10 % to CALABARZON's overall fish catches (Hamoy-Obusan 2004). In addition, the Bicol region contributed 5 % (137,168 t) to the total national fisheries catches in 2008 (West *et al.* 2011), 52 % of which was from the artisanal sector.

[47] Western Visayas remains as the 4th largest contributor to the country's fishery production, posted on May 8, 2012. National Statistical Coordination Board accessed on 02/12/13 from http://www.nscb.gov.ph/ru6/WA-Fishery2012.htm

[48] http://countrystat.bas.gov.ph/?cont=16&r=4; http://countrystat.bas.gov.ph/?cont=16&r=17; http://countrystat.bas.gov.ph/?cont=16&r=5

Table 2. Results of the rank and percentile analysis of marine artisanal landings for southern Luzon (representing Regions IV-V and NCR, or Subzone B) from 1981 to 2006 reported by the Philippine Bureau of Agricultural Statistics.

Rank	Percentile	English name	Scientific name
1	100.0	Round scad	*Decapterus macrosoma*
2	98.9	Anchovy	*Encrasicholina* spp.
3	97.8	Indian mackerel	*Rastrelliger kanagurta*
4	96.8	Frigate tuna	*Auxis* spp.
5	95.7	Slipmouth	*Leiognathus* spp.
6	94.7	Fimbriated sardine	*Sardinella fimbriata*
7	93.6	Yellowfin tuna	*Thunnus albacares*
8	92.6	Threadfin bream	*Nemipterus virgatus*
9	91.5	Skipjack tuna	*Katsuwonus pelamis*
10	90.5	Blue crab	*Portunus pelagicus*
11	89.4	Cavalla	*Caranx ignobilis*
12	88.4	Indian sardine	*Sardinella* sp.
13	87.3	Siganid	*Siganus* spp.
14	86.3	Big-eyed scad	*Selar crumenophthalmus*
15	85.2	Crevalle	*Alepes* spp.
16	84.2	Grouper	*Cephalopholis* spp.
17	83.1	Squid	*Loligo* spp.
18	82.1	Flying fish	*Cypselurus poecilopter*
19	81.0	Indo-Pacific mackerel	*Rastrelliger brachysoma*
20	80.0	Spanish mackerel	*Acanthocybium solandri*

The multigear and multispecies artisanal fisheries of Southern Luzon are similar to that of Northern Luzon. Gillnet is the most common gear employed by fishers in the Batangas (Hamoy-Obusan 2004) and Bicol regions (Amparado 1993; Garces and Silvestre 2010; Lim *et al.* 1995; Mines *et al.* 1986; Ordoñez *et al.* 1975; Smith and Pauly 1983; Sunderlin 1994; Yater 1982), representing 56 % of all gears used in this subzone (Silvestre and Cinco 1995; Soliman and Dioneda 1997). Soft-bottom demersal fishes, e.g., Leiognathidae, Sciaenidae, and Mullidae, make up more than 55 % to the total annual landings from San Miguel Bay, i.e., 56 % for 1997-2002 (Olaño *et al.* 2009) and 55% in 2004 (Pelea 2008). Other species caught were of the following types (based on habitat): hard-bottom demersal fishes (i.e., Serranidae, Lutjanidae, Chaetodontidae, etc.), coastal pelagic species (i.e., Clupeidae and Engraulidae), and occasional oceanic pelagic species (i.e., Scombridae) entering the bay (Pauly 1982b; Mines *et al.* 1986; Lim *et al.* 1995).

Tuna spawning grounds along the waters off west Palawan, Mindoro Strait and Sulu Sea (Barut 2007, Figure 8, p. 15) provide the adult tuna population that is exploited by this fishery. The Sulu Sea is centered on a deep isolated basin (with 500 m depths on the average; Gordon *et al.* 2011) bordered by topographic barriers which permit through flow of oceanic waters to and from the South China Sea, only through the Balabac Strait in the south and northern Palawan waters and Mindoro Strait in the north (Gordon *et al.* 2011). The migration of tuna species through these water passages allows for the mixing of stocks between the South China Sea and those from the Pacific Ocean via the Celebes Sea (Barut 2007; Campos *et al.* 2007), thus making the Sulu Sea the major tuna fishing ground of Subzone B. Palawan alone is surrounded by 13 major fishing grounds, i.e., Bacuit Bay, Malampaya Sound, Imuruan Bay, Ulugan Bay, Malanut Bay, Eran Bay, Coral Bay, Island Bay, Binunsalian Bay, Honda Bay, Green Island Bay, Taytay Bay and Sharkfin Bay (Pido *et al.* 1996, Figure 3, p. 20), where yellowfin, big-eye and skipjack tuna are the dominant species (Itano and Williams 2009). The most common gear types employed by tuna fishers are handlines (Barut *et al.* 1997; West *et al.* 2011) and gillnets (Dickson and Natividad, 1997; Itano and Williams 2009; Olaño *et al.* 2009). In Lagonoy Gulf, the largest and most important tuna fishing ground in the Bicol region, 89 % of the total landings were taken by these gears,

with scombrids and carangids making up 72 % of the catch (Olaño *et al.* 2009). Skipjack, yellowfin, eastern little, bigeye, albacore and frigate tuna (de Jesus 1982) represent 91.3 % of the Gulf's total annual landings since the late 1980s (Amparado 1993); the rest of the catch consists of large pelagic species such as sailfish, blue marlin, wahoo and dolphinfish (Olaño *et al.* 2009). Tuna fishing picked up speed in the 1960s (Barut *et al.* 2003), and by the 1970s, contributed to the dramatic increase in the country's total fish landings (Dickson and Natividad, 1997). This was not sustained, however, and by the 1980s, tuna catches from the west Sulu Sea were overtaken by small pelagic species, i.e., roundscads (*Decapterus* spp., Carangidae), anchovies (*Stolephorus* spp., Engraulidae), sardines (*Sardinella* spp., Clupeidae) and mackerels (*Rastrelliger* spp., Scombridae) (Zaragoza *et al.* 2004). Other species included in the group were round herrings (Clupeidae), fusiliers (Caesionidae), big-eyed scads (Carangidae), flying fishes (Exocoetidae), halfbeaks (Hemiramphidae), etc. (Lim *et al.* 1995; Mines *et al.* 1986; Olaño *et al.* 2009, Zaragoza *et al.* 2004), while commercially important invertebrate catches include penaeid shrimps and crabs, i.e., *Portunus pelagicus* and *Scylla serrata* (Lim *et al.* 1995).

Various reports indicate that most of the resources in this subzone are overexploited. Studies warned of biological overfishing as early as the 1960s for Manila Bay (Storer 1967) and the 1980s for San Miguel Bay (Lim *et al.* 1995; Smith and Pauly 1983). The major fishing grounds in southern Luzon, i.e., Honda Bay (Pido *et al.* 1996), Ragay Gulf (Malig and Montemayor 1987; Tandog-Edralin *et al.* 1988; Trinidad *et al.* 1993), Manila Bay (Munoz 1991), Lagonoy Gulf (Olaño *et al.* 2009; Soliman and Yamaoka 2010), San Miguel Bay (Lim *et al.* 1995; Mines *et al.* 1986; Smith and Pauly 1983; Sunderlin 1994), were reportedly overexploited since the 1980s (Malig and Montemayor 1987; Tandog-Edralin *et al.* 1987; Trinidad *et al.* 1993; Aypa 1994).

The San Miguel Bay fisheries are well studied, i.e., the comprehensive work of the International Centre on Living Aquatic Resources Management in the 1980s prompted continuous monitoring until recent years. San Miguel Bay's demersal fisheries was described as overexploited since the shift from traditional gears (i.e., hook and line and gillnet) to trawls as early as 1935; this was again described in 1947 (Warfel and Manacop 1950; Mines *et al.* 1986). Since 1948, the uncontrolled in-migration of fishers from other Philippine provinces attracted by the fishing success in the area further increased pressure on the resources (Lim *et al.* 1995). Artisanal fisheries contributed 64 % (Mines *et al.* 1986) to the total annual landings from San Miguel Bay in the early 1980s, but their contribution declined to 44 % in 1991 (Lim *et al.* 1995). Moreover, successive estimations of the artisanal catch, i.e., 19,100 t in 1980 (Pauly and Mines 1982), 17,750 t in 1990 (Silvestre and Cinco 1995), and 16,900 t in 1994-1995 allows the estimation of a decline of 12 % over a 15-year period (Soliman and Dioneda 1997).

Manila Bay, the oldest and most important demersal fishing area in the NCR (see Pauly and Chua 1988), was studied by Storer (1967). In 1951, total reported landings from the bay was 9,000 t, but by 1984, this increased to 45,000 t (Silvestre *et al.* 1987). Still, studies in the late 1950s showed a decline in both the average catch rates of fishers and in the catches of demersal fish (Munoz 1991).

This pattern is also observed in Malampaya Sound, an important fishing ground in northern Palawan, which in 1973 contributed 19 % to the total national 'municipal' landings, a figure reduced to just over 1 % in 1993 (Pido *et al.* 1996). In Lagonoy Gulf, heavy fishing pressure (Nieves *et al.* 2010; Olaño *et al.* 2009; Pelea, 2008) affecting 25 % of the demersal and pelagic fishes contributed to growth overfishing, i.e., capture of undersized and immature fishes, primarily of tuna and other important species (Olaño *et al.* 2009), and caused a 7 % decline in landings in a span of 10 years (1994-2004; Soliman *et al.* 2008).

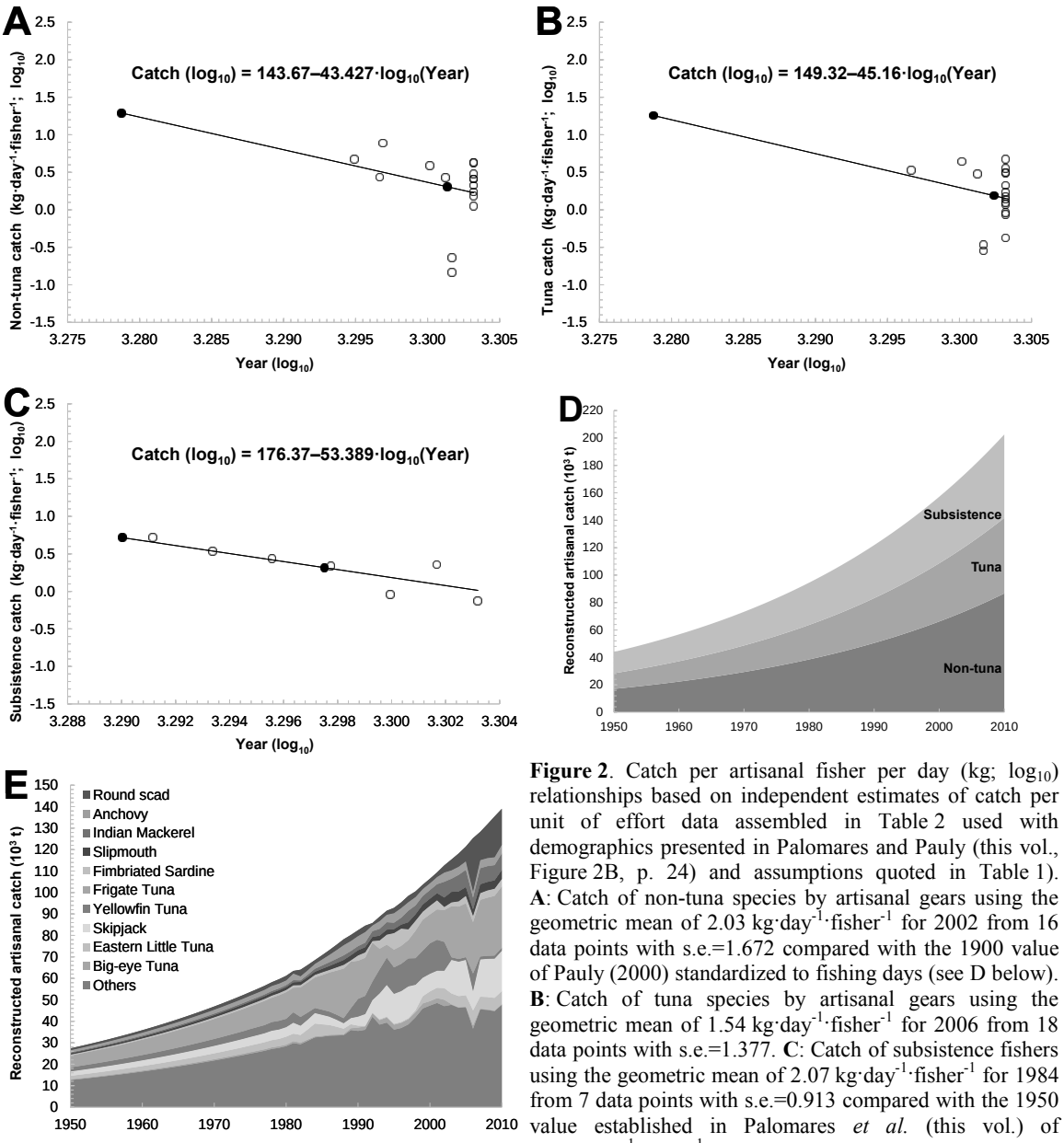

Figure 2. Catch per artisanal fisher per day (kg; $\log_{10}$) relationships based on independent estimates of catch per unit of effort data assembled in Table 2 used with demographics presented in Palomares and Pauly (this vol., Figure 2B, p. 24) and assumptions quoted in Table 1). **A**: Catch of non-tuna species by artisanal gears using the geometric mean of 2.03 kg·day^{-1}·fisher^{-1} for 2002 from 16 data points with s.e.=1.672 compared with the 1900 value of Pauly (2000) standardized to fishing days (see D below). **B**: Catch of tuna species by artisanal gears using the geometric mean of 1.54 kg·day^{-1}·fisher^{-1} for 2006 from 18 data points with s.e.=1.377. **C**: Catch of subsistence fishers using the geometric mean of 2.07 kg·day^{-1}·fisher^{-1} for 1984 from 7 data points with s.e.=0.913 compared with the 1950 value established in Palomares *et al.* (this vol.) of 5.2 kg·day^{-1}·fisher^{-1}. **D**: Reconstructed catches assuming: (i) an average of 216 fishing days in a year (based on Muallil *et al.* 2012 for landing areas within Subzone B) for non-tuna artisanal fishers; (ii) 233 fishing days for tuna artisanal fishers based on the average established for Tabaco City, Albay (with the highest landed tuna catch in the Bicol region) from West *et al.* (2011); (iii) only half of the fishers from this region engage in tuna fishing; and (iv) coastal gleaners spend 156 days in a year on subsistence fishing based on the average established from Nieves *et al.* (2010). **E**: Composition of the catch based on percentage distribution of species from available national statistics (Appendix A) and reconstructed catches in (D) showing top 5 non-tuna and all 5 tuna species caught in Subzone B.

Despite what seems to be a general trend of decreasing catch per unit of effort, reported catch from Subzone B in the 1980s continued to increase (see Smith and Pauly 1983) as did fishing effort, the number of fishers and the motorization of fishing crafts (Smith and Pauly 1983; Yater 1982). One case in point: based on the fisheries statistics published by the Bureau of Fisheries and Aquatic Resources (BFAR) and Bureau of Agricultural Statistics (BAS), the estimated total annual landings of Lagonoy Gulf was 7,737 t in 1980, but jumped to 24,292 t in 1992 (Olaño *et al.* 2009), i.e., a 68 % increase in a span of 12 years. We think these catches landed in the southern parts of the Philippines, to the extent that they actually reflect increasing catches, are due to the geographic expansion of fishing operations, a widespread phenomenon (Swartz *et al.* 2010). In the Philippines, this is manisfested in the form of increasingly frequent incursions into the EEZ of neighboring countries, especially by fisheries targeting tuna. This expansion is partly corrected for in the synthesis paper by Palomares and Pauly (this vol.).

Subsistence fishery

Extensive (qualitative) studies on the subsistence fishery specific to this area is scarce, the only records applicable to our analyses are those presented in this study. Some descriptive studies, however, provide insights on the validity of our results. In Coron, Palawan, women and children of the Calamian-Tagbanwa group were observed to engage in reef gleaning – a fishing activity performed in the day during low tides and lasts for about two hours; catches include crabs collected in the mangroves and sea urchins, sea shells, seaweeds and reef fish collected from seagrass beds and rocky reefs (Sampang, 2007). In Lagonoy Gulf, gleaning was also a traditional practice conducted by women and children along shallow reef flats, mud flats, sand and rocky areas, seagrass beds, and mangrove areas; catches include shellfish, crustaceans and other invertebrates (Nieves *et al.* 2010). Gleaning is actually an alternative source of income for the majority of fishing households along the coast, especially when fishing activities are precluded by the northeast and southwest monsoons (Barut 2007). In the case of Mabini, Batangas, during the 1950s and 1960s, gleaning of macroinvertebrates was purely for subsistence (Palomares *et al.* this vol.); likewise, 0.5-1 kg from the artisanal catch is kept by each fisher for the same purpose (Hamoy-Obusan, 2004). In addition, only 20 % of the gleaned catch was consumed and the remaining 80 % was either shared or bartered (Palomares *et al.* this vol.). In a similar case, 40 % of the catch in Lagonoy Gulf was consumed and 60 % was sold as part of the artisanal fishery (Nieves *et al.* 2010). The reconstructed catch data (see Figure 2D) suggests that the sector contributed 35 % to the total artisanal catch in 1950 and 30 % in 2010. These results are in line with the observations presented in the studies we cite above and may be a good representation of the evolution of subsistence catch in southern Luzon.

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Marine artisanal and subsistence fisheries of the Philippines, Subzone C – Visayas (Regions VI-VIII)[49]

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Abstract

Subzone C is composed of Regions VI, VII, and VIII administrative regions in the Visayas, Philippines. The Subzone C has 6 islands: Bohol, Cebu, Leyte, Panay, Samar, and Siquijor islands. The islands are fringed with mangroves, seagrass beds, coral reefs, coastal waters, and bays that are habitats of a diverse flora and fauna. This biodiversity is exploited, but the daily catch per fisher in artisanal non-tuna fisheries, artisanal tuna fisheries, and subsistence fisheries all declined from 1950 to the 2010. The reconstructed artisanal catches, increased from 31,732 t in 1950 to 71,661 t in 2010 because of increase in number of fishers in the region, and the modification of fishing gears. The artisanal non-tuna catches and artisanal tuna catches increased by 18,389 t from 1950 to 40,769 t in 2010, while tuna catches ranged from 13,342 t (1950) to 30,892 t (2010). The most notable increase was in subsistence catch, from about 15,251 t 1950 to 58,829 t in 2010. The composition of the top 20 taxa in the reconstructed catches in 1950 to 1980 changed in 1980 to 1990, and again from 1990 to 2010. The over-exploitation of the fish stocks by the artisanal fisheries is attributed to many factors, including the open access nature of the fisheries, the increase in coastal population, poverty and poor governance, all of which require different tools under the Ecosystem Approach to Fisheries.

Introduction

Subzone C covers three administrative regions (Regions VI, VII, and VIII) in the Visayas group of islands in the central Philippines (Figure 1). Samar and Leyte islands are in the eastern Visayas and bordering the Philippine Sea, west of the Pacific Ocean. Cebu, Bohol, Siguijor, and Negros islands are in central Visayas. These islands are surrounded by internal seas of the Philippines, the Bohol Sea, Camotes Sea, Visayan Sea, Tanon Strait, Cebu Strait. Panay Island is found in the western part of the Visayas and bordering the eastern part of Sulu Sea.

The islands are fringed by mangrove forests, seagrass beds, and coral reefs that provide habitats for fishes and invertebrates that are exploited by artisanal fisheries. Samar has the largest stand of mangrove forest (Zamora, 2003) and the largest man-made mangrove forest (1,700 ha) is Banacon Island, Bohol (Green *et al.* 2004; Christie *et al.* 2006). The Philippine Double Barrier Reef, one of only six double barrier reefs in the world, is found in Danajon Bank between Bohol, Cebu, and Leyte islands. The islands also have bays

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and gulfs that are enriched by nutrients from land, e.g., Carigara Bay, Leyte Gulf, Maqueda Bay, Panay Gulf (Edralin *et al.* 1988).

Subzone C is biodiverse, and 26 (21 %; n=123) integrated marine Key Biodiversity Areas (KBAs) were identified in Regions VI, VII, VIII by experts in the Philippines, based on the presence of species that are threatened and endangered (Ambal *et al* 2012). This list includes Iloilo Strait (Iloilo and Guimaras Provinces) and Concepcion (Iloilo Province) in Region VI, Sagay Protected Seascape (Negros Occidental), Bantayan Islets, Gilotangan Marine Sanctuary, and Moalboal (Cebu Province), Bais Bay (Negros Oriental), eastern coast of Siquijor (Siquijor Province), Danajon Bank (mainly in Bohol Province). The area around Cebu is the "center-of-the-center" of the world's marine biodiversity (Carpenter and Springer, 2005). The subzone has rich fishing grounds. The internal seas are shallower than the Philippine Sea to the east of Samar. The coastal waters (up to 15 km from the shoreline) surrounding the islands are the natural and accessible fishing grounds for artisanal fishers (e.g., Green *et al.* 2004; West *et al.* 2011).

The Visayas has active and complex oceanographic characteristics and a regional circulation of marine waters that responds strongly to monsoonal winds (Gordon *et al.* 2011). Oceanic water from the Pacific Ocean enters the San Bernardino Strait between Luzon Island and the Samar Islands and Surigao Strait between Samar and Surigao peninsula, northeast Mindanao. The northern inflow through San Bernardino Strait travels to the Cebu Strait and then to the Bohol Sea, where it mixes with the southern oceanic in-flow to Surigao Strait. In the Bohol Sea, there is a double estuary pattern of water movement, with the interaction of the inflow from the Sulu Sea at the surface and from the South China Sea at deeper depths (400-500 m) over the Dipolog sill. In the Bohol Sea, the in-flow from the Pacific Ocean meets the in-flow of waters from the South China and Sulu Seas forming a shallow estuary pattern over the Dipolog sill. The bottom estuary is formed by the in-flow from the South China Sea, moves over and down the sill, displacing (upwelling) waters from the bottom to the surface, where it moves to the direction of the Sulu Sea. In the Sulu Sea, monsoonal winds circulate marine waters in clockwise and counter-clockwise directions and bathe the western shoreline of Panay Island and flow into the Bohol and Visayan Seas through the Panay Strait. The active circulation of shallow and deep waters transports nutrient-rich coastal waters and up-welled waters, which drive primary productivity and fisheries.

Region VI , with a land area of 22,000 km^2, is composed of 6 provinces, 16 cities, and 117 municipalities and had a population reported at 12,500 heads in 2007 (annual growth rate at 1.35 % during the period 2000-2007; NEDA[50]). It is bounded by Jintolo Channel to the north; the Visayan Sea to the east; Panay Gulf, Sulu Sea to the south. Coral reefs and mangrove areas (swamp-land) was estimated at about 14,110 km^{-2}; Anon. 1988[51]). There are 77 coastal municipalities with rich coastal resources[52].

Region VII, with a land area of 15,000 km^2, is composed of the island provinces of Cebu, Bohol, Siquijor, and Oriental Negros (the eastern portion of Negros Island). It is bounded by the Visayan Sea to the north, Leyte to the east, Mindanao Sea to the south, and the spine of Negros Island, divides the 2 provinces of Negros Island and covers 113 municipalities with a total population of 5.2 million in 2010[53] and a fishing fleet of 78,400 vessels (Green *et al.* 2004) both motorized and non-motorized.

Region VIII , with a land area of 202 km^2, is composed of the Provinces of Leyte and Samar bounded by the Visayan Sea and the San Bernardino Strait in the north, the Mindanao Sea and Surigao Strait in the south, the Cebu Strait in the west, and the Philippine Sea in the east. It covers, 6 provinces and 136

[50] http://www.neda.gov.ph/RDP/main.asp
[51] http://www.rfu6.da.gov.ph/agribiz/index.htm
[52] http://www.rfu6.da.gov.ph/agribiz/index.htm
[53] http://www.nscb.gov.ph/

municipalities with a population of 3.9 million in 2010[3] and a fishing fleet composed of about 58,000 municipal vessels recorded in 2000 (Riviera-Guieb *et al.* 2002).

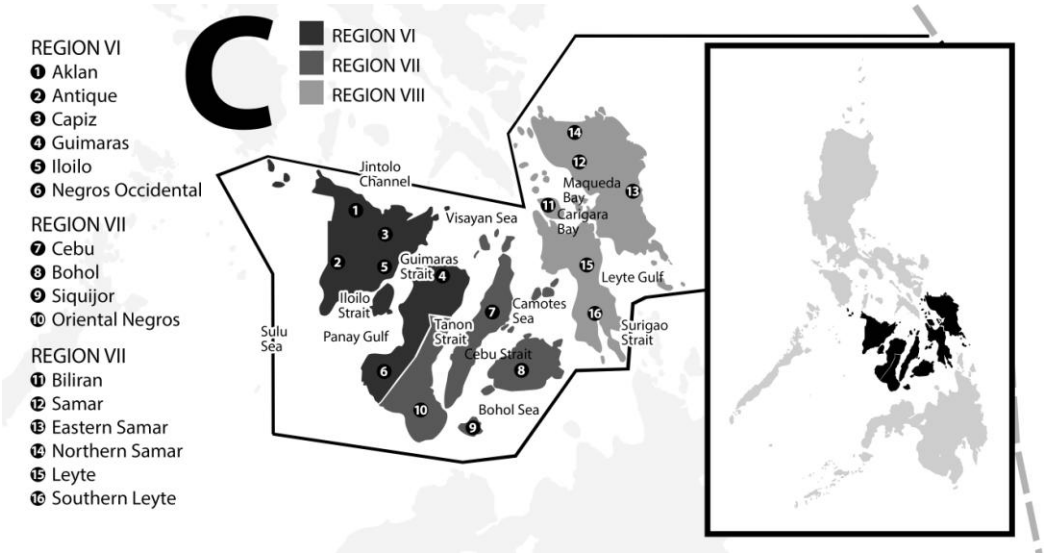

Figure 1. Map of the Visayas group of islands, central Philippines representing Subzone C (Regions VI, VII, and VIII), provinces, fishing grounds, and its surrounding waters; the insert shows this subzone (dark) relative to the Philippine EEZ (Redrawn by Mr. M.A. Yap from Figure 1 of Palomares and Pauly (this vol.) and a composite of open source maps).

Regions VI, VII, and VIII are inhabited by 16.2 million Visayans (2010[54]) with Cebu City being the second largest city in the Philippines. The provincial capital cities are also densely populated (e.g., Catbalogan, Samar, Tacloban, Leyte, Tagbilaran, Bohol, Dumaguete, Oriental Negros, Bacolod, Occidental Negros, Iloilo, Iloilo, etc.). The urban populations depend on agricultural and fishery products from rural areas of the provinces (e.g., Bais Bay supplies fishery products to Dumaguete City while Banate Bay supplies shellfish to Iloilo City – see Cabanban *et al.* this vol.; Green *et al.* 2004). The path of typhoons that develop in the Pacific Ocean passes through this area, and generally affects Samar and Leyte Island. However, on 8 December 2013, super-typhoon Yolanda landed on 5 coastal areas in Subzone C, and Guiuan, Eastern Samar, Tolosa, Leyte, Daang Bantayan, Cebu, Bantayan Island, Cebu, Concepcion, Iloilo, and Busuanga, Palawan were affected. All the typhoon's land-falls were on the islands within Regions VI, VII, and VIII except Busuanga (Region IV, Subzone B). The super-typhoon brought 10 to 30 mm hr^{-1} precipitation and winds at 215 km h^{-1}, with gusts at 250 km h^{-1}. The typhoon destroyed fishing villages and fishing boats (*bancas*) that are used by artisanal fishers.

Daily catch per fisher data

Catch (kg) per fisher per day was taken from reports or was calculated from data provided by reports (see Table 1). The annual catch per fisher was calculated as the product of catch per fisher per day and the average number of days of fishing in a year, while the average number of days of fishing was calculated based on the data in Table 2 of Muallil *et al.* 2012 for various localities.

[54] http://www.nnc.gov.ph

Artisanal non-tuna fishery

The reconstructed non-tuna fishery using artisanal gears, from the 1900 value of 4.2 $t \cdot fisher^{-1} \cdot year^{-1}$ of Pauly (2000) to geometric mean of 1.3 $kg \cdot fisher^{-1} \cdot year^{-1}$ (for 1997), was based on 29 independent data points with s.e.= 1.937 from 14 sources, mainly from localities in Central Visayas (Region VII) were research and conservation of coastal and marine resources were implemented since 1979 by Silliman University and projects funded by bilateral and multilateral donors (e.g., Coastal and Marine Resources Management Project, Fisheries Improved for Sustainable Fisheries, and others).

Artisanal tuna fishery

The reconstructed tuna catch for the Subzone was based on 4 data points in 1977 (Aprieto 1981; Table 1). These were estimates of catches using hook-and-line. The species in the catches were skipjack, yellow fin, big-eye, and frigate tunas.

Subsistence fishery

The reconstructed catch for subsistence fishery was based on information from three types of sources, 6 data points altogether (s.e.=0.814). Empirical data on gleaning were collected in Negros and Panay Islands in 2011 (Cabanban *et al.* this vol.). Secondary data were obtained from the literature (e.g., Savina and White 1986). The subsistence portion of the artisanal fishery was assumed at 10 % of the reported landing. This assumption is based on the observation of artisanal fishery in Negros Oriental by the first author that fishers keep a portion of their catch for the consumption of their families.

Catch composition data

The catch composition data was extracted from the Bureau of Agriculture and Statistics (BAS). The treatment of this data is explained in Parducho and Palomares (this vol.).

Results

The daily catch of fishers engaged in non-tuna fishing (Figure 2A), tuna-fishing (Figure 2B), and subsistence fishing (Figure 2C) strongly declined, while the reconstructed catches from these fisheries increased from 1950 to 2010 (Figure 2D). The daily catch of non-tuna species estimated by the resulting relationship expressed in Equation (1) decreased by 81% from 4.7 kg in 1950 to 0.85 kg in 2010 (Figure 2A).

$$\textbf{Non-tuna catch } (kg \cdot day^{-1} \cdot fisher^{-1};\ \log_{10}) = 179.63 - 54.394 \log_{10}(\text{Year}) \quad \dots (1)$$

The daily catch of tuna artisanal fishers estimated by the resulting relationship expressed in Equation (2) decreased by 80 % from 4.3 kg in 1950 to 0.82 kg in 2010 (Figure 2B).

$$\textbf{Tuna catch } (kg \cdot day^{-1} \cdot fisher^{-1};\ \log_{10}) = 174.88 - 52.962 \log_{10}(\text{Year}) \quad \dots (2)$$

The daily catch per subsistence fisher estimated by the resulting relationship expressed in Equation (3) decreased by 69 % from 5.2 kg in 1950 to 1.6 kg in 2010 (Figure 2C).

$$\textbf{Subsistence } (kg \cdot day^{-1} \cdot fisher^{-1};\ \log_{10}) = 128.69 - 38.897 \log_{10}(\text{Year}) \quad \dots (3)$$

Table 1. Catch of artisanal (tuna and non-tuna fisheries) and subsistence fishers in Sub-zone C (Regions VI-VIII) assembled from independent sources and used in the analysis shown in Figure 2.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal	**Non-tuna species**		
1977	0.64	Not specified	Not specified	Sumilon Island, Negros Oriental (VII)	14 $t \cdot km^{-2} \cdot year^{-1}$ (Alcala 1988, p. 197) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Alcala 1988).
1980	1.10	Not specified	Not specified	Sumilon Island, Negros Oriental (VII)	24 $t \cdot km^{-2} \cdot year^{-1}$ (Alcala 1988, p. 197) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Alcala 1988).
1980	0.38	Not specified	Not specified	Apo Island, Negros Oriental (VII)	16.75 $t \cdot km^{-2} \cdot year^{-1}$ (Alcala 1988, p. 197) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
1980	0.59	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 18.68 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
1980	0.45	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others)	Apo Island, Negros Oriental (VII)	Average daily catch per fisher assuming 3 hours of fishing per day (Maypa *et al.* 2012, p. 209)
1984	1.69	Not specified	60-65 % Caesionidae, others	Sumilon Island, Negros Oriental (VII)	36.9 $t \cdot year^{-1}$ (Alcala and Russ, 2002, p. 184) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Alcala 1988).
1984	1.78	hook and line, gillnet, trap	Not specified	Sumilon Island, Negros Oriental (VII)	Averaged from daily catch per fisher of all gears (Alcala 1988, Table 2, p. 197).
1985	0.89	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 36.7 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
1986	0.98	hook and line, gillnet, trap	Not specified	Sumilon Island, Negros Oriental (VII)	Averaged from daily catch per fisher of all gears (Alcala 1988, Table 2, p. 197).
1986	0.60	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 24.87 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Non-tuna species (continued)**		
1997	0.56	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 23.08 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
1997	3.00	hook and line	Not specified	Apo Island, Negros Oriental (VII)	Average daily catch per fisher assuming 3 hours of fishing per day (Maypa *et al.* 2012, p. 209)
1997	5.55	hook and line	Not specified	Apo Island, Negros Oriental (VII)	Average daily catch per fisher assuming 3 hours of fishing per day (Maypa *et al.* 2012, p. 209)
1999	0.70	–	–	Cangmating,, Negros Oriental (VII)	(Murphy *et al.* 1999)
2000	0.49	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 20.28 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
2001	0.98	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 19.09 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
2001	6.00	hook and line	Not specified	Apo Island, Negros Oriental (VII)	Average daily catch per fisher assuming 3 hours of fishing per day (Maypa *et al.* 2012, p. 209)
2001	3.59	hook and line	Carangidae, Acanthuridae	Apo Island, Negros Oriental (VII)	Average daily catch per fisher assuming 3 hours of fishing per day (Maypa *et al.* 2002, p. 209)
2002	3.18	gleaning	mollusks, crustaceans, brachiopods, crabs	Banate Bay, Panay Island (VI)	Averaged from annual catch, assuming 80 % of the catch was sold (del Norte-Campos *et al.* 2005, p. 15).
2004	8.84	hook and line, nets, spear, fish trap	Not specified	Bohol (VII)	Averaged from catch rates of different gears per trip (Samonte-Tan *et al.* 2007, p. 327) divided by the number of fishers (n=242; Samonte-Tan *et al.* 2007, p. 326), assuming 80 % of the catch was sold (del Norte-Campos *et al.* 2005, p. 15).
2010	3.70	Not specified	14 % demersal (such as parrotfishes, emperors, snappers, groupers), 86 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Amlan, Negros Oriental (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.14.
2010	3.30	Not specified	32 % demersal (such as parrotfishes, emperors, snappers, groupers), 68 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Boljoon, Cebu (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.32.

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Non-tuna species (continued)**		
2010	2.00	Not specified	69 % demersal (such as parrotfishes, emperors, snappers, groupers), 31 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Hinunangan, Southern Leyte (VIII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.69.
2010	2.20	Not specified	67 % demersal (such as parrotfishes, emperors, snappers, groupers), 33 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Inabanga, Bohol (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.67.
2010	4.90	Not specified	38 % demersal (such as parrotfishes, emperors, snappers, groupers), 62 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	San Francisco, Cebu (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.38.
2010	2.00	Not specified	47 % demersal (such as parrotfishes, emperors, snappers, groupers), 53 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	San Francisco, Southern Leyte (VIII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.47.
2010	4.60	Not specified	43 % demersal (such as parrotfishes, emperors, snappers, groupers), 57 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Tagbilaran City, Bohol (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.43.
2012	1.67	–	–	Bais Bay, Negros Oriental (VII)	Average daily catch per fisher (Cabanban *et al.* this vol.).
2012	0.99	–	–	Banate Bay, Panay Island (VI)	Average daily catch per fisher (Cabanban *et al.* this vol.).
		Artisanal	**Tuna species**	–	–
1980	0.59	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 18.68 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
1985	0.89	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 36.7 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
1986	0.60	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 24.87 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Tuna species (continued)**		
1989	1.82	—	—	Region VI	Guerrero (1989)
1997	0.56	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 23.08 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
2000	0.49	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 20.28 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
2001	0.98	hook and line, gillnet, spear, bamboo traps	reef (Carangidae, Acanthuridae, Caesionidae, Cephalopoda, Scaridae, Lethrinidae, Lutjanidae, Serranidae, Epinephelinae, others) and non-reef (Scombridae) fish species	Apo Island, Negros Oriental (VII)	Averaged daily catch per fisher from the total annual catch of 19.09 $t \cdot km^{-2} \cdot year^{-1}$ from a 1.06 km^2 reef area (Maypa *et al.* 2012, Table 1, p. 210) for 218 fishing days per year (average from Muallil *et al.* 2012, Table 1, p. 3) divided by the number of fishers (Russ *et al.* 2004).
2010	3.18	Not specified	14 % demersal (such as parrotfishes, emperors, snappers, groupers), 86 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Amlan, Negros Oriental (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.86.
2010	2.24	Not specified	32 % demersal (such as parrotfishes, emperors, snappers, groupers), 68 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Boljoon, Cebu (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.68.
2010	0.62	Not specified	69 % demersal (such as parrotfishes, emperors, snappers, groupers), 31 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Hinunangan, Southern Leyte (VIII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.31.
2010	0.73	Not specified	67 % demersal (such as parrotfishes, emperors, snappers, groupers), 33 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Inabanga, Bohol (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.33.
2010	3.04	Not specified	38 % demersal (such as parrotfishes, emperors, snappers, groupers), 62 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	San Francisco, Cebu (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.62.
2010	1.06	Not specified	47 % demersal (such as parrotfishes, emperors, snappers, groupers), 53 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	San Francisco, Southern Leyte (VIII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.53.

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Tuna species (continued)**		
2010	2.62	Not specified	43 % demersal (such as parrotfishes, emperors, snappers, groupers), 57 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Tagbilaran City, Bohol (VII)	Average daily catch per fisher (Muallil *et al.* 2012, Table 1, p. 3) multiplied by 0.57.
		Subsistence	**Mixed**		
2002	1.94	gleaning	–	Cordova, Cebu (VII)	Average daily catch per fisher from annual catch per gleaner (Montenegro *et al.* 2005, p. 18) for 237 fishing days per year (based on data for San Francisco, Cebu, from Muallil *et al.* 2012, Table 1, p. 3).
2002	0.80	gleaning	mollusks, crustaceans, brachiopods, crabs	Banate Bay, Panay Island (VI)	Averaged from annual catch, assuming 20 % of the catch was consumed (del Norte-Campos *et al.* 2005, p. 15).
2004	2.75	gleaning	gastropods, bivalves, echinoderms	Bohol (VII)	Average daily catch per fisher (Samonte-Tan *et al.* 2007, p. 327).
2004	2.21	hook and line, nets, spear, fish trap	Not specified	Bohol (VII)	Averaged from catch rates of different gears per trip (Samonte-Tan *et al.* 2007, p. 327) divided by the number of fishers (n=242; Samonte-Tan *et al.* 2007, p. 326), assuming 20 % of the catch was consumed (del Norte-Campos *et al.* 2005, p. 15).
2012	2.31	gleaning	fish and invertebrate	Negros Oriental (VII)	Average daily catch per fisher (Cabanban *et al.* this vol.).
2012	1.23	gleaning	fish and invertebrate	Banate Bay, Panay Island (VI)	Average daily catch per fisher (Cabanban *et al.* this vol.).

The total reconstructed catches of the artisanal non-tuna, artisanal tuna, and subsistence fisheries increased from 46,983 t in 1950 to 130,490 t in 2010 (Figure 2D). Non-tuna catches increased on the average by 14 % from 18,400 t (1950) to 40,800 t (2010), while tuna catches increased on the average by 15 % from 13,300 t (1950) to 30,900 t (2010). Subsistence catch also increased on the average by 25 % from 15,250 t (1950) to 58,800 t (2010).

Catch composition data

The catches of marine artisanal fisheries from 1981 to 2006 is mainly composed of small pelagic fishes (Table 2), including several species of sardines (rank 1, 2, 3, 7, and 14), two species of mackerel (rank 9 and 12), and 2 scads (rank 11 and 19) (Table 2). The tuna species that compose 7 % of the catches were frigate tuna (rank 8) and eastern little tuna (rank 10). The reconstructed catches of the top 20 fishes and invertebrates and those that compose 75 % of the total catches increased from 1950 to 2010 (Figure 2E).

Discussion

The artisanal fisheries is over-exploited in Regions VI, VII, and VIII as evidenced by the steady decline of catch per fisher from 1950 to 2010 in the artisanal non-tuna, artisanal tuna, and subsistence catches (Figures 2A, B, C). The decline of catches of fishers is commonly reported in coastal resources management projects but the trend is rarely quantified. The daily catch per fisher in Danajon Bank (Region VII and III) was 17.8 kg in 1950, but declined to 2.0 kg in 2000 (CRMP 1998 in Ablong *et al.*

1999). In Olango Island, Cebu (Region VII), the decline was from 20 $kg \cdot day^{-1} \cdot fisher^{-1}$ in 1960 to less than 2 $kg \cdot day^{-1} \cdot fisher^{-1}$ in 1998 (CRMP 1998). This over-exploitation of artisanal fisheries along the coastal waters surrounding the Visayan Islands was also reported in the commercial fisheries in the major fishing grounds of these Regions. For instance, Carigara Bay, Danajon Bank, Northern and South Southern Tanon Strait are exploited by more than 70 fishers km^2, while 2-70 fishers km^2 fish the waters of Northern Panay and Visayan Sea (Edralin *et al.* 1988).

Table 2. Rank and percentile analysis of marine artisanal landings for Visayas (representing Regions VI, VII and VIII, i.e., Subzone C) from 1981 to 2006 reported by the Philippine Bureau of Agricultural Statistics.

Rank	Percentile	English name	Scientific name
1	100.0	Blue crab	*Portunus pelagicus*
2	98.6	Fimbriated Sardine	*Sardinella fimbriata*
3	97.3	Slipmouth	*Leiognathus* spp.
4	96.0	Anchovy	*Encrasicholina* spp.
5	94.6	Squid	*Loligo* spp.
6	93.3	Threadfin Bream	*Nemipterus virgatus*
7	92.0	Sardine	*Sardinella* spp.
8	90.6	Frigate Tuna	*Auxis* spp.
9	89.3	Indo-Pacific Mackerel	*Rastrelliger brachysoma*
10	88.0	Eastern Little Tuna	*Euthynnus affinis*
11	86.6	Round Scad	*Decapterus macrosoma*
12	85.3	Indian Mackerel	*Rastrelliger kanagurta*
13	84.0	Sillago/Whiting	*Sillago sihama*
14	82.6	Indian Sardine	*Sardinella* sp.
15	81.3	Flying fish	*Cypselurus poecilopter*
16	80.0	Mullet	*Mugil* spp.
17	78.6	White Shrimps	*Fenneropenae* spp.
18	77.3	Crevalle	*Alepes* spp.
19	76.0	Big-eyed Scad	*Selar crumenophthalmus*
20	74.6	Acetes	*Acetes* spp.

This decline was attributed to illegal fishing practices and socio-economic conditions (e.g., Green *et al.* 2004; Alcala and Russ, 2002). Dynamite-fishing was introduced in World War II and poisoning using plant extracts began in the 1950s. The use of poisons extended to the use of cyanide to catch fish for the aquarium trade (Albaladejo *et al.* 1981) and the live reef fish food trade (Sadovy *et al.* 2003) in the 1960s. Fine-mesh nets, that are un-selective for juvenile stages, trawls that destroy the bottom fauna, and highly efficient fishing technology increasing exploitation rate were introduced in the 1970s. Monofilament and fine-mesh nets were introduced in the 1980s, while fishing vessels with large wattage of lights to attract fishes were introduced in the 1990s (albeit in commercial fisheries). Clearing of mangrove forests, reclamation on mudflats, seagrass beds, and reef flats (*e.g.*, Alcala and Russ, 2002; Christie *et al.* 2004; Green *et al.* 2003), and pollution of coastal waters from land-based sources contribute the destruction of habitats of fishes and invertebrates. Poverty in fishing communities and the incessant increase in human population are often mentioned as the causes of over-exploitation of artisanal fisheries in the Visayan region (e.g., Le Blanc 1997; Rivera-Guieb *et al.* 2002; Green *et al.* 2004).

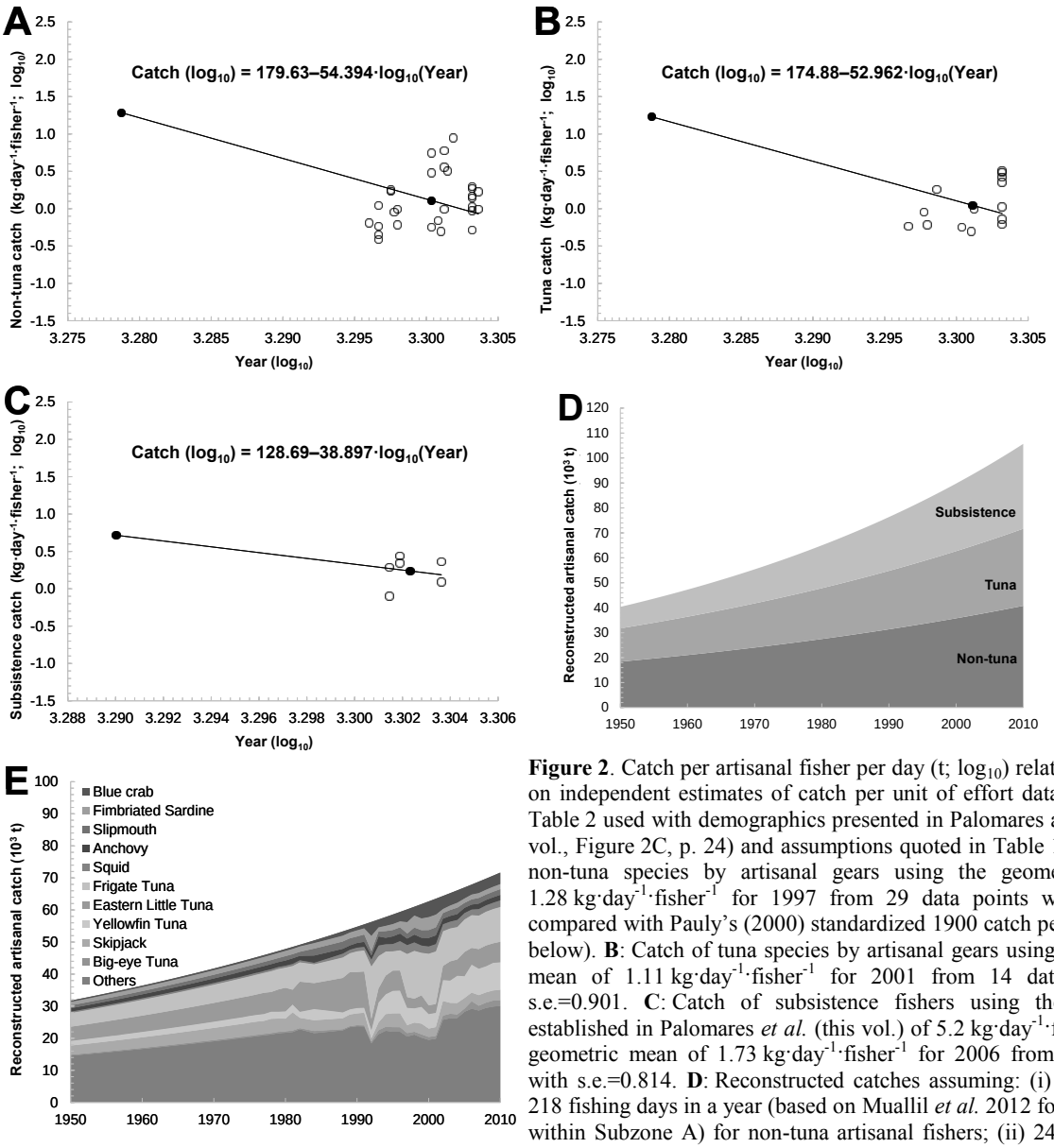

Figure 2. Catch per artisanal fisher per day (t; $\log_{10}$) relationships based on independent estimates of catch per unit of effort data assembled in Table 2 used with demographics presented in Palomares and Pauly (this vol., Figure 2C, p. 24) and assumptions quoted in Table 1). **A**: Catch of non-tuna species by artisanal gears using the geometric mean of 1.28 $kg \cdot day^{-1} \cdot fisher^{-1}$ for 1997 from 29 data points with s.e.=1.937 compared with Pauly's (2000) standardized 1900 catch per fisher (see D below). **B**: Catch of tuna species by artisanal gears using the geometric mean of 1.11 $kg \cdot day^{-1} \cdot fisher^{-1}$ for 2001 from 14 data points with s.e.=0.901. **C**: Catch of subsistence fishers using the 1950 value established in Palomares *et al.* (this vol.) of 5.2 $kg \cdot day^{-1} \cdot fisher^{-1}$ and the geometric mean of 1.73 $kg \cdot day^{-1} \cdot fisher^{-1}$ for 2006 from 6 data points with s.e.=0.814. **D**: Reconstructed catches assuming: (i) an average of 218 fishing days in a year (based on Muallil *et al.* 2012 for landing areas within Subzone A) for non-tuna artisanal fishers; (ii) 247 fishing days for tuna artisanal fishers based on the average established for Amlan, Negros Oriental, i.e., landing site of most tuna fishers from the region based on Muallil *et al.* (2012); (iii) 70 % of the fishers from this region engage in tuna fishing; and (iv) coastal gleaners spend 120 days in a year on subsistence fishing based on the average established for Banate, Iloilo from Cabanban *et al.* this vol.). **E**: Composition of the catch based on percentage distribution of species from available national statistics (Appendix A) and reconstructed catches in (D) showing top 5 non-tuna and all 5 tuna species caught in Subzone C.

This finding is similar to the rest of the Philippines and requires attention of national and local authorities to implement policies for sustainability and to enforce regulations for effective governance. Some steps are being undertaken by the government to regulate fishing effort, while ensuring that coastal communities benefit from the productivity of coastal and marine ecosystems. The Government of the Philippines has devolved the management of coastal and marine ecosystems and resources to local governments (under the Republic Act 7160, commonly called the Local Government Code). This is consistent with the principles and lessons learned in coastal resources management (e.g., DENR-BFAR- and DILG, 2001; Russ and Alcala 1999), but more is needed. The Bureau of Fisheries and Aquatic Resources are enlisting fishers in municipalities which can be considered as an initial step toward addressing the open access nature of artisanal fisheries that is another reason for the over-exploitation (DENR, BFAR, and DILG, 2001; Green *et al.* 2004).

There was an increase of catches of artisanal fisheries from 1950 to 2010 (Figure 2D and 2E), as reconstructed from available data, in spite of the progressive decline of catch-per-unit effort (Figure 2A, 2B, 2C). This increase is due to the increase in the number of fishers involved in the fishery and the modification of traditional gears (Armada *et al.* 2003, in Green *et al.* 2004). The increase was most notable in subsistence fishing, from gleaning and from various fishing gears (Cabanban *et al.* this vol.). This component of artisanal fishing is often unreported and can account for as much as 40 % of the artisanal catch in Bohol (Savina and White 1986). Subsistence fishers are traditionally from the coastal communities, but in the 1990s, farmers, especially from sugar-cane plantations in Negros Island, glean on reef flats and mud-flats for food (e.g., Le Blanc 1997; Calumpong and Pauly 1984). This suggests a certain resilience of the coastal and marine ecosystems and exploited populations in the face of an enormous fishing pressure, which could be due to the rich biodiversity of these ecosystems.

The monitoring of landings is important and needed in artisanal fisheries management in the Philippines, despite the difficulties inherent in multi-species, multi-gear, and multi-landing characteristic of the fisheries (e.g., West *et al.* 2011). The absence of reef taxa in the top 20 could indicate the under-reporting of landings from the largest reef cover in the Philippines (Gomez *et al.* 1981; Gomez *et al.* 1994; Alcala *et al.* 1987). Reef fisheries can contribute to marine fisheries catches; reef fisheries constituted 15-20 % of the marine fish production in the 1970s (Carpenter 1977; Murdy and Ferraris 1980). Groupers and wrasses were two families of reef fishes that were exploited in the live reef fish trade in the 1970s and a whole suite of species were collected for the aquarium trade in the 1960s (Albaladejo *et al.* 1981; Padilla *et al.* 2003). These trades and livelihoods based on reef fisheries contribute to marine fisheries production, incomes for fishers and associated commercial activities, and revenue for the country (Albaldejo *et al.* 1981; Sadovy *et al.* 2003). Management of reef fisheries will improve starting with the monitoring of catches in municipal waters.

The composition of the top 20 taxa (as reconstructed and illustrated in Figure 2D) changed by the decade since 1950. Non-tuna species are consistently more than tuna species in the top 20. This can be attributed to the limited data on hook-and-line fishing of tuna species (Aprieto 1995; Babaran, 2007 Lewis, 2004). The bulk of the catch from 2000 to 2010 was slipmouths (Leiognathidae), which are benthic and planktonic feeders (Pauly and Wade-Pauly 1981) and predated on by lizardfishes (Cabanban 1992). This indicates overfishing and fishing down the food-chain (Pauly *et al.* 1998; see Palomares and Pauly this volume for more in discussion of this topic).

The state of the artisanal fisheries as a result of multi-faceted factors requires a different approach to management. Establishing Marine Protected Areas appears to be insufficient to arrest the decline of the artisanal fisheries and at the same time meeting the protein requirements of people in coastal villages and urban areas. The anticipated increase in biomass in MPAs will take decades. The populations of target species on coral reefs in the MPAs in Apo and Sumilon Islands, Central Visayas will reach the threshold

in 15-40 years (Russ *et al.* 2004). Spill-over of biomass from MPAs to adjacent unprotected and fishing area albeit within 3 to 5 years were reported to have increased the catch of fishers (from the baseline, i.e., at the establishment of the MPA; see Russ *et al.* 2004). A concerted effort is needed under the framework of the Ecosystem Approach to Fisheries (FAO, 2003) management that can address the socio-economic factors that lead to the decline of catch per effort, the over-exploitation of fish stocks, and the destruction of habitats of exploited populations by illegal fishing.

Natural disasters are unpredictable events that compound the impacts of socio-economic factors on fisheries. Typhoon Yolanda destroyed the fishing boats and gears of fishers and the coastal habitats of fishes (coral reefs, seagrass beds). It was reported that 31,655 boats are needed to replace boats that were damaged or lost in the Visayas. The rehabilitation of fishing communities affected by Yolanda should learn from the lessons and recommendations of the tsunami that affected the coastal, fishing communities in Aceh, Indonesia (Anonymous, 2007). The issues or problems on the fishery sector are many, including the following: (i) change in number of fishers or nets or fishing ground (related to resource status); (ii) increased fishing capacity (boats/gear) – but varied (Aceh Besar, west vs. east coast). The corresponding recommendations were to: (i) provide fishing boats and gear in less exploited fishing areas; and (ii) promote alternative livelihoods (aquaculture, seaweed culture); and (iii) promote agriculture and land-based economic activities, etc). The general principles to rehabilitate fishing communities and their livelihoods should be founded on the following principles: (i) strategies and policies to reduce vulnerability and improve resilience (economic, sociological and environmental); (ii) consultative and participatory process with local communities, and adoption of best practices; (iii) rehabilitation of livelihoods should be based on local needs and better understanding of the enabling conditions (social, environmental, etc). The impact of the Yolanda on the coastal fisheries in Samar, Leyte, Cebu, Panay, and Palawan presents an opportunity for science-based capacitation of the artisanal fisheries for sustainability. Rebuilding livelihoods from fisheries without structural reform will only exacerbate the decline of catch per unit effort and conflicts between small-scale and commercial fishers (Pauly, 2005). The challenge is to rebuild fisheries while supporting aspirations, providing educational opportunities, and skills-development for fishers to take on land-based jobs.

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Marine artisanal fisheries of Subzone D – Mindanao (Regions IX-XIII and ARMM)[55]

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Abstract

Independent estimates of daily catch per fisher (n=27) from Misamis Occidental (X), Davao del Norte and Davao Oriental (XI), Sarangani and General Santos City (XII), and Surigao del Sur (XIII) were obtained from 11 published sources; no applicable data was found to represent the fishing ground in the Zamboanga and ARMM regions. These indicated a breadth of non-tuna catches from 1.08 $kg \cdot day^{-1} \cdot fisher^{-1}$ to 5.81 $kg \cdot day^{-1} \cdot fisher^{-1}$ (n=12, s.e.=1.27, covering 1996-2010) and tuna catches from 1.43 $kg \cdot day^{-1} \cdot fisher^{-1}$ to 6.71 $kg \cdot day^{-1} \cdot fisher^{-1}$ (n=12, s.e.=1.51, covering 1993-2010). These data sets were compared, using log-transformed regression analyses, to the 1900 estimates of 18.4 $kg \cdot day^{-1}$ $fisher^{-1}$ (standardized to 228 fishing days as practiced in the region) for the non-tuna, and 20.2 kg $fisher^{-1} \cdot day^{-1}$ (standardized to 208 fishing days) for the tuna fisheries. Results indicate decreasing trends in daily catches per fisher from the 1950s to the 2000s, with average rates of 68% for non-tuna and 71% for tuna fisheries. Estimates of subsistence catch obtained from Misamis Occidental (X) and Sarangani (XII) ranging 1.89-2.5 kg $fisher^{-1} \cdot day^{-1}$ (n=3; s.e.=0.26; covering 1998-2010) were compared to the baseline of 5.2 $kg \cdot day^{-1} \cdot fisher^{-1}$ in a log-transformed regression analysis. Results indicate an average decline in daily subsistence catch per fisher of 71% over a 50-year period. Total artisanal catch for the subzone estimated as the product of predicted daily catch per fisher, number of fishers and average number of fishing days in a year resulted in a reconstructed time series with catches of 30,459 $t \cdot year^{-1}$ (1950) to 209,613 $t \cdot year^{-1}$ (2010) and an average increase of 38% per decade. The reconstructed total catch separated into species components, using the percent species composition of reported artisanal fisheries statistics for the subzone, suggests that frigate tuna (*Auxis* sp.) is the most important exploited species in the subzone over the three decades for which this data was collected (1980s to 2000s), while other tuna species (e.g., yellowfin tuna, eastern little tuna and skipjack) and small pelagic species (eg. anchovy and sardines) are consistently represented in the upper 80% of the catch.

Introduction

Mindanao, hereafter referred to as Subzone D (see Figure 1), the second largest island following Luzon, is subdivided into six administrative regions (IX, X, XI, XII, XIII and ARMM) located south of the Philippine archipelago. It was named after the Maguindanaos, the largest Sultanate group in the 17th and 18th centuries; it is also the area in the country where most Filipino Muslims reside.[56] The region has a vast land mass and surrounding extent of marine waters (i.e., Sulu Sea on the west, Celebes Sea on the south and Philippine Sea on the east), and agriculture and fishery each contribute 37 % to the island's Gross Domestic Product (GDP) in 2002 (NSCB Fact Sheet, August 6, 2003).

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[56] Mindanao. Northern Mindanao Natural Resources Management Council and the Mindanao Association of Water Districts accessed on 29/11/13 from http://www.benphil.com/mindanaoprofile.htm

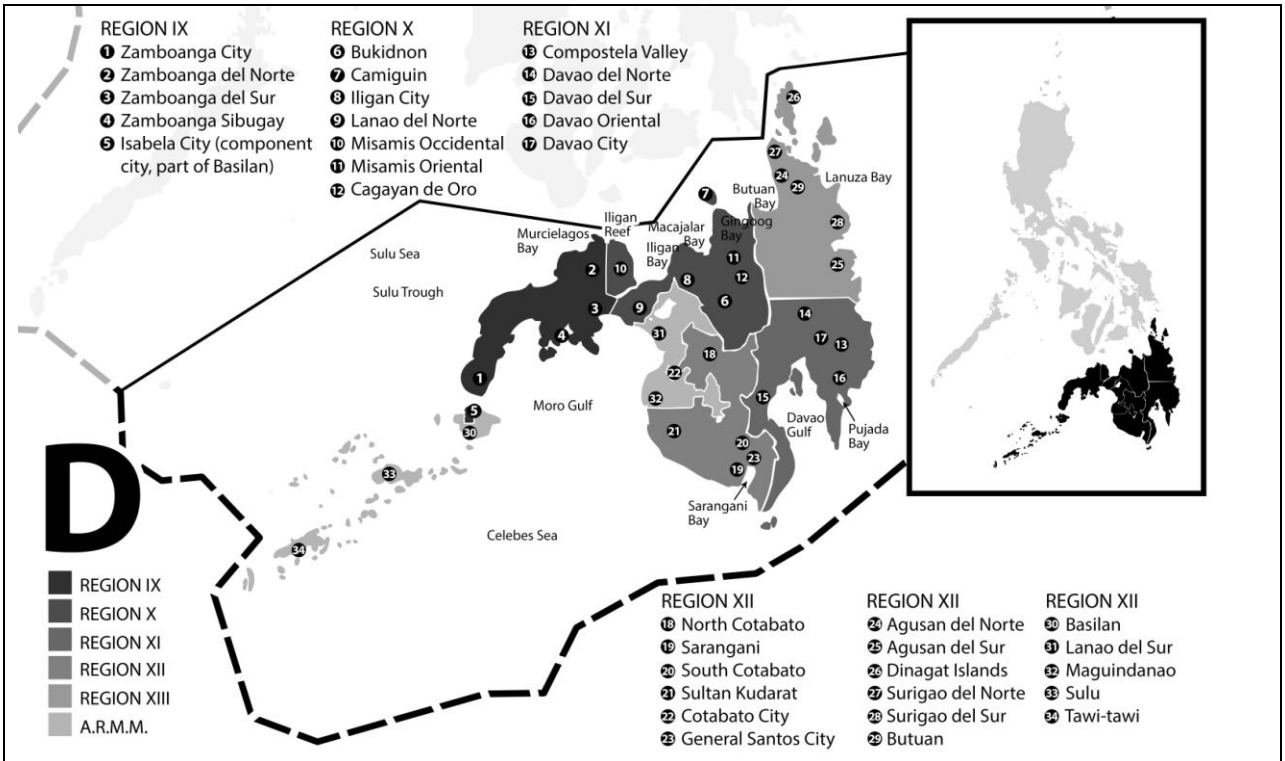

Figure 1. Subzone D, Mindanao, showing the administrative regions (Regions IX, X, XI, XII, XIII and ARMM), provinces, fishing grounds, and its surrounding waters; the insert shows this subzone (dark) relative to the Philippine EEZ (Redrawn by Mr. M.A. Yap from Figure 1 of Palomares and Pauly (this vol.) and a composite of open source maps).

Region IX, previously known as Western Mindanao, is now called the Zamboanga Peninsula by virtue of Executive Order No. 36 of 2001.[57] It is composed of basically three provinces (i.e., Zamboanga del Norte, Zamboanga del Sur and Zamboanga Sibugay) and two cities, Zamboanga City and Isabela City, part of Basilan), covering a total land area of 18,730 km^2 – 18 % of Mindanao's land mass – with Zamboanga del Norte as the widest and Isabela City as the narrowest.[58] The region is bounded by the Sulu Sea on the north, Panguil Bay on the east, and Moro Gulf on the south. [59]

Region X, Northern Mindanao is subdivided into five provinces (i.e., Bukidnon, Camiguin, Lanao del Norte, Misamis Occidental and Misamis Oriental) and two cities (i.e., Cagayan de Oro and Iligan), covering a total land area of 17,150 km^2.[60] It is bounded by Mindanao Sea on the north, Zamboanga Peninsula in the west, Davao and Cotabato in the south and CARAGA region in the east. It had a population growth rate of 2.08 %·$year^{-1}$ in 2000, higher than the national growth rate of 2.02 %·$year^{-1}$, with Cagayan de Oro as the most populous. Panguil Bay and Murceillagos Bay, the two most important

[57] Zamboanga Peninsula. Department of Environment and Natural Resources accessed on 29/11/13 from http://r9.denr.gov.ph/index.php/about-us/regional-profile
[58] Region IX Zamboanga Peninsula regional profile brief description. Department of Tourism accessed on 29/11/13 from http://www.visitmyphilippines.com/index.php?title=Brief%20Description&func=single&pid=790&Page=1&tbl=0
[59] Regional profile of Zamboanga peninsula region. Department of Agriculture accessed on 29/11/13 from http://zambo.da.gov.ph/profile.html
[60] Region X regional profile. Department of Environment and Natural Resources accessed on 29/11/13 from http://r10.denr.gov.ph/index.php/about-us/regional-profile

fishing grounds in the area, are currently threatened by siltation and dumping of mine tailings which may impact the fishery resources.[61]

The Davao region (Region XI) is located southeast of Mindanao, thus its other name of 'Southern Mindanao'. Based on records of early Jesuit priests, it was named from the word *daba-daba*, the *Bagobo* term for fire.[62] It is composed of four provinces (i.e., Compostela Valley, Davao del Norte, Davao Oriental and Davao del Sur) and an independent city (i.e., Davao City), encompassing a total land area of 20,000 km^2 with Davao Oriental as the widest and Davao City as the narrowest.[63] It is bounded by the CARAGA region in the north, Philippine Sea on the east, Celebes Sea on the south and Cotabato in the west. Five of the country's major fishing grounds are located here, i.e., Davao Gulf, Mayo Bay, Pujada Bay, Sarangani Bay and Sarangani Strait.

Region XII, otherwise known as Central Mindanao, was created under Presidential Decree No. 742 in 1975; with the creation of ARMM in 2001 under Executive Order No. 36, the region was reorganized and is now called SOCCSKSARGEN.[64] The acronym stands for its four provinces (i.e., North Cotabato, Sarangani, South Cotabato and Sultan Kudarat) and two independent cities (i.e., Cotabato City and General Santos City) , covering a total land area of 19,000 km^2 – 18.5 % of Mindanao's land mass, slightly larger than the Zamboanga peninsula.[65] It is bounded by Bukidnon and Lanao del Sur in the north, Davao in the east, Celebes Sea on the south and Moro Gulf on the west[66] The region ranked second most populous in the country, with a population growth of 2.5 %·$year^{-1}$ which is far higher than the national growth rate.[67]

The CARAGA Administrative Region (Region XIII), located northeast of Mindanao created under Republic Act No. 7901 in 1995, is subdivided into five province (i.e., Agusan del Norte, Agusan del Sur, Surigao del Norte, Surigao del Sur and the Dinagat Island province) and an independent city (i.e., Butuan City), covering a total land area of 19,000 km^2 – 7 % of the country's total land area. It is bounded by Surigao Strait on the north, Philippine Sea on the east, Compostela Valley in the south and the provinces of Northern Mindanao in the west.[68]

The Autonomous Region in Muslim Mindanao (ARMM), located southwest of Mindanao, was created under Republic Act No. 6734 in 1989 as part of a negociated settlement with the Moro National Liberation Front (MNLF). Its administrative divisions (i.e., Lanao del Sur, Maguindanao, Sulu and Tawi-tawi) were later reorganized in 2001 under Executive Order No. 36 and Republic Act No. 9054 to include Basilan (except Isabela City).[69] It is bounded by Sulu Sea on the north, Moro Gulf on the east, Celebes Sea on the south and Sulu Sea on the west.

[61] Northern Mindanao. Commission on Population accessed on 29/11/13 from http://www.popcom.gov.ph/regions/10/Regional%20Profile.htm

[62] Regional profile. Department of Environment and Natural Resources accessed on 29/11/13 from http://r11.denr.gov.ph/index.php/about-us/regional-profile

[63] Regional profile. Department of the Interior and the Local Government accessed on 29/11/13 from http://region11.dilg10.org/index.php/regional-profile

[64] Regional profile. Department of Environment and Natural Resources accessed on 29/11/13 from http://r12.denr.gov.ph/index.php/about-us/regional-profile

[65] Region 12. Department of Trade and Industry accessed on 29/11/13 from http://www.dti.gov.ph/dti/index.php?p=82

[66] Region XII profile. Department of Health accessed on 29/11/13 from http://chd12.doh.gov.ph/index.php/profile/regional-profile

[67] Region XII: SOCCSKSARGEN. National Nutrition Council accessed on 29/11/13 from http://www.nnc.gov.ph/component/k2/itemlist/category/85

[68] Profile. Department of Environment and Natural Resources accessed on 29/11/13 from http://denrcaraga.site90.com/index.php?p=1_3

[69] ARMM history. National Nutrition Council accessed on 29/11/13 from http://www.nnc.gov.ph/component/k2/itemlist/category/97

The whole island of Mindanao is surrounded by rich fishing grounds, among them IliganBay and Panguil Bay in the north and Sarangani Bay in the south (see Figure 1). There is evidence of declining fish catch based on studies conducted by Abrea *et al.* (1986), Perpetua (2007) and the Mindanao State University (MSU) along the coastal municipalities of Misamis Occidental, under the PCAMRD-DOST project entitled "Formation of a provincial coastal resource management alliance for Misamis Occidental" in 2007 and 2009. Panguil Bay is thus considered overfished since the 1970s or early 1980s (see also Jimenez *et al.* 2009). Sarangani Bay, located south of Mindanao, on the other hand, is characterized by fringed mangroves and coral reefs with some areas having a rocky shoreline (de Jesus *et al.* 2001); no reports on its exploitation status were available.

The degree of exploitation in these marine ecosystems is basically dependent on the number and types of gear used by fishers, these are: (1) hook and line, i.e., handline, longline, simple and multiple hook and lines; (2) net types, i.e., gillnet, bottom-set gillnet, drift gillnet, fish net, etc.); (3) spear and traps; and (4) others, i.e., beach seine, fish corral, fish pot, bagnet, etc. (de Guzman, 2004; de Guzman *et al.* 2009; de Jesus *et al.* 2001; Jimenez *et al.* 2009; Perpetua 1997; Valle *et al.* 2000). Demersal fish species are the major catch of the artisanal sector, i.e., parrotfishes (Scaridae; *Scarus* spp.), rabbitfishes (Siganidae; *Siganus* spp.), emperors (Lethrinidae; *Lethrinus* spp.), mojarras (Gerreidae), wrasses (Labridae), moray eels (Muraenidae), cardinal fish (Apogonidae), goatfish (Mullidae), unicornfish (Acanthuridae), sea bream (Nemipteridae). However, small pelagic fish species such as halfbeaks (Hemiramphidae), flying fishes (Exocoetidae) and anchovies (Engraulidae) are also included in the catch; as well as some macroinvertebrates such as squids (*Loligo* spp. and *Sepioteuthis* spp.), octopus (*Octopus* spp.), cuttlefish (*Sepia* spp.), crabs (Portunidae) and penaeid shrimps (de Guzman, 2004; de Jesus *et al.* 2001; Valle *et al.* 2000). The similarity in the gears employed and the catch composition of landings in these two fishing grounds support our assumption that the behaviour of fishing and fishers in the regions within this subzone are similar, even if it covers a wide range of habitats.

Daily catch per fisher data

The following sections present the catch per fisher per sector data obtained from sources independent from those estimated by Philippine government institutions. The sectors were divided into 3, namely: artisanal non-tuna, artisanal tuna, and subsistence catches (see Parducho and Palomares. this vol.).

Artisanal non-tuna fishery

The reconstructed non-tuna artisanal catch of subzone D were based on 12 independent estimates of catch per fisher per day from 8 sources (Table 2). These were based on studies along the coasts of Davao Oriental, General Santos City, Misamis Occidental, Sarangani and Surigao del Sur. No applicable catch per fisher data were found to represent catch rates from the Zamboanga and ARMM regions. The available data are believed to be a good representation for Subzone D since the fishing grounds listed above cover all its parts. The different gears employed in each coastal region represented by data in Table 1 are principally of the following types: hook and line (single/multiple), net (bottom-set gillnet, encircling gillnet, surface/drift gillnet, lift net, bagnet, scissor net), spear and traps (beach seine, fish trap). Other gears used were fish corral, fish pot, jigger, etc. The catch of these gears are composed mostly of demersal fish species (e.g., emperors, fusilier, goatfish, groupers, parrotfish, siganids, snappers, etc.) and may often include small pelagic fish species (e.g., anchovies, herring, mackerels and scads) and/or macroinvertebrates (blue crab, shrimps, squids, etc.).

The daily catch per fisher of non-tuna species, ranging from 1.1 kg to 5.8 kg were obtained from different data types, as was the case in Parducho and Palomares (this vol.). Direct estimates of catch per fisher were multiplied to the percentage of non-tuna in the catch (as e.g., in Muallil *et al.* 2012), following the

procedure described by Parducho and Palomares (this vol.). Monthly and annual catch rates of gears were divided by the average number of fishing days per year based on the number of days per month and/or the number of months per year of gear use (as, e.g., in Perpetua 1997). Different catch rates of gears per subarea were averaged to represent the locality as a whole. These 12 data points were then compared with the estimate in Pauly (2000) of 4.2 $t \cdot fisher^{-1} \cdot year^{-1}$, standardized to 18.4 $kg \cdot fisher^{-1} \cdot day^{-1}$, assuming that the number of fishing days per year was equivalent to 228 days based on the average obtained from data for the region from Muallil *et al.* (2012).

Tuna artisanal fishery

The reconstructed artisanal tuna catch of the subzone was based on 12 independent estimates of daily catch per fisher from 6 sources (Table 1). The majority were from studies made along the coasts of Davao, i.e., Davao del Norte and Davao Oriental, while others were from General Santos City, Misamis Occidental, Sarangani and Surigao del Sur. The fishing grounds to which these regions are exposed to are similar to those previously stated for the non-tuna artisanal fishery of this subzone. The gears used by fishers in this sector were gillnet (bottom-set gillnet, encircling gillnet, surface/drift gillnet), handline (multiple/simple), hook and line (multiple/simple), longline (surface longline, bottom-set longline), and fish corral. The catch was usually composed of frigate (*Auxis thazard*) and yellowfin tuna (*Thunnus albacares*). Although tuna was the most important group in terms of weight, the catch includes other groups, i.e., dolphinfish (*Coryphaena hippurus*), sharks and rays, anchovies, herring, mackerels, mullet and scads, and some demersal species.

The maximum and minimum daily catches of tuna species per fisher were recorded at 6.7 kg and 1.4 kg, respectively. These values were of the same data types as those discussed for the non-tuna artisanal fishery. For cases where tuna was included as target species, the estimated catch per fisher was multiplied by the percentage of tuna in the catch; if not specified, this percentage was computed based on the corresponding weight contributions of each species to the total catch (see, e.g., Valle *et al.* 2000). The 1900 estimate was standardized to 20.2 $kg \cdot fisher^{-1} \cdot day^{-1}$, assuming that the number of fishing days then was equivalent to 208 days, based on the average tuna fishing days for Lanuza, Surigao del Sur, and Mati City, Davao Oriental, (areas with the highest % pelagic species in their catch, i.e., >40 % of the total catch), from Muallil *et al.* (2012).

Subsistence fishery

The reconstructed subsistence catch of this subzone was based on 3 independent estimates of daily catch per fisher (Table 1). Catch rates were from Sarangani and Misamis Occidental, from gleaning and artisanal fishery studies, respectively. De Jesus *et al.* (2001) reported gleaning as a separate data from the analysis of artisanal fishery for Sarangani Bay. It was assumed to be purely subsistence, but was not further discussed. Also note that a portion of the artisanal catch, i.e., 10-20 %, is retained by fishers for household consumption, as reported by de Guzman *et al.* (2009). This percentage was used to estimate the subsistence catch per fisher from the artisanal sector. These values were then compared with the 1950 estimate of a purely subsistence catch in Palomares *et al.* (this vol.) of 5.2 $kg \cdot fisher^{-1} \cdot day^{-1}$.

Catch composition data

The most important species in the catch were obtained using rank and percentile analysis (see Parducho and Palomares, this vol.). This list was then used to graph the species or taxon groups that represent 75 % of the catch.

Table 1. Catch of artisanal (tuna and non-tuna fisheries) and subsistence fishers in Zone D (Regions IX-XIII and ARMM) assembled from independent sources and used in this analysis.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal	**Non-tuna species**		
1996	2.70	encircling gillnet, surface/drift gillnet, bottom-set gillnet, multiple hook and line, single hook and line, lift net, bag net, beach seine	*Stolephorus* spp., *Carangoides malabaricus*, *Dussumieria acuta*, *Sardinella* spp., *Pterocaesio pisang*, *Hemirhamphus* sp., *Atherina atherina*, *Leiognathus* sp., *Decapterus kurroides*, *Selar* boops, exocoetids	Iligan Bay (X)	Total recorded catch of 79,373.6 kg from 3 municipalities surrounding the bay, i.e., Initao, Kauswagan and Sinacaban, for 228 fishing days (Perpetua 1997, Table 10, p. 33) divided by the number of fishers (n=129; Perpetua 1997, Table 14, p. 42).
1998	2.24	beach seine, bottom-set gillnet, drift gillnet, fish corral, fish net, fish trap, gillnet, jigger, multiple hook and line, spear gun, set gillnet, single hook and line	mackerel, runner, goatfish, milkfish, damselfish, rabbitfish, slipmouth, ponyfish, jack/ cavalla/crevalle/trevally/darts, sardine/herring/sprat gizzard shad, fusilier/banana fish, whiting/sillago, moonfish, squid, octopus, billfish, scad, hairtail/cutlass, mullet, terapon/tigerfish, parrotfish, spadefish, scat, emperor bream, glassyfish, mud/mangrove crab, squirrel/soldier fish, anchovy, threadfin bream, halfbeak, snapper, grouper	Sarangani and General Santos City (XII)	Averaged from daily catch rates of non-tuna gears (de Jesus *et al.* 2001, Tables 5.9-5.10, p. 71) divided by the total number of fishers (n=3007; de Jesus *et al.* 2001, Table 5.8, p. 70).
2001	2.26	fish corral, gillnet, single hook and line, multiple hook and line, fish pots, spear gun, scissor net, beach seine, others	Acanthuridae, Serranidae, Haemulidae, Scaridae, Lethrinidae, Caesionidae, Pomacentridae, Labridae, others	Danao Bay, Misamis Occidental (X)	Averaged from daily catch per fisher estimates for Mar 2001-Feb 2002 from 6 coastal villages surrounding the bay, i.e., Tugas, Misom, Landing, Sinian, Bato and Danao (de Guzman, 2004, Table 8, p. 28).
2005	1.36	simple hook and line, bottom-set gillnet, spear fishing, traditional fish corral, bottom-set longline, modified fish corral, filter net, crab lift net, bamboo crab pot, fish trap, cast net, staionary lift net, small bag net, drift gill net	finfish, crustaceans, mollusks	Panguil Bay	Total landed catch of 201.1 t from 10 barangays surrounding the bay, i.e., Segapod, Rebucon, Darumawang, Raw-an Pt., Margos, Lintugop, Angeles, Migpange, Maquilao and San Antonio (Jimenez *et al.* 2009; Table 1, p. 17) for Apr-Dec 2005 (i.e., 180 fishing days; assumed from a maximum of 20 fishing days per month, based from Jimenez *et al.* 2009, p. 16) divided by the average number of fishers (n=825; Jimenez *et al.* 2009, Table 3, p. 23).
2007	2.53	set gillnet, bottom-set gillnet, gillnet, surface/drift gillnet, simple hook and line, multiple hook and line, seine, hook and line, squid jigger, spear	highly valued demersal species caught: *trakito*/*mamsa* (jack/trevally), *katambak* (snapper), *kitong* (rabbitfish), *danggit* (siganid), *timbongan* (goatfish) and *nokos* (seabass)	Jimenez, Misamis Occidental (X)	Averaged from daily catch rates of non-tuna gears (MSU, 2007a, Table 13, p. 34) divided by the number of fishers per gear (MSU, 2007a, Table 12, p. 32).
2007	3.50	bottomset longline, single/multiple hook and line, bottom-set gillnet, modified squid handline, net type, spear, beach seine, fish pot, fish corral	highly valued demersal species caught: *trakito*/*mamsa* (jack/trevally), *katambak* (snapper), *kitong* (rabbitfish), *danggit* (siganid) and *timbongan* (goatfish)	Panaon, Misamis Occidental (X)	Averaged from daily catch rates of non-tuna gears (MSU, 2007b, Table 15, p. 35) divided by the number of fishers per gear (MSU, 2007b, Table 13, p. 33).

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal (continued)	**Non-tuna species (continued)**		
2008	1.90	hook and line, simple hook and line, spear, fish trap, gillnet, surface longline, scoop net, spear, drive-in net, handline, seine	Not specified	Oroquieta City, Misamis Occidental (X)	Averaged from estimated annual catch rates of non-tuna gears for 6 barangays, i.e., Paypayan, Mobod/Dulapo, Canubay, Lower Loboc, Taboc Norte/Sur, and San Vicente Bajo, divided by the average number of fishing days and months the gear was used and number of fishers using the gear (MSU, 2009, Table 14, p. 42)
2010	3.90	Not specified	64 % demersal (such as parrotfishes, emperors, snappers, groupers), 36 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Cantilan, Surigao del Sur (XIII)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.64 for non-tuna catch.
2010	3.00	Not specified	83 % demersal (such as parrotfishes, emperors, snappers, groupers), 17 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Cortes, Surigao del Sur (XIII)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3).
2010	1.08	Not specified	43 % demersal (such as parrotfishes, emperors, snappers, groupers), 57 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Lanuza, Surigao del Sur (XIII)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.43 for non-tuna catch.
2010	5.81	Not specified	57 % demersal (such as parrotfishes, emperors, snappers, groupers), 43 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Mati City, Davao Oriental (XI)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.57 for non-tuna catch.
2010	2.99	Not specified	65 % demersal (such as parrotfishes, emperors, snappers, groupers), 35 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Samal City, Davao Oriental (XI)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.65 for non-tuna catch.
1993	1.62	nets (bag net, bottom set gillnet, drift gillnet, gillnet, lift net, scoop net), hook and line (long line, multiple hook and line), traps (fish trap, squid trap), others (speargun, fish corral)	80 % tuna (*Auxis thazard*, *Thunnus albacares*), stingray *Dasyatis* sp.), shark, flying fish, dolpin fish (*Coryphaena* sp.), other pelagic (mullet, anchovies, mackerels, scads); 20 % demersal (siganid, goatfish, parrotfish, emperor, wrasse, grunt/perch, surgeonfish, grouper, cavalla, cardinal fish, snapper, fusilier) and invertebrates (squid, octopus, cuttlefish, blue crabs, shells, shrimps, prawns)	Malalag Bay, Davao del Norte (XI)	Average annual landed catch of 537 t divided by the average number of fishers (n=1456) from 5 municipalities surrounding the area, i.e., Hagonoy, Malalag, Padada, Sta. Maria and Sulop (Valle *et al.* 2000, Table 5.3, p. 66).
1994	1.70	nets (bag net, bottom set gillnet, drift gillnet, gillnet, lift net, scoop net), hook and line (long line, multiple hook and line), traps (fish trap, squid trap), others (speargun, fish corral)	80 % tuna (*Auxis thazard*, *Thunnus albacares*), stingray *Dasyatis* sp.), shark, flying fish, dolpin fish (*Coryphaena* sp.), other pelagic (mullet, anchovies, mackerels, scads); 20 % demersal (siganid, goatfish, parrotfish, emperor, wrasse, grunt/perch, surgeonfish, grouper, cavalla, cardinal fish, snapper, fusilier) and invertebrates (squid, octopus, cuttlefish, blue crabs, shells, shrimps, prawns)	Malalag Bay, Davao del Norte (XI)	Average annual landed catch of 553 t divided by the average number of fishers (n=1424) from 5 municipalities surrounding the area, i.e., Hagonoy, Malalag, Padada, Sta. Maria and Sulop (Valle *et al.* 2000, Table 5.3, p. 66).

Table 1. Continued.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
		Artisanal	**Tuna species**		
1995	2.92	nets (bag net, bottom set gillnet, drift gillnet, gillnet, lift net, scoop net), hook and line (long line, multiple hook and line), traps (fish trap, squid trap), others (speargun, fish corral)	80 % tuna (*Auxis thazard*, *Thunnus albacares*), stingray *Dasyatis* sp.), shark, flying fish, dolpin fish (*Coryphaena* sp.), other pelagic (mullet, anchovies, mackerels, scads); 20 % demersal (siganid, goatfish, parrotfish, emperor, wrasse, grunt/perch, surgeonfish, grouper, cavalla, cardinal fish, snapper, fusilier) and invertebrates (squid, octopus, cuttlefish, blue crabs, shells, shrimps, prawns)	Malalag Bay, Davao del Norte (XI)	Average annual landed catch of 964 t divided by the average number of fishers (n=1446) from 5 municipalities surrounding the area, i.e., Hagonoy, Malalag, Padada, Sta. Maria and Sulop (Valle *et al.* 2000, Table 5.3, p. 66).
1996	2.72	nets (bag net, bottom set gillnet, drift gillnet, gillnet, lift net, scoop net), hook and line (long line, multiple hook and line), traps (fish trap, squid trap), others (speargun, fish corral)	80 % tuna (*Auxis thazard*, *Thunnus albacares*), stingray *Dasyatis* sp.), shark, flying fish, dolpin fish (*Coryphaena* sp.), other pelagic (mullet, anchovies, mackerels, scads); 20 % demersal (siganid, goatfish, parrotfish, emperor, wrasse, grunt/perch, surgeonfish, grouper, cavalla, cardinal fish, snapper, fusilier) and invertebrates (squid, octopus, cuttlefish, blue crabs, shells, shrimps, prawns)	Malalag Bay, Davao del Norte (XI)	Average annual landed catch of 826 t divided by the average number of fishers (n=1335) from 5 municipalities surrounding the area, i.e., Hagonoy, Malalag, Padada, Sta. Maria and Sulop (Valle *et al.* 2000, Table 5.3, p. 66).
1998	2.21	bottom-set gillnet, drift gillnet, fish corral, gillnet, single hook and line	tuna, dolphinfish, shark, flying fish, some demersal and small pelagic species	Sarangani and General Santos City (XII)	Averaged from daily catch rates of tuna gears (de Jesus *et al.* 2001, Tables 5.9-5.10, p. 71) divided by the total number of fishers (n=3007; de Jesus *et al.* 2001, Table 5.8, p. 70).
2007	1.44	set gillnet, bottom-set gillnet, gillnet, surface/drift gillnet, multiple hook and line, hook and line, seine	majority of species caught: *pirit* (tuna), *borot* (scad), *lumayagan* (squid), *bolinao* (anchovy), *lupoy* (sardines)	Jimenez, Misamis Occidental (X)	Averaged from daily catch rates of tuna gears (MSU, 2007a, Table 13, p. 34) divided by the number of fishers per gear (MSU, 2007a, Table 12, p. 32).
2007	6.42	bottom-set longline, multiple hook and line, bottom-set gillnet, modified squid handline, beach seine, fish pot, fish corral	majority of species caught: *pirit* (tuna), *borot* (scad), *lumayagan* (squid), *bolinao* (anchovy), *lupoy* (sardines)	Panaon, Misamis Occidental (X)	Averaged from daily catch rates of tuna gears (MSU, 2007b, Table 15, p. 35) divided by the number of fishers per gear (MSU, 2007b, Table 13, p. 33).
2008	6.71	gillnet, surface longline, handline, FAD	Not specified	Oroquieta City, Misamis Occidental (X)	Averaged from estimated annual catch rates of non-tuna gears for 6 barangays, i.e., Paypayan, Mobod/Dulapo, Canubay, Lower Loboc, Taboc Norte/Sur, and San Vicente Bajo, divided by the average number of fishing days and months the gear was used and number of fishers using the gear (MSU, 2009, Table 14, p. 42).
2010	2.20	Not specified	64 % demersal (such as parrotfishes, emperors, snappers, groupers), 36 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Cantilan, Surigao del Sur (XIII)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.36 for non-tuna catch.
2010	1.43	Not specified	43 % demersal (such as parrotfishes, emperors, snappers, groupers), 57 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Lanuza, Surigao del Sur (XIII)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.57 for non-tuna catch.

Table 2. Continuation.

Year	Catch ($kg \cdot day^{-1} \cdot fisher^{-1}$)	Gear	Target Species	Locality (Region)	Remarks (Source)
2010	4.39	Not specified	57 % demersal (such as parrotfishes, emperors, snappers, groupers), 43 % pelagic (major species: tunas and mackerels, jacks and scads, sardines)	Mati City, Davao Oriental (XI)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.43 for non-tuna catch.
2010	1.61	Not specified **Subsistence**	65 % demersal (such as parrotfishes, emperors, snappers, groupers), 35 % pelagic (major species: tunas and mackerels, jacks and scads, sardines) **Mixed species**	Samal City, Davao Oriental (XI)	Average daily catch per fisher (Muallil *et al*, 2012, Table 1, p. 3) multiplied by 0.35 for non-tuna catch.
1998	2.50	gleaning	shells, crabs, fish	Sarangani Bay (XII)	Average daily catch per fisher (de Jesus *et al.* 2001, Table 5.4, p. 67).
2006	1.89	squid hook and line, single hook and line, bottom-set longline, drift gillnet	finfish, crustaceans, mollusks	Lopez Jaena, Misamis Occidental (X)	Averaged from 10-20 % of the total annual catch by 5 major gears divided by the number of fishers (n=712; de Guzman *et al.* 2009, p. 56) assuming 120 fishing days (based on the average gleaning days per month for Danao Bay, Misamis Occidental, from Heinen, 2001, p. 15).
2010	1.10	gleaning	*Lutraria philippinarum*	Glan, Sarangani (XII)	Averaged from daily catch per fisher ranging 1-10 kg based from interviews of selected 5 gleaners in the area (Bantoto and Ilano, 2012, p, 1814).

Results

Non-tuna artisanal fishery

The cloud of 12 data-pairs ($kg \cdot day^{-1} \cdot fisher^{-1}$ *vs*. year; s.e.=1.27) for this sector (see Figure 2A), related to the 1900 value of Pauly (2000) resulted in a logarithmic linear relationship with a low corefficient of determination (r^2=0.57). The trend was declining from the 1996 data point onwards, despite the large values reported in 2007 and 2010, i.e., at least 3 kg per fisher. Removing these values yielded a better fit (r^2=0.85). However, to avoid bias, we used the geometric mean for n=12 at 2.5 kg in 2006, see Equation (1) below:

$$\textbf{Non-tuna catch } (kg \cdot fisher^{-1} \cdot day^{-1};\ log_{10}) = 121.22 - 36.584 \cdot log_{10}(Year) \quad \ldots (1)$$

Equation (1) was then used to reconstruct the daily catch of non-tuna species by artisanal fishers from 1950-2010, multiplied by the average number of fishing days (228 days; see above) and then multiplied by the number of artisanal fishers estimated for this subzone in Palomares and Pauly (this vol., Figure 2D, p. 24). The resulting annual catch of non-tuna species is presented in Figure 2D, which increased from 16,650 t in 1950 to 118,500 t in 2010.

Tuna artisanal fishery

The cloud of 12 points (standard error of 1.51) for this sector (see Figure 2B) related to the 1900 value of Pauly (2000) resulted in a logarithmic linear relationship also with a low coefficient of determination(r^2=0.54). The geometric mean of daily catch per fisher at 2.6 kg in 2003 (see Figure 2B)

was linked to the standardized baseline of 20.2 kg in 1900. The resulting relationship is presented in Equation (2):

$$\textbf{Tuna catch (kg·day}^{-1}\textbf{·fisher}^{-1}\textbf{; log}_{10}\textbf{) = 129.39 – 39.066·log}_{10}\textbf{(Year)} \quad \dots (2)$$

Tuna fishery is seasonal throughout the country, i.e., the prevalence of typhoons may prevent boats from sailing and may hamper the setting of fish aggregating devices (Barut 2007). Thus, the 208 tuna fishing days average from data in Muallil *et al.* (2012) maybe an acceptable assumption. In addition, given that tuna have spawning grounds in surrounding areas, i.e., Pacific Ocean in the east, Celebes Sea in the south and Sulu Sea in the northwest (Barut 2007, Figure 8, p. 15), it is safe to assume that the bulk (90%) of fishers in the region will go for tuna most of the days. The calculated daily tuna catch from Equation (2) were thus multiplied by 208 fishing days and then by 0.9*number of fishers as estimated in Palomares and Pauly (this vol.) for Subzone D. The resulting annual tuna catches ranged from 13,800 t in 1950 to 91,100 t in 2010 (Figure 2D).

Subsistence fishery

The three data points for this sector (see Figure 2C) compared with the 1950 estimate resulted in a logarithmic linear relationship also with a good fit (r^2=0.85). The geometric mean of daily catch per fisher at 1.7 kg in 2005 was plotted with the 1950 baseline and presented in Equation (3):

$$\textbf{Subsistence catch (t·day}^{-1}\textbf{·fisher}^{-1}\textbf{; log}_{10}\textbf{) = 128.53 – 39.762·log}_{10}\textbf{(Year)} \quad \dots (3)$$

The daily catch per fisher estimated from Equation (3) was multiplied with an average of 120 days based on the average fishing/gleaning days for Danao Bay, Misamis Occidental, from Heinen (2001). The product then was multiplied with the number of subsistence fishers estimated in Palomares and Pauly (this vol.). The resulting annual subsistence catches ranged from 9,100 t 1950 to 62,800 t in 2010 (Figure 2D).

Catch composition

The rank and percentile analysis resulted in a list of 20 taxa making up 75 % of the catch, the most important of these taxa being frigate tuna (Figure 2E). In the 1980s, 90 % the total landed catch was contributed by the following taxa in decreasing order: anchovy, sardine, yellowfin tuna, frigate tuna, eastern little tuna, fimbriated sardine, slipmouth and skipjack. In the 1990s, this configuration slightly changed to frigate tuna, anchovy, big-eyed scad, fimbriated sardine, squid, Indian sardine, round scad and yellowfin tuna. In the 2000s, catch was primarily composed of big-eyed scad, frigate tuna, Indian sardine, round scad, squid, anchovy, eastern little tuna and yellowfin tuna. In all three decades, frigate tuna and yellowfin tuna dominated the catch. They are followed by squid, other tuna species (i.e., eastern little tuna and skipjack), flying fish, demersal taxa (i.e., slipmouth, snapper, parrotfish/wrasse, goatfish and siganid and snappers) and some pelagic taxa usually targeted by the industrial fleet (i.e., mackerel and sardines) made up the rest of the upper 75 %. We present in Figure 2E only the most important species for clarity of the graph, including the five species of tuna, as there are more than 100 species caught by the artisanal fisheries in this subzone.

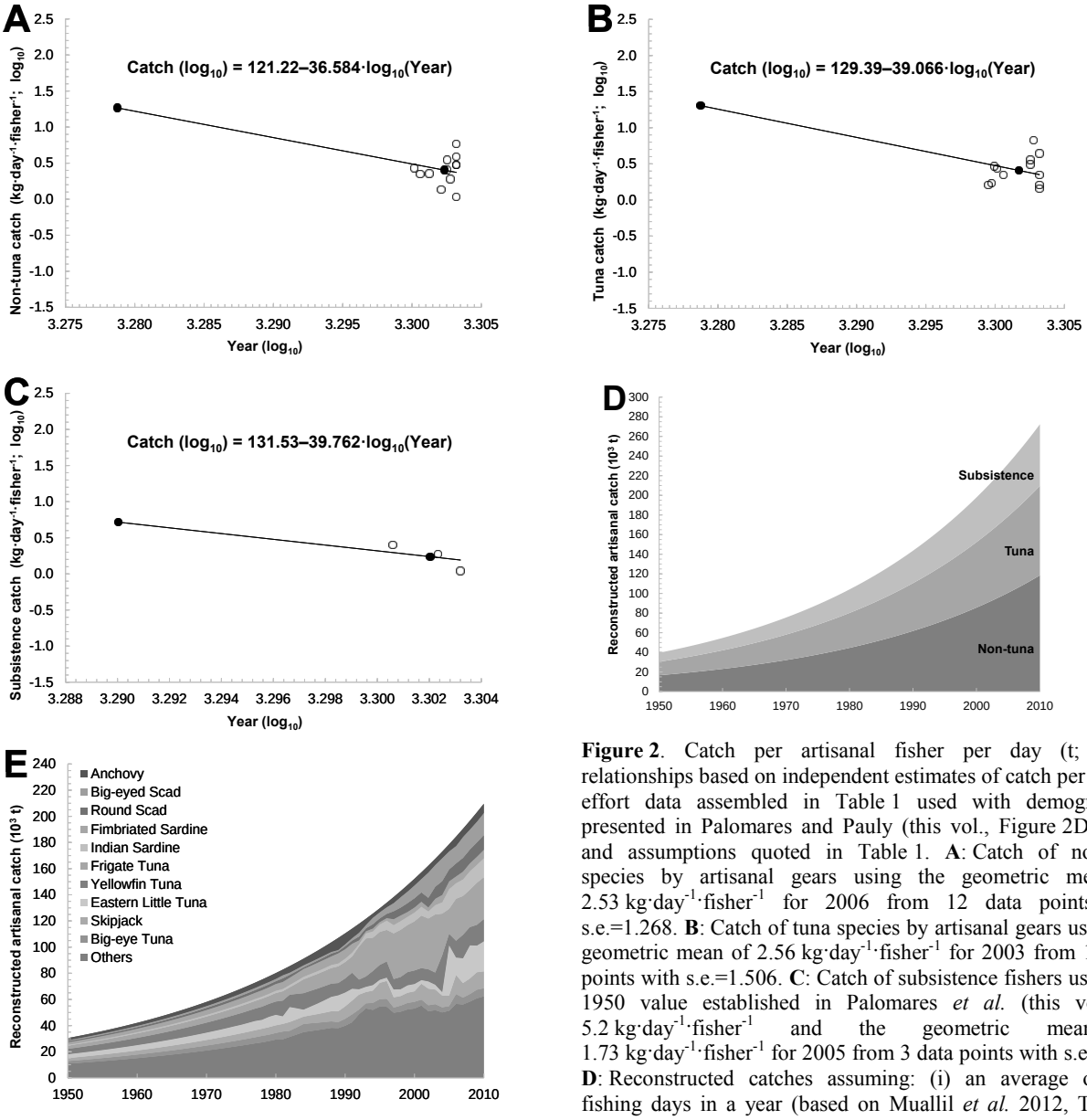

Figure 2. Catch per artisanal fisher per day (t; $\log_{10}$) relationships based on independent estimates of catch per unit of effort data assembled in Table 1 used with demographics presented in Palomares and Pauly (this vol., Figure 2D, p.24) and assumptions quoted in Table 1. **A**: Catch of non-tuna species by artisanal gears using the geometric mean of 2.53 kg·day^{-1}·fisher^{-1} for 2006 from 12 data points with s.e.=1.268. **B**: Catch of tuna species by artisanal gears using the geometric mean of 2.56 kg·day^{-1}·fisher^{-1} for 2003 from 12 data points with s.e.=1.506. **C**: Catch of subsistence fishers using the 1950 value established in Palomares *et al.* (this vol.) of 5.2 kg·day^{-1}·fisher^{-1} and the geometric mean of 1.73 kg·day^{-1}·fisher^{-1} for 2005 from 3 data points with s.e.=2.59. **D**: Reconstructed catches assuming: (i) an average of 228 fishing days in a year (based on Muallil *et al.* 2012, Table 1, p. 3, for landing areas within Subzone D) for non-tuna artisanal fishers; (ii) 208 fishing days for tuna artisanal fishers based on the average established for Lanuza, Surigao del Sur, and Mati City, Davao Oriental, i.e., landing sites of most tuna catches from the region (>40 %) based on Muallil *et al.* (2012); (iii) 90 % of the fishers from this region engage in tuna fishing; and (iv) coastal gleaners spend 120 days in a year on subsistence fishing based on the average established for Danao Bay, Misamis Ocidental, from Heinen, 2001, p. 15). **E**: Composition of the catch based on percentage distribution of species from available national statistics (Appendix A) and reconstructed catches in (D) showing top 10 species caught in Subzone D.

Table 2. Results of the rank and percentile analysis of marine artisanal landings for Mindanao (representing Regions IX-XIII and ARMM or Subzone D) from 1981 to 2006 reported by the Philippine Bureau of Agricultural Statistics.

Rank	Percentile	English name	Scientific name
1	100.00	Frigate Tuna	*Auxis* spp.
2	98.50	Anchovy	*Encrasicholina* spp.
3	97.10	Big-eyed Scad	*Selar crumenophthalmus*
4	95.70	Round scad	*Decapterus macrosoma*
5	94.30	Fimbriated Sardine	*Sardinella fimbriata*
6	92.90	Indian Sardine	*Sardinella* spp.
7	91.50	Yellowfin Tuna	*Thunnus albacares*
8	90.10	Squid	*Loligo* spp.
9	88.70	Eastern Little Tuna	*Euthynnus affinis*
10	87.30	Skipjack	*Katsuwonus pelamis*
11	85.90	Flying fish	*Cypselurus poecilopter*
12	84.50	Miscellaneous fish	–
13	83.00	Indian Mackerel	*Rastrelliger kanagurta*
14	81.60	Slipmouth	*Leiognathus* spp.
15	80.20	Snapper	*Pristipomoides filamentosus*
16	78.80	Parrot fish/Wrasse	*Scarus* spp./ Labridae
17	77.40	Goatfish	*Upeneus moluccensis*
18	76.00	Siganid	*Siganus* spp.
19	74.60	Grouper	*Cephalopholis* spp.
20	73.20	Threadfin bream	*Nemipterus virgatus*

Discussion

Fisheries are among the major contributors to Mindanao's economy (Ferolin and Dunaway, 2013). In 2011, ARMM and Zamboanga belonged to the top six fishery producers of the country, ARMM being the top producer for 1995-2011.[70] The high productivity from these regions may be attributed to several factors such as the oceanographic characteristics of Subzone D. Its marine ecosystems are characterized by sandy to muddy substrates (e.g. Panguil Bay; Roxas and Gorospe 2007) supporting shrimp and crab fisheries (Hopkins and McCoy 1976; Jimenez *et al.* 2009), to pseudobarrier and fringing types of coral reefs (e.g. Iligan Bay; Mendoza *et al.* 1986) supporting demersal (Abrea *et al.* 1986) and some macroinvertebrate fisheries (de Guzman *et al.* 2009), and to the deeper waters of the Celebes Sea in the south and Philippine Sea in the east supporting pelagic fisheries including tuna (de Jesus *et al.* 2001) and small pelagic species such as anchovy and sardines (Perpetua 2007). Several shallow embayments along the coasts of Mindanao, the Moro Gulf for example, are important nursery grounds for demersal species (Ganaden 1992) and thus provide the basis for Subzone D's demersal fisheries (Munro 1986; Silvestre and Ganaden 1987).

The multigear and multispecies types of fisheries (Abrea *et al.* 1986; de Guzman 2004; de Jesus *et al.* 2001; Hopkins and McCoy 1976; Jimenez *et al.* 2009; Perpetua 1997) of Mindanao generally have large artisanal catches. In Panguil Bay, gillnet was the most common type used by fishers (Perpetua 2007), while hook and line was the most common gear in Iligan Bay (MSU 2007a; MSU 2007b; MSU 2009) and Sarangani Bay, accounting for 65 % of its total landed catch in 1997 (de Jesus *et al.* 2001). The artisanal catch is usually composed of demersal species, whose majority are surgeonfishes (Aulostomidae), wrasses (Labridae), emperors (Lethrinidae), snappers (Lutjanidae), goatfishes (Mullidae), parrotfishes

[70] *Western Visayas remains as the 4th largest contributor to the country's fishery production,* posted on May 8, 2012. National Statistical Coordination Board accessed on 02/12/13 from http://www.nscb.gov.ph/ru6/WA-Fishery2012.htm

(Scaridae), and groupers (Serranidae) (de Jesus *et al.* 2001). However, in terms of weight, small pelagic species, i.e., roundscads (Carangidae), sardines (Clupeidae), anchovies (Engraulidae), mackerels (Scombridae), big-eyed scads (Carangidae), round herrings (Clupeidae) and flying fish (Exocoetidae), make up 90 % of the catch (Dalzell and Ganaden 1987; Perpetua 1997) since late 1970s (Dy-Ali 1988).

Tuna fishing is a traditional subsistence fishing practice in the southern Philippines (e.g., Davao, Zamboanga and Cotabato; Vera and Hipolito, 2006). Zamboanga was the largest tuna landing place in the country until the late 1970s, when majority of local shippers closed due to low export quality (Thomas 1999; Vera and Hipolito, 2006). Since then, General Santos City, located north of Sarangani Bay, became the next largest tuna landing place (West *et al.* 2011), and the country's second major landing site (de Jesus *et al.* 2001), both for the industrial and artisanal sectors. The high productivity of this subzone's tuna fishery may be related to its direct access to the Philippine Sea in the east, Celebes Sea in the south and Sulu Sea in the northwest, and to Indonesian and Malaysian waters.

The Celebes Sea is the major tuna spawning ground in the country; together with Sulu Sea, it serves as a transition zone for fish stocks between the Pacific Ocean and South China Sea (Barut 2007). Among the list of gears in de Jesus (1982) that are employed by fishers in this sector, the longline was the most efficient gear in terms of catch effort in Malalag Bay, located south of Davao Oriental (Valle *et al.* 2000); while in Sarangani Bay, hook and line was the most commonly used gear, followed by gillnets (de Jesus *et al.* 2001). The major tuna species caught by these gears are yellowfin tuna *(Thunnus albacares*) and frigate tuna (*Auxis thazard thazard*), and some demersal species such as goatfish (*Upeneus* spp.) and rabbitfish (*Siganus canaliculatus*) (de Jesus *et al.* 2001; Valle *et al.* 2000; Vera and Hipolito 2006). Other tuna species that are less commonly caught are skipjack (*Katsuwonus pelamis*), eastern little tuna (*Euthynnus affinis*) and big-eye tuna (*Thunnus obesus*) (Vera and Hipolito 2006). Other pelagic species included in the catch are dolphinfish (*Coryphaena* sp.), stingray and small pelagic species such as clupeids (*Sardinella* sp.) (de Jesus *et al.* 2001; Valle *et al.* 2000).

Despite the high catches from Subzone D, reports of overexploited stocks persist. For instance, the northern waters of Mindanao, i.e., Iligan Bay (Abrea *et al.* 1996) and Panguil Bay (Ferolin and Dunaway, 2013; Jimenez *et al.* 2009), were reported as overexploited since the early 1980s (Ganaden 1992). This is likely because of the high number of artisanal fishers in Mindanao (Rivera *et al.* 2002; White *et al.* 2006; ABS-CBN News, March 7, 2008)[71], with Zamboanga having the highest number of active fishers (NSO 1980). It is also one of the major landing centers in Mindanao, together with Davao and General Santos City (de Jesus *et al*. 2001; Jamir 1988). Increased landings were recorded from these centers, in contrast to the reported decline in catch of individual fishers, and the increasing competition for resources between fishing sectors (Israel 2004). The high degree of exploitation in these fishing grounds, based on previous fisheries assessments (Alfeche, 2003; Jimenez *et al.* 2009; Herrin *et al.* 1978; MSU 2007a; MSU 2007b; MSU 2009; Philreefs 2003; Rivera *et al.* 2002; Smith *et al.* 1980) are characterized by: (1) decrease in coral reef cover; (2) unregulated increase in fishing effort especially from the artisanal sector; (3) development of non-selective gears for better catch opportunities; (4) evidences of illegal fishing practices such as dynamite and cyanide fishing; (5) persistent competition between the industrial and artisanal sectors for commercially important species such as tuna and small pelagic species.

Subsistence fishery

There are no records of catch per unit of effort from this sector in government databases. However, evidences of subsistence fishing date back in the early 1900s when fishing was purely for consumption (Vera and Hipolito 2006). Nowadays, fishing is more directed as an income-generating activity; however,

[71] Llanto, J.F. March 7, 2008. Mindanao still poorest island in nearly a decade. ABS-CBN accessed on 11/12/13 from http://www.abs-cbnnews.com/special-report/03/07/08/mindanao-still-poorest-island-nearly-decade-0

a portion of the catch, some 10-20 % (see Cabanban *et al.* this vol.), is retained by fishers for household consumption which they exclude from the landed catch as is practiced in Iligan Bay, on the coasts of Lopez Jaena, Misamis Occidental (de Guzman *et al.* 2009). Note that fishing is restricted during the monsoon season because the traditional banca (dugout boats with or without outriggers) and cast nets are incapacitated by bad weather (Barut 2007; Rivera *et al.* 2002; Smith *et al.* 1980). Fishers engage in other livelihood activities to compensate for the lost income during these times such as gleaning, farming, etc. (Rivera *et al.* 2002; Smith *et al.* 1980).

Gleaning is a popular coastal activity usually involving women and children of fishing households (de Guzman, 2004; de Guzman *et al.* 2009; de Jesus *et al.* 2001). In Sarangani Bay, women primarily gather shells, crabs and sometimes fish from mangrove areas together with their children; the catch is generally consumed rather than sold (de Jesus *et al.* 2001). A similar case was reported for Danao Bay by de Guzman (2004). In Iligan Bay, edible invertebrates such as bivalves (e.g., mussels and clams), gastropod shells and sea urchins are commonly gleaned from seagrass beds which are part of the locals' staple food (de Guzman *et al.* 2009). The unregulated gleaning in these areas resulted to increased fishing effort coupled with declining abundances of invertebrate species along the coasts (de Guzman *et al.* 2009); their sizes were also observed to have shrunk in the past decades (Bantoto *et al.* 2012).

The results and observations of the studies cited above are similar to the results we presented in Figure 2C and suggest that the reconstruction presented in Figure 2E may well be a valid representation of the evolution of subsistence catch in Mindanao.

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The recreational marine sport fisheries catch of the Philippines, 1950-2010[72]

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Abstract

This study attempts to characterize recreational fishing in the Philippines and construct a historical overview of this industry. Using sport fishing tournament records, photos and videos in social media, we estimate the amount of catch generated from recreational fishing. Results indicate a general decreasing trend in the amount of catch over 6 decades, from more than 115 $t \cdot year^{-1}$ in the 1960s to less than 55 $t \cdot year^{-1}$ in 2013, despite an increase in the average number of sport fishers (from 25 sport fishing clubs) as the sport became more popular. Sport fishing data used in this study was categorized to line fishing and spear fishing catches. Line fishing appears to be more organized than for spearfishing, with at least 8 major tournaments organized annually. Spearfishing is usually a weekend or holiday activity; very few individuals/organizations openly promote and/or engage in this sport because of legal issues. Popular catches in the Philippines include billfishes, marlins, tunas, trevallies, dolphin fishes and wahoos, comprising 70% of the annual catches from this sector.

Introduction

The Philippines is a relatively poor country, and its industrial, artisanal and subsistence fisheries struggle to keep up with an increasing seafood demand (Barut 1997; Pauly 2000; Aliño, 2001; DA-BFAR, 2004). However, there is a recreational marine fisheries sector in the Philippines consisting of two components: (1) line fishing or angling, mainly for large and medium pelagic fishes, from day boats and from the shoreline; and (2) reef fishing with spear gun, with and without SCUBA gear. The time series of catch estimates and catch composition derived for these fisheries are very approximate, but they should suffice to initiate a discussion about the management of recreational fisheries in the Philippines.

Sport fishing in the Philippines particularly line fishing, started in the late 1930s, with the catch of a wahoo (*Acanthocybium solandri*) near Manila in 1936 and the establishment of the Philippine Game Fishing Foundation (PGFF) in 1940, by members of the Manila Yacht Club. Back then, this sport was mostly for expatriates; in fact, of the founding members, only one, Florentino Zamora, was a Filipino. It was not until the late 1960s that the PGFF slowly regained attention; it has since grown in membership and organizes regular fishing tournaments in both freshwater and marinewaters. By mid-1980s, sport fishing became popular with more Filipinos, and at least 2 new clubs were established, the Panay Anglers Association Inc. (Panay Island, Region VI)[73] and the Philippine Sport Fishing Club (headquarters not located on the website). Tournaments became more frequent, with as much as 8 tourneys per year

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[73] Facebook page of the Panay Anglers Association Inc. at https://www.facebook.com/pages/Panay-Anglers-Association-Inc/182789708734

organized by the PGFF alone. Numerous other fishing groups were formed and most were localized in popular fishing hotspots in the country (see Figure 1).

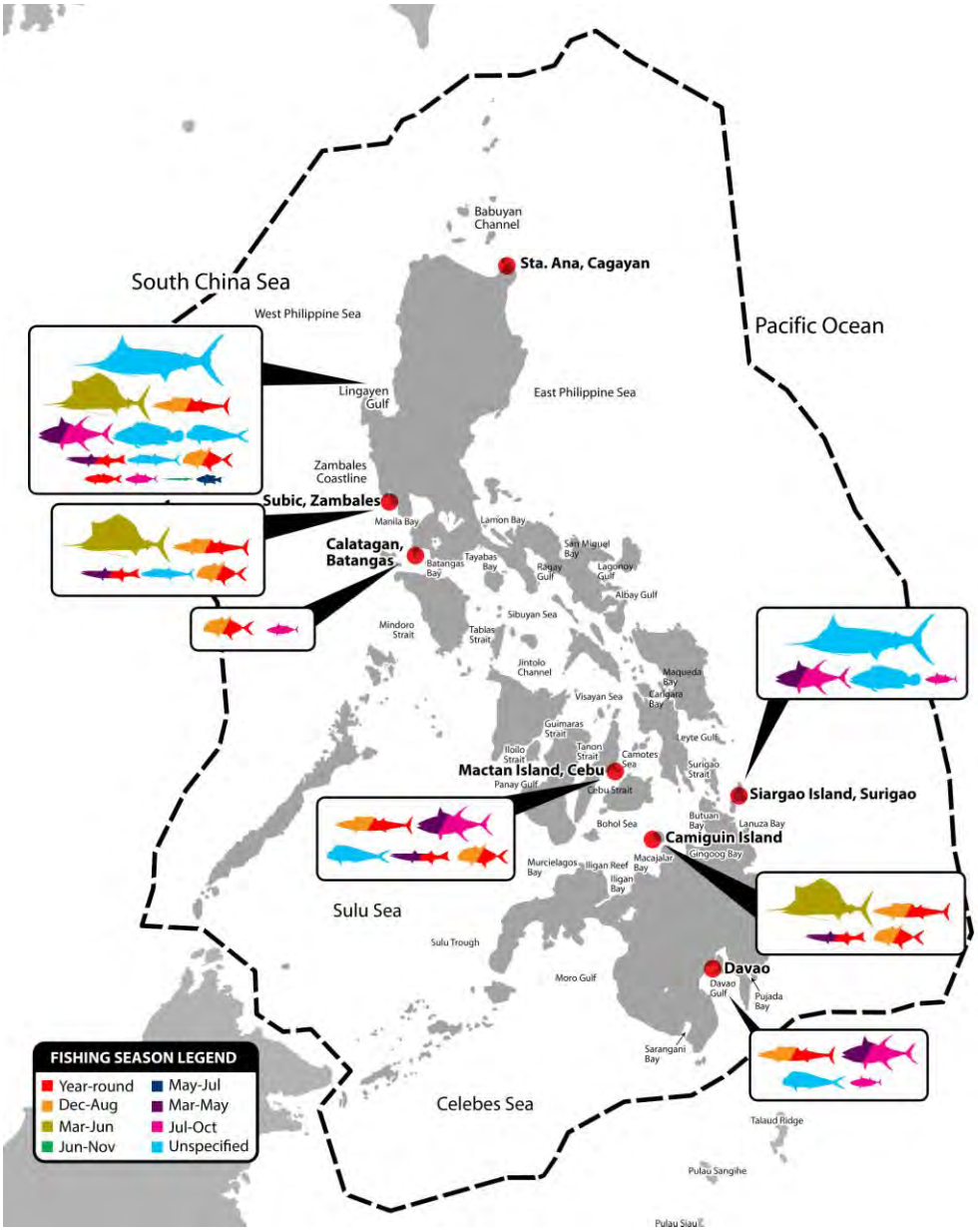

Figure 1. Major sport fishing sites in the Philippines: Sta. Ana, Cagayan; Subic, Zambalez; Calatagan, Batangas; Mactan Island, Cebu; Camiguin Island; Siargao Island, Surigao; Davao, with some of the popular catches shown per site and fishing months. In general, the months of March to October are ideal for game fishing.[74]

[74] Gamefishing information for the Philippines at http://www.e-philippines.com.ph/philippine-adventures/gamefishing-information-and-packages/

Spear(gun)fishing, on the other hand, is not a very popular sport in the Philippines. It is considered 'illegal' in most parts of the country (Walsh, 2013; FAO, 2005[75]), especially in sanctuaries and popular reef areas, particularly those managed by large resorts (White, 2005). Although there is no explicit law that prohibits spearfishing in the country, possession of a speargun is likely to get one into trouble with the existing weapons laws. However, for most cases, the use of SCUBA gear during spearfishing deems this practice as destructive, because it makes hunting more efficient (Dalzell 1996; Coll *et. al*., 2004; Walsh 2013). For this reason, spearfishing, which targets the large breeding individuals of the population, contributes greatly to an imbalance in stocks of larger fishes in coastal habitats (Meyer, 2007, Lloret *et. al*., 2008; Godoy, *et al.* 2010; Walsh, 2013). Despite strict enforcement of the spearfishing "ban" by some members of the coastguard and its auxiliaries, a couple of spearfishing groups still engage in the sport. One in particular has been spearfishing around Samal Island in Davao for the last 30 years (according to spearfishing enthusiast and businessman from Davao, Vi de Ocampo pers. comm.).

Government fisheries statistics in the Philippines include only data on municipal and commercial fishing (Dolan 1991; FAO, 2005; FAO 2007; BFAR, 2011) and apart from record catches from websites of sport fishing groups, there are no consolidated reports of catches from recreational fisheries. Although the department of tourism calls on sport fishing tournament organizers to submit tournament results[76], such data are used for tourism statistics and are not publicly available. Most of these sport-fishing organization websites use FishBase (www.fishbase.org) as reference for their identification, which are accurate to the family level, if not always at the level of species. Some of the popular catches (and the months they are caught) in the Philippines are shown in Figure 1.

Materials and Methods

The Philippines being an archipelagic country with almost 2,000,000 km^2 of fishing grounds (ADB 1993; Lugten and Andrew, 2008), offers numerous sites ideal for sport fishing. Fishing as a recreational activity is associated mostly with the well off, and/or with the expatriate community, as can be deduced from its history. Little is known of the catch from this sector in its early years (1940s-1950s). It is only since the 1960s that sport fishing evolved into a weekend activity, with several tournaments held regularly in various parts of the country, and at least 6 large pelagic species caught year round. Thus, here we reconstruct recreational fisheries catches only for the period 1960-2010.

Line fishing (angling)

Catch information used in this study was gathered from sport fishing club catch records (i.e., name and weight of fish caught, name of fisher, location, and date), photos and videos (sometimes with species name, date and location of catch, length and/or weight) posted in organizational websites (Table 1) and other social media from 2006 to 2013. The PGFF's website provides, by far, the most extensive information on sport fishing in the country; it contains record catches by family/species, dating back to the 1980's and tournament records since 2002. For example, the club reported a total catch of over 100 fishes weighing 1.2 t by 18 participants from their annual tournament in 2001 and 31 anglers caught a total of 80 fishes weighing over 0.9 t in 2002. At present, over 25 sport fishing clubs compete in national annual tournaments and as many as 17 countries participate in international tournaments held in the Philippines.

[75] 2005 Fisheries profile of the Philippines at http://www.fao.org/fi/oldsite/FCP/en/phl/profile.htm
[76] Philippine Department of Tourism promoting sport fishing at
http://www.tourism.gov.ph/Pages/BaittheGeminPhilippineAngling.aspx

Table 1. Sport fishing clubs in the Philippines, year established, website URL, current number of members and number of tournaments hosted each year.[77]

Sport fishing Club (Year founded)	Website	Details
NCR		
Bass Anglers Sportsman Society of the Philippines, BASS (2005)	bassphil-subscribe@yahoogroups.com	members: 57; tournaments per year: 4
Filipino Anglers	filipinoanglers.org/phpBB3/index.php	members: 690
Manila Anglers Club		
Manila Baywalk Anglers Association Inc (2011)	facebook.com/pages/Manila-Baywalk-Anglers-Association-Inc/445589738825485?fref=ts	members: 92
Philippine Game Fishing Foundation, PGFF (1940)	pgff.net/xe/main	member: 162; tournaments per year: 8
Philippine Sport Fishing Club (1985)		tournaments per year: 1
Pinoy Anglers Club Inc., PACI (2010)	pinoyanglersclub.webs.com	members: 211
Navotas Anglers	facebook.com/groups/navotas.anglers/?fref=ts	members: 192
Silver Jack Anglers		
Region I		
Dagupan Anglers Club		
Region III		
Angeles Anglers Club		
Angeles City Fishing Club	angelescityfishingclub.com/fish2/index.html	
Pampanga Anglers Club		
Pampanga Sport fishing Association		
Region IVA		
D Anglers of Laguna, DALag	facebook.com/groups/318928384793963	members: 35
Lucena Anglers Club		
Region VI		
Iloilo Anglers Association (1989)		
Iloilo Game Fishing Association (2007)	igfamunit.blogspot.com	members: 17
Panay Anglers Association Inc. (2007)	facebook.com/pages/Panay-Anglers-Association-Inc/182789708734	members: 450
Negros Sport Fishing Club	facebook.com/groups/191066250927099	members: 153
Sport fishing Or. Negros, SPOON		
Region VII		
Cebu Fish Wars	facebook.com/groups/287865154620455	
Sport Fishing Club of Cebu, SFCC (2009)	facebook.com/pages/Cebu-Sport-Fishing/438335015272	
Region IX		
Baitcaster Association of Zamboanga (2013)	facebook.com/groups/501700826568438	

*Membership details based mostly on forum/ (Facebook) group page memberships.

Spear gun fisheries (spearfishing)

Data collected for spearfishing is limited because spearfishing is not as popular and organized as line fishing. There is no tournament information or record catches available on the web as this is usually a weekend or holiday recreation activity (Oakley 1984). The bulk of the data for spearfishing are from photos, videos and blogs of a handful of people and personal interviews with some spearfishing enthusiasts. One group openly promoting spearfishing in the Philippines is the Freediving and Spearfishing in the Philippines[78] Facebook group created by Wolfgang Dafert, an Austrian national living in Moalboal, Cebu since 2006 and proprietor of Freediving-Philippines[79]. Spearfising is offered by Freediving-Philippines together with a free-diving course but there are also groups that use SCUBA when spearfishing, for instance, a group of 8 sportfishers from Davao (Vi de Ocampo pers. comm.).

[77] List of sport fishing clubs in the Philippines at http://fishingthephilippines.com/fishing-clubs/
[78] Facebook group page of Freediving and Spearfishing in the Philippines at https://www.facebook.com/groups/23136294001/
[79] Freediving-Philippines website at http://www.freediving-philippines.com/

Catch records

Length and/or weight information, when available, were encoded from the website/photo/video records. Otherwise, length was estimated from photos/videos using various indicators, e.g., height of fisher with respect to the length of the fish caught as shown in Figure 2. Fish species was identified to the nearest possible taxon, if not already available from the record. Weight, when not given, was estimated from length-weight parameters of the same species, or of similar species obtained from FishBase (www.fishbase.org). Line fishing and spearfishing data are presented separately.

Figure 2. Sport anglers fishing in Philippine waters (photos from various sport fishing websites). Clockwise from bottom left: 1) earliest members of the PGFF in 1940 (photo from PGFF website); 2) a 237 kg blue marlin caught by Mr. Victor Villavicencio off the coast of Susay Rock, San Vicente, Cagayan in 1999. This marlin holds the record of largest blue marlin caught in Asia since 1999; 3) a 12 kg (approx.) grouper caught from Cagayan in 2012; 4) Large trevally (approx 71 kg) caught off Bohol; 5) a 45 kg (approx.) sailfish and 6) a 32 kg (approx.) dolphinfish both caught during the 2008 International Game Fishing Tournament in Siargao.

The daily catch per line fisher (c/f; $kg \cdot day^{-1} \cdot fisher^{-1}$) was estimated as the sum of the weights of fishes caught in a reporting year (which may include several tournament records) divided by the number of fishers, assuming that 1 record = 1 $fisher \cdot day^{-1}$. A log-linear regression analysis was performed on the data presented in Table 2 to obtain empirical estimates of annual c/f values for 1960-2010. The number of line fishers was estimated from monthly PGFF tournament data from 2002 to 2013 complimented with data from the annual Siargao International Game Fishing Tournament (Table 3). This better represents the number of line fishers who actively participate in tournaments and contribute to the catch. A log-linear regression analysis was performed on the number of tournament participants per year to obtain estimates for 1960-2010, with the 1966 value based on the number of active PGFF members deduced from a historical anecdote (in 1967, a total of 63 members with 17 new members)[80] and the average number of participants of tournament records in 2002-2013, as comparison points. The number of line fishing days per year was estitmated from the number and duration (in days) of tournaments per year. Assuming that on the average, tournaments last 4 days, and that there is an average of 8 tournaments per year, the average number of fishing days per year would be 32.

The daily catch per spear fisher was estimated as the average c/f computed from the catch data for spear fishers in Table 3, again following the assumption that 1 record = 1 $fisher \cdot day^{-1}$. A log-linear regression analysis was performed on the 1965-2013 spear fisher records to obtain empirical estimates of the number of spear fishers for 1960-2010. The number of (spear) fishing days per year was obtained assuming that: 1) the sport fishing season in the Philippines is April-October (7 months); 2) spearfishers go out 2/4 weekends in a month; and 3) 1/2 days in a weekend. This results in an average spear fishing of 14 days in a year.

[80] http://pgff.net/xe/about

Table 2. Catch information obtained from tournament records, photos and videos grouped by year where catch per unit of effort was computed from the total annual catch (kg) divided by the number of records, which we assume to represent the number of fishers per day.

Year	Recreational fishing			Line fishing			Spearfishing		
	# records	Total catch (kg)	CPUE ($kg \cdot day^{-1} \cdot f^{-1}$)	# records	Total catch (kg)	CPUE ($kg \cdot day^{-1} \cdot f^{-1}$)	# records	Total catch (kg)	CPUE ($kg \cdot day^{-1} \cdot f^{-1}$)
1940*	8	296.91	37.11	8	123.95	296.91	–	–	–
1965*	1	8.10	8.10	–	–	–	1	8.10	8.10
1966*	1	8.60	8.60	–	–	–	1	8.60	8.60
1987	6	607.95	101.33	6	208	607.95	–	–	–
1988	4	200.50	50.13	4	80	200.50	–	–	–
1989	10	777.65	77.77	10	208.26	777.65	–	–	–
1990	11	343.20	31.20	11	93.75	343.20	–	–	–
1991	3	123.60	41.20	3	65.10	123.60	–	–	–
1992	15	389.77	25.98	15	86.25	389.77	–	–	–
1993	18	580.55	32.25	18	145	580.55	–	–	–
1994	5	166.45	33.29	5	78.80	166.45	–	–	–
1995	16	516.89	32.31	16	83	516.89	–	–	–
1996	8	251.05	31.38	8	91.50	251.05	–	–	–
1997	7	147.63	21.09	7	67.25	147.63	–	–	–
1998	18	768.15	42.68	18	575	768.15	–	–	–
1999	7	352.09	50.30	7	236.84	352.09	–	–	–
2000	22	162.76	7.40	22	41	162.76	–	–	–
2001	23	1015.65	44.16	5	59	108.65	–	–	–
2002	40	997.95	24.95	9	30	97.95	–	–	–
2003	19	249.35	13.12	19	69	249.35	–	–	–
2004	15	151.20	10.08	15	43.10	151.20	–	–	–
2005	2	31.47	15.74	2	26.90	31.47	–	–	–
2006	31	559.89	18.06	31	106	559.89	–	–	–
2007	38	910.15	23.95	32	127.22	855.08	–	–	–
2008	71	1062.15	14.96	59	61.13	987.56	12	17.38	74.59
2009	81	1382.47	17.07	77	94.03	1351.26	4	22	31.21
2010	70	934.22	13.35	63	90	862.84	7	25	71.38
2011	69	791.83	11.48	57	140	706.08	12	31.63	85.74
2012	56	467.83	8.35	55	48.90	466.98	1	0.85	0.85
2013	69	1391.49	20.17	40	318	1163.71	29	57.13	227.79

*Records not used, as they appear to have been outliers

The reconstructed catch (t) of line/spear fishers was obtained as the product of daily catch per fisher, number of fishers and number of fishing days. The total reconstructed recreational fisheries catch is then the sum of line and spear fishing catches. Composition of the catch was analyzed using the rank and percentile method described in Parducho and Palomares (this volume).

Results

A total of 689 catch records (622 line fishing; 67 spear fishing) were collated, describing a 27-year history of recreational fisheries catches in the Philippines, from 1987 to 2013 ($kg \cdot day^{-1} \cdot fisher^{-1}$; standard error of X/Y pairs at 15.7).

Line fishing (angling)

The log-linear regression analysis of the annual sums of line fishing catches (see Figure 3A) explains 0.55 of the variability and is presented in equation (1):

$$\log_{10}(kg \cdot day^{-1} \cdot fisher^{-1}) = 243.3 - 73.32 \cdot \log_{10}(year) \quad \ldots (1)$$

Table 3. Membership and/or tournament participants of Philippine game Fishing Foundation (PGFF) and Siargao International game Fishing Tournament (SIGFT).

Year	PGFF[81]		SIGFT[82]
	#Members	Total tournament participants	Total tournament participants
1940	6	–	–
1966	46	–	–
1967	63	–	–
1984	120	–	–
1991	71*	–	–
1992	114	–	–
1993	46*	–	–
1994	103	–	–
1995	104	–	–
1996	65*	–	–
2001	–	18**	–
2002	100	203	–
2003	–	78**	–
2004	–	13**	–
2005	–	28**	–
2006	–	59	–
2007	–	93	–
2008	54*	77	76
2009	–	86	65
2010	55*	41	41
2011	45*	61	52
2012	64*	100	46
2013	62*	88	36

*Number of members based on Angler of the Year records and not on actual membership list, data not used

** Number of participants is from less than 3 tournaments that year, data not used.

The log-linear regression analysis of the annual number of line fishing tournament participants (standard error of X/Y pairs at 45.1; see Figure 3B) compared with the base value for 1966 of 46 PGFF members, and the geometric mean of 118 line fishers in 2009 is presented in equation (2):

$$\textbf{Line fishers} = 43.74 \cdot \log_{10}(\textbf{year}) - 142.4 \quad \textbf{… (2)}$$

The product of the estimates produced by equations (1) and (2) and the average number of 32 line fishing tournament days a year is the reconstructed time series of line fishing total catches (see Figure 4A).

[81] PGFF monthly fishing report at http://pgff.net/xe/REPORT

[82] Annual Siargao International Game Fishing Tournament details at http://www.siargaogamefishing.com

Spear gun fisheries (spearfishing)

The 67 spear fishing records in Table 3 resulted to an average of 8 kg·day^{-1}·fisher^{-1} (s.e.=1.5). The log-linear regression analysis of the annual number of spear fishers (see Figure 3B) explains 0.57 of the variability and is presented in equation (3):

Spearfishers = 76 log$_{10}$(year)-250 … (3)

The product of the estimates produced by equation (3), the average daily catch per fisher and the average number of spear fishing days of 14 is presented as the reconstructed time series of spear fishing total catches. The total reconstructed recreational fisheries catches (sum of line and spear fishing catches) is presented in Figure 4A.

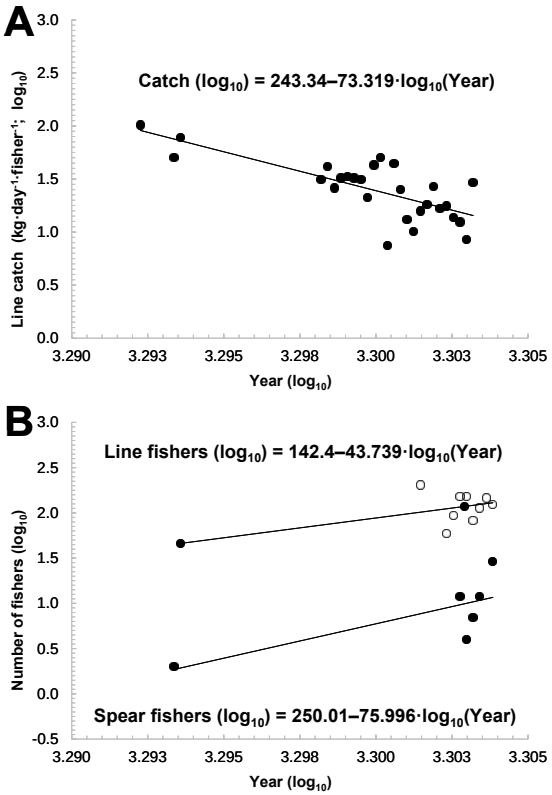

Figure 3. Summary of catch from recreational fishing in the Philippines using 679 sport fishing records from 1987-2013. A: Catch per recreational line fisher per day (kg; log$_{10}$) from 1987 to 2013; B: Number of line fishers from 2002-2013 from tournament data, using the 1966 estimate of 46 fishers from PGFF membership records and the geometric mean of 118 fishers for 2009 from 9 data points, and number of spearfishers from 1965-2013.

Catch composition

Rank and percentile analyses of the data gathered from 1987-2013 are presented in Table 4. Some of the frequent game fishes caught during these years include the Indo-Pacific sailfish (*Istiophorus platypterus*), the biggest, caught from Sta. Ana, Cagayan in 2007 weighed more than 127 kg; wahoo (*Acanthocybium solandri*) with a record specimen of more than 30 kg from Bolinao, Pangasinan in 2003; the giant trevally (*Caranx ignobilis*), with a 37 kg record specimen from Camiguin Island, Cagayan in 1995; dolphinfishes were also very common and a large 32 kg specimen was caught near Siargao during the 2008 International Game Fishing Tournament.

Recalculated catch composition for the years 1950 to 2010 shows 7 dominant taxon groups comprising 80% of the total catch (Figure 4B for total catch and Figure 4C for line fishing catch). The 1965 and 1966 catch records were not used in the catch composition calculations as these contained single records which created a bias.

The results of this study are very approximate as we used mainly tournament data, especially to estimate the number of fishers per year. Nonetheless, it gives a projection of how much sport fishing contributes to the local fisheries in the country. We believe that, though of great potential for the tourism industry, this sector is highly dependent on the status of fish stocks, i.e., overexploitation implies less (in number) and smaller (in size) game fishes.

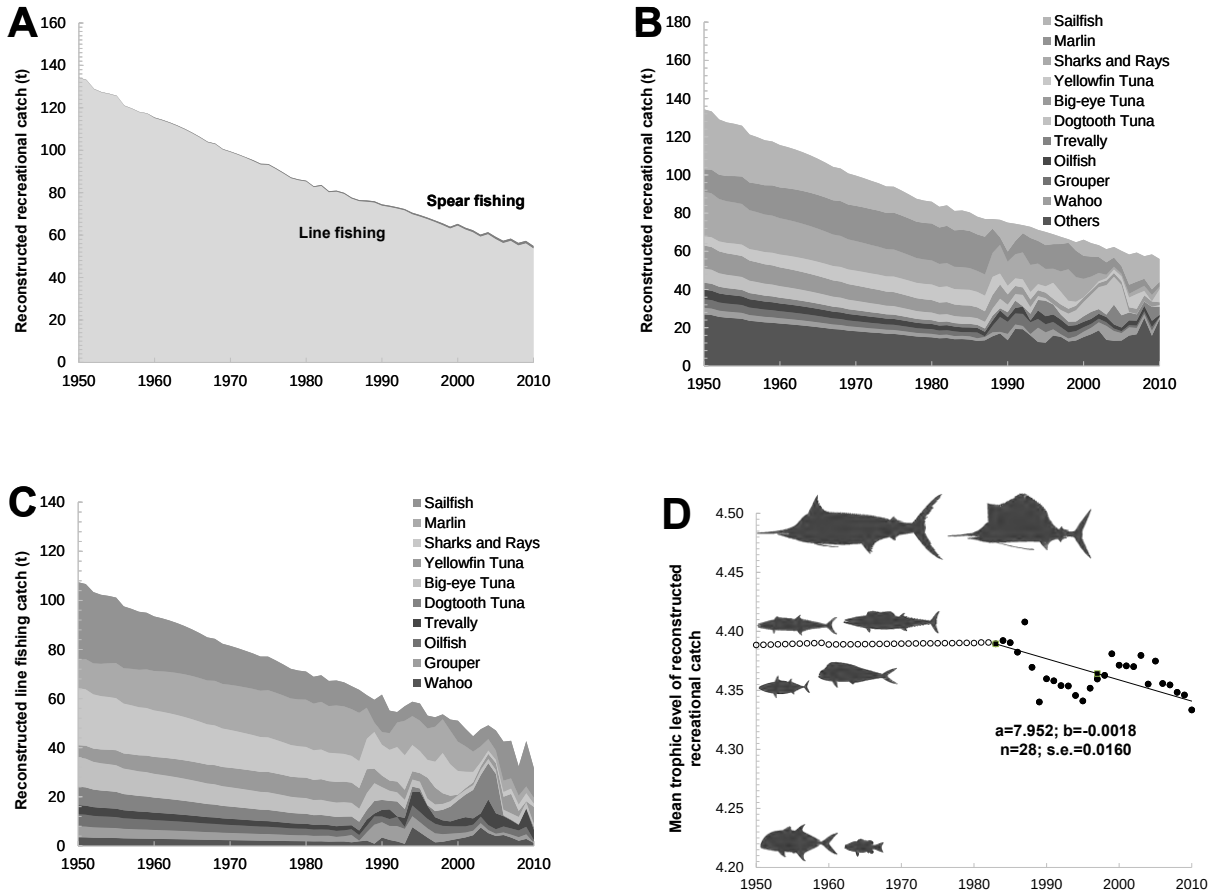

Figure 4. Summary of catch from recreational fishing in the Philippines**. A**: Reconstructed annual recreational catch (kg) from 1960 to 2010 assuming an average of 32 line fishing days in a year (based on average number of national tournaments per year) and an estimated 14 spearfishing days in a year (see methods). Composition of the total catch **(B)** and line fishing catch **(C)** based on percentage distribution of species from recorded catches (Table 4) and reconstructed catches in (A) showing the 7 most dominant species, i.e., 80 % of the total catch. **D:** Summary of catch from Philippine recreational fisheries from 1960 to 2010 represented as a function of the trophic level of the catch. Note that the trend in trophic level of the catch was plotted only from 1983, i.e., when record catches started to fluctuate, through the average trophic level of 4.364 in 1997, and which may indicate the onset of the 'fishing down the food web' phenomenon.

Discussion

Fishing in the Philippines is a 170 million pesos (4.25 million USD) industry (BFAR, 2011) that makes up as much as 4.4% of the country's GDP[83]. National fisheries statistics include industrial and artisanal marine fisheries, which in 2011 reported a total production of 2,365,468 t (BFAR, 2011). The recreational fishery is a component of marine fisheries in most tropical countries that rely heavily on coastal resources (Cowx 1995; Coleman *et al.* 2004; Cooke and Cowx, 2006). Although recreational fishing is mostly for leisure and sport, some, if not most, of the landings are consumed (Cooke and Cowx, 2004; 2006).

[83] 2009 fisheries contribution to Philippine economy at http://www.bfar.da.gov.ph/pages/AboutUs/maintabs/stat-fishcontri.html

Table 4. Results of the rank and percentile analysis of sport fishing catches in the Philippines based on accumulated data from 1987-2013 presented in Table 2.

Rank	Percent	Taxa	Popular Species
1	100	Sailfish	*Istiophorus platypterus, Xiphias gladius*
2	96.9	Marlin	*Istiompax indica, Makaira indica, Makaira mazara, Makaira nigricans*
3	93.9	sharks and rays	*Alopias pelagicus, Carcharhinus falciformis, Dasyatis , Galeocerdo curvier, Isurus oxyrinchus, Prionace glauca, Sphyrna tiburo, Sphyrna zygaena*
4	90.9	yellowfin tuna	*Thunnus albacares*
5	87.8	Trevally	*Alectis indica, Carangoides dinema, Carangoides orthogrammus, Caranx ignobilis, Caranx melampygus, Caranx papuensis, Caranx sexfasciatus, Gnathanodon speciosus, Ulua mentalis*
6	84.8	Dolphinfish	*Coryphaena hippurus*
7	81.8	Wahoo	*Acanthocybium solandri*
8	78.7	dogtooth tuna	*Gymnosarda unicolor*
9	75.7	Barracuda	*Sphyraena barracuda*
10	72.7	Spanish mackerel	*Grammatorcynus bicarinatus, Scomberomorus cavalla, Scomberomorus commerson*
11	69.6	bigeye tuna	*Auxis rochei rochei, Thunnus obesus*
12	66.6	Grouper	*Cephalopholis boenak, Cephalopholis cyanostigma, Epinephelus coioides, Epinephelus malabaricus*
13	63.6	Snapper	*Etelis carbunculus, Lutjanus decussatus, Lutjanus griseus, Symphorichthys spilurus, Symphorus nematophorus*
14	60.6	Oilfish	*Ruvettus pretiosus, Thyrsitoides marleyi*
15	57.5	Jacks	*Elagatis bipinnulata, Scomberoides lysan, Seriola*
16	54.5	Skipjack	*Katsuwonus pelamis*
17	51.5	misc. demersal perch-likes	*Evoxymetopon poeyi, Lates calcarifer*
18	48.4	other fish	*Pseudorhombus dupliciocellatus, Rachycentron canadum*
19	45.4	Pompano	*Alectis ciliaris, Trachinotus blochii*
20	42.4	Bluefish	*Pomatomus saltatrix*
21	39.3	Jobfish	*Aphareus rutilans, Pristipomoides filamentosus, Pristipomoides multidens*
22	36.3	Triggerfish	*Balistoides viridescens*
23	33.3	misc. coastal fishes	*Lagocephalus lagocephalus*
24	30.3	Salmon	*Eleutheronema tetradactylum, Polydactylus sexfilis*
25	27.2	Mackerel	*Megalaspis cordyla*
26	24.2	misc. coastal perch-likes	*Cheilinus fasciatus, Chlorurus bowersi, Gerres erythrourus, Mesopristes cancellatus, Parupeneus heptacanthus, Platax orbicularis, Priacanthus tayenus, Seriphus politus, Terapon jarbua*
27	21.2	Ladyfish	*Elops hawaiensis*
28	18.1	Sweetlips	*Plectorhinchus pictus*
29	15.1	emperor fish	*Gymnocranius elongatus, Lethrinus harak, Lethrinus lentjan, Lethrinus olivaceus*
30	12.1	Needlefish	*Strongylura gigantea, Strongylura leiura*
31	9	other non-fish	*Dosidicus gigas, Panulirus ornatus*
32	6	Tripletail	*Lobotes*
33	3	Surgeonfish	*Acanthurus gahhm*
34	< .01	Rabbitfish	*Siganus canaliculatus, Siganus guttatus*

In this study we find that recreational fishing, especially line fishing, occurs and is widely popular in the Philippines. The assumptions we made in this study, e.g., the number of tournaments per year, were very conservative, and do not include, e.g., local tournaments held by smaller sport fishing clubs and weekly private sport fishing trips by enthusiasts. We see an increase in the popularity of sport line fishing in the Philippines over the past decades as more and more people engage in the sport and thus in organized groups forming tournaments, i.e., consequences of a presumably improving economy and thus of a widening middle class. This is also seen by the Philippine tourism department as a lucrative industry especially as we enter the international scene (Ditton, 2002).

In other countries where sport fishing is well established, the sector generates greater revenues than industrial fishing (Southwick, 2006; 2013). For instance, in 2004, recreational fisheries in the United States alone earned 34 billion USD in sales, compared to commercial fisheries (finfish only) which generated 10 billion USD in sales, not to mention the contribution of sport fishing to nearly 360,000 jobs and billions in taxes (Southwick, 2006). In the Philippines we estimate that each angler spends, on the average, about 48,000 pesos (about 1,000 USD) per large tournament (including tournament fees, airfare and accommodations), which occurs about twice per year (e.g., Siargao International Game Fishing Tournament) and about 21,250 pesos (about 500 USD) per local tournament (tournament held within the same zone[84] as the anglers), which occurs six times a year. The tournaments alone have a potential income of almost 8.6 million pesos (about 0.2 million USD) not to mention gears employed by sportfishers, which range from 50,000-100,000 pesos (1000-2000 USD) per set (brand new) and about 25,000-50,000 pesos (500-1000 USD) in upgrades, and incidentals ('pasalubong', i.e., gifts, and side trips). This is easily a 10 million pesos (0.225 million USD) industry as it is today (see Table 5 for cost estimates). Sport fisher, John Paul "JP" Suanico from Iloilo, told us in an interview that "*fisherfolk prefer to guide anglers. Their* [the guides'] *income is sure regardless of catch or* [even when there is] *no catch.* […] *You can take the example of Laiya, Batangas* [and]*, Pundaquit, Zambales, where fishermen have improved their lives because of guiding anglers*". Thus, like any touristic activity, this sector serves the economies of local businesses as well as those of fisherfolks.

In the Philippines, projected catch from recreational fisheries ranged from more than 130 t in the 1950s to around 55 t in recent years where 94 % of the catches are billfish, tuna and sharks, of which, 3 species are tagged by IUCN as Near-Threatened (NT) and 5 as Vulnerable (VU). Other Near-Threatened species also fall target to recreational fishing, such as: the orange-spotted grouper (*Epinephelus coioides*), the Malabar grouper (*E. malabaricus*), Bower's parrotfish (*Chlorurus bowersi*) and the narrow-banded Spanish mackerel (*Scomberomorus commerson*). Given that the target species of this fishery are large, long-lived top predators, which are now categorized as threatened species, we can see comparable impacts of this fishery to that of commercial fishing, that is, both truncate size and age structures, reduce biomass, and alter community composition (Coleman *et al.* 2004). However, some might argue that fishing as a sport actually benefits the environment as anglers become more engaged in conservation, ecosystem monitoring and raising environmental awareness, since better ecosystem means bigger fish and bigger fish means trophies for fishing enthusiasts (Brown *et al.* 2012; Walsh, 2013).

Despite legal concerns, spearfishing occurs in the Philippines and is estimated to contribute about 10 % of the total recreational catch per year. This estimation is also very conservative as it only reports spearfishing activities of freedivers who are more open about their spearfishing activities. However, there are small SCUBA spearfishing groups like Vi de Ocampo's, engaging in this activity for the past 25-30 years, targeting larger individuals with more accuracy. Most of them hunt for fish at least 1 kg in size, and species of choice include jacks, yellowfin tuna, mackerel and lapu-lapu (Vi de Ocampo pers. comm.). The estimates on spearfishing catch gathered from this study is presumed to be far lower that the actual values.

The trophic level of the catch (range: 2.72 for rabbitfishes to 4.50 for billfishes, sharks and rays, tuna, Spanish mackerel) of this sector tells us that the "fishing down the food web" phenomenon is present and might have set in during the mid-1980s (see Figure 4D). The consistent catch of billfishes (trophic level around 4.5) throughout the 1950s and 1970s broke down in the mid-1980s when amberjacks (4.0), trevallies (4.2) and mackerels (4.4) started to figure more into record catches. The fluctuating pattern of the trophic level of the catch from the mid-1990s is due to the decreasing contribution of billfishes and other trophic level 4.5 species to the record catches. The peak in the early 2000s is explained by a marked increase in dogtooth tuna catch, probably a function of the tournament locations during that period. These

[84] UNCLOS mandated Philippine Exclusive Economic Zone (EEZ) of the Philippines

statistics are reflected in some observations made by linefishers, who 'feel' that the waters around the Philippines are overexploited. Filipino sport fisher JP Suanico observes that "*sport fishing will never be as big here* [in the Philippines as opposed to neighbouring islands like Palau or even the US]. *Our fisheries are depleted. Even us fishing addicts are sometimes reluctant to fish since we doubt if we will catch something*". He does argue, however, that it is "unlikely" that anglers impact the fish stocks, saying that "*the number we catch and the frequency we go is immaterial. We do release a lot of fish after taking photos, but the volume is just insignificant compared to commercial fishing, legal or otherwise*". JP Suanico speaks true, because reconstructed current catches by sport fishing only totals to 55 t, pailing significantly to the 1.5 million t estimated in Palomares and Pauly (this vol.) for the industrial fisheries sector.

Table 5. Projected income in Philippine pesos from recreational fisheries estimated from tournaments. Note that current exchange rate is about 40 pesos to 1 USD.

Estimated tournament cost	angler	angler + family*
Big international tournaments[85]		
Registration	1,500	1,500
Boat	5,000	5,000
Gasoline	2,000	2,000
accomodation w/meals	4,800	19,200
Bait	2,500	2,500
flights[86]	10,000	40,000
Total (average 50 participants)	**645,000**	**1,755,000**
Revenue per big tournament	**2,400,000**	
2 big tournaments/year	**4,800,000**	
Local tournaments[87]		
Registration	1,000	1,000
Boat	3,500	3,500
Gasoline	1,500	1,500
accomodation w/meals	3,000	12,000
Bait	1,500	1,500
Transportation	2,500	10,000
Total (average 30 participants)	**195,000**	**442,500**
Revenue per local tournament	**637,500**	
6 local tournaments/year	**3,825,000**	
Estimated annual income from sport fishing tournaments	**8,625,000**	
Estimated annual income from gears**	**1,500,000**	
Total	**10,125,000**	

*assuming that 50 % of the anglers bring with them their families, average of 4 members in a family
**assuming that there are 5 new anglers per year and that, of 120 anglers (average from 2010-2013), 25 % upgrade their gears.

In spite of JP Suanico's arguments as to the extent of the impact of recreational fisheries to our fish resources, we still believe that effective monitoring and regulations are applicable to this more lucrative and target precise sector, if the common goal is to sustain viable marine resources and ecosystems, and improve the economic stability of fishers.

[85] Based on 2012 Siargao International GameFishing Tournament
[86] Based on average roundtrip base fare Manila to Siargao at https://www.cebupacificair.com/
[87] Based on an interview with John Paul Suanico (pers. comm.) and adjusted accommodation and transportation

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A short history of gleaning in Negros and Panay Islands, Visayas, Philippines[88][89]

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Abstract

Gleaning for seafood along the seashore to supplement the food requirements of coastal villages is a widely known and accepted activity in the Philippines. However, its importance in the socio-economy of the fishing communities is not fully appreciated. This study fills this gap by reporting the empirical data on gleaning gathered from 3 sites in Negros Island and 1 in Panay Island, Central Philippines. The weighted catch per unit effort (CPUE) is calculated at 2.31 $kg \cdot day^{-1} \cdot fisher^{-1}$ and 1.23 $kg \cdot day^{-1} \cdot fisher^{-1}$ for Negros Island and Banate Bay, Panay, respectively. Gleaning in Agan-an, Bantayan, Cangmating, and Piapi in Negros Oriental is for subsistence and sharing with relatives, and the excess sold to neighbours but gleaning in Bais and Banate Bays are not only for subsistence, but also for livelihood. Gleaning catch in Bais Bay, Negros Island and Banate, Panay Island is estimated at 58 t and 27 t in 2012, valued at 2.38 million PHP and 0.404 million PHP, or 59,500 USD and 10,100 USD respectively.

Introduction

Studies on gleaning are sparse in the Philippines (see Palomares *et al.* this vol.). In the Visayas, a comprehensive study on gleaning was conducted in Bais Bay, Oriental Negros in the early 1990s (Leblanc 1997). This study described gleaners, the collecting sites, the resources, and retailing the catch. The gleaners are an informal sector of society who compete for coastal resources. Gleaning is an important activity for sustenance and livelihood, depending on the needs of the household. The social importance of gleaning is more obvious than its contribution to the economy.

Several studies have reported information on gleaning. Edible molluscs, cephalopods, and holothurians harvested in the Bay were identified in Alcala and Alcazar (1984) and efforts to conserve these invertebrate populations began already in the early 1990s (ERMP-DAP 1991 and Silliman University 1992, unpublished reports). The composition of invertebrates in the harvest from Banate was described in Campos *et al.* (2005), while the Bureau of Fisheries and Aquatic resources (BFAR, 2012) prepared a guide on the commercially-important shellfish in Banate.

Gleaning is reported as an activity to supplement the food of coastal villagers (e.g., Ablong *et al.* 1999, LeBlanc 1997), but total catch from gleaning is presumed negligible and are not recorded in marine fisheries statistics. Here, we report that gleaning contributes greatly to coastal fisheries catch, and that its

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level is a function of the coastal population that depends on it in Negros and Panay islands, in the Visayas islands (i.e. within Subzone C as defined in Palomares *et al.* this vol.).

Materials and Method

Study sites

The study sites are in Negros Island and Panay Island in Visayas (Figure 1). The two islands are adjacent to each other and separated by the Guimaras Strait, which is a shipping channel. The study sites were limited to the eastern provinces of these islands and are briefly described below.

The Province of Oriental Negros has an extensive, mangrove-lined coastline along Tanon Strait. The area covered mangrove stands, with parts converted to fishponds, cropland, and settlements was reported at 5,030 ha (Ablong *et al.* 1999). Most of the mangrove forests are found in Bais Bay but it has decreased from 812 ha in 1979 to 250 ha in 1999 (Luchavez and Abrenica 1997; Murphy *et al.* 1999). Seagrass beds are also found in some parts (Bantayan, Dumaguete City), but their area is not known. Fringing coral reefs are also found along the coastline and cover an area of 26 km^2 (Montebon 1997; Ablong *et al.* 1999). Coral reef condition has declined from 1981 to 1995; 56 % of coral reefs have less than 30 % coral cover (Montebon 1997; Murphy *et al.* 1999). Piapi and Bantayan, and Cangmating and Agan-an, are adjacent to each other along the coast, north of Dumaguete City (Figure 1). The habitat in Piapi and Bantayan consists of a wide reef flat, with isolated coral heads and patches of sea grass beds, while the habitat in Cangmating and Agan-an consists of a wide mud-flat. Bais Bay, located about 100 km north of Dumaguete City, has sandy-muddy substrate and sea grass beds. Bais Bay has an area of 54 km^2 and the gleaning area is the intertidal strip that is composed of mangroves forests, seagrass beds, and reef flat. These coastal ecosystems provide food and livelihoods to the population of the province (Ablong *et al.* 1999).

The fishing communities in Bantayan, Cangmating, and Agan-an are dependent on fisheries (Yambao *et al.* 2001). The coastal communities that live in the villages (*barangays*) near Dumaguete City were mainly artisanal fishing communities in the past 50 years. Cangmating had a population of 2,206 and 128 fishers who landed 22,000 $kg \cdot year^{-1}$ (Murphy *et al.* 1999). The profile of the villages has changed in the last 10 years with the growth of the economic activities associated with shipping (near Piapi) and tourism, i.e., with the extension of the runway and number of flights to airport in Sibulan. The extension of the runway in the 1980s has caused erosion in Bantayan and Piapi while it caused accretion in the fishing communities of Cangmating and Aga-an.. The coastline from Piapi northward to Cangmating has restaurants, a resort, and picnic facilities along the beach. These have provided alternative employment to the men and women in the coastal communities and a few persons who fish.

The coastal community of Bais Bay is an artisanal fishing community since its founding (see Cabanban *et al.* this vol.). Gleaning activity is an informal, but important economic activity by its members and the workers in the sugar plantations (described comprehensively by Leblanc 1997). There were 25,223 gleaners and 3,077 coastal fishers in 1993-1994 (Leblanc 1997) who exploit the resources in the gleaning area, but with only 250 doing so on a daily basis. About 82 % were reported land-less laborers and workers in the haciendas who glean for food subsistence and only 18 % are from coastal and upland communities that glean for subsistence. The profile of the gleaners remains the same because sugar planting and milling remain as the main economic activity around the city.

The catch of gleaning are consumed and sold to traders (Leblanc 1997). A diverse group of molluscs are taken from mangrove forest floor and intertidal area and sold fresh by the bus terminal, at the local market, and in Dumaguete City market. Some wild oysters are shacked and preserved in brine and sold in the markets. The empty shells are sold to souvenir-makers in Cebu.

Iloilo Province is in the eastern part of Panay Island, the third largest island in the Philippines with a population of 2.2 million in 2010 (http://www.nscb.gov.ph/ru6/western.htm). Iloilo has 18 coastal municipalities with patches of mangrove stands in protected areas (Zamora, 2003), seagrass beds (Trono, 2003), notably in Guimaras, Nueva Valencia, and coral reefs (Ajuy and Concepcion), and mud-flats in Banate. The marine waters off Estancia have rich marine resources and as such commonly known as the 'Alaska' of the Philippines, with the best developed fishing port in the northern Visayas.

Banate Bay, at 50 km north of Iloilo City, is a sandy-muddy intertidal area of about 1,315 hectares. The Bay is under the jurisdiction of Anilao, Banate, and Barotac Nuevo. There are 1,315 fishing households in 22 barangays commonly share and benefit from this bay. The Bay is an important fishing ground as source of seafood and livelihood for the local people and Iloilo City.

Negros and Panay Islands are not in the usual path of typhoons in the Philippines, although the depression that is associated with the typhoons is usually experienced in these islands. Yolanda (internationally known as Haiyan), a super typhoon landed – among other places – on Concepcion – the 5th District of Iloilo Province. The typhoon brought heavy to intense (10-30 mm hour^{-1}) rain and caused flooding in the Second District of northern Negros Island. Yolanda had wind strengths of 215-250 km hour^{-1} that rendered 90 % of the 212 inhabitant of Concepcion homeless and displaced coastal communities including those in Banate, where coastal waters rose by 4.1 m. The typhoon is reported to have affected 9,000 fishers in all of Panay.

Methodology

Interviews were conducted by the first two authors in Negros Oriental (Piapi, Bantayan, Cangmating, Agan-an, and Bais Bay) and in Banate, Panay Island in 2012 using a questionnaire (Appendix I), designed by the first author, to define the profile of the gleaners and gather information on the following:

- number of persons in the family who are gleaning;
- start of gleaning;
- recollection of historical catches;
- implements used in gleaning;
- use of vessel;
- number of hours gleaning per day;
- number of days gleaning per month;
- habitat where gleaning is done;
- catch of gleaning at present; use of catch (consumption, sharing, selling); and
- monitoring of catch by authorities.

Interviews in Agan-an, Bantayan, Cangmating, and Piapi were conducted with the assistance of a fisher, while that in Bais City was conducted with the assistance of a government staff. The interviews conducted in Banate were conducted by an assistant with a degree in fisheries.

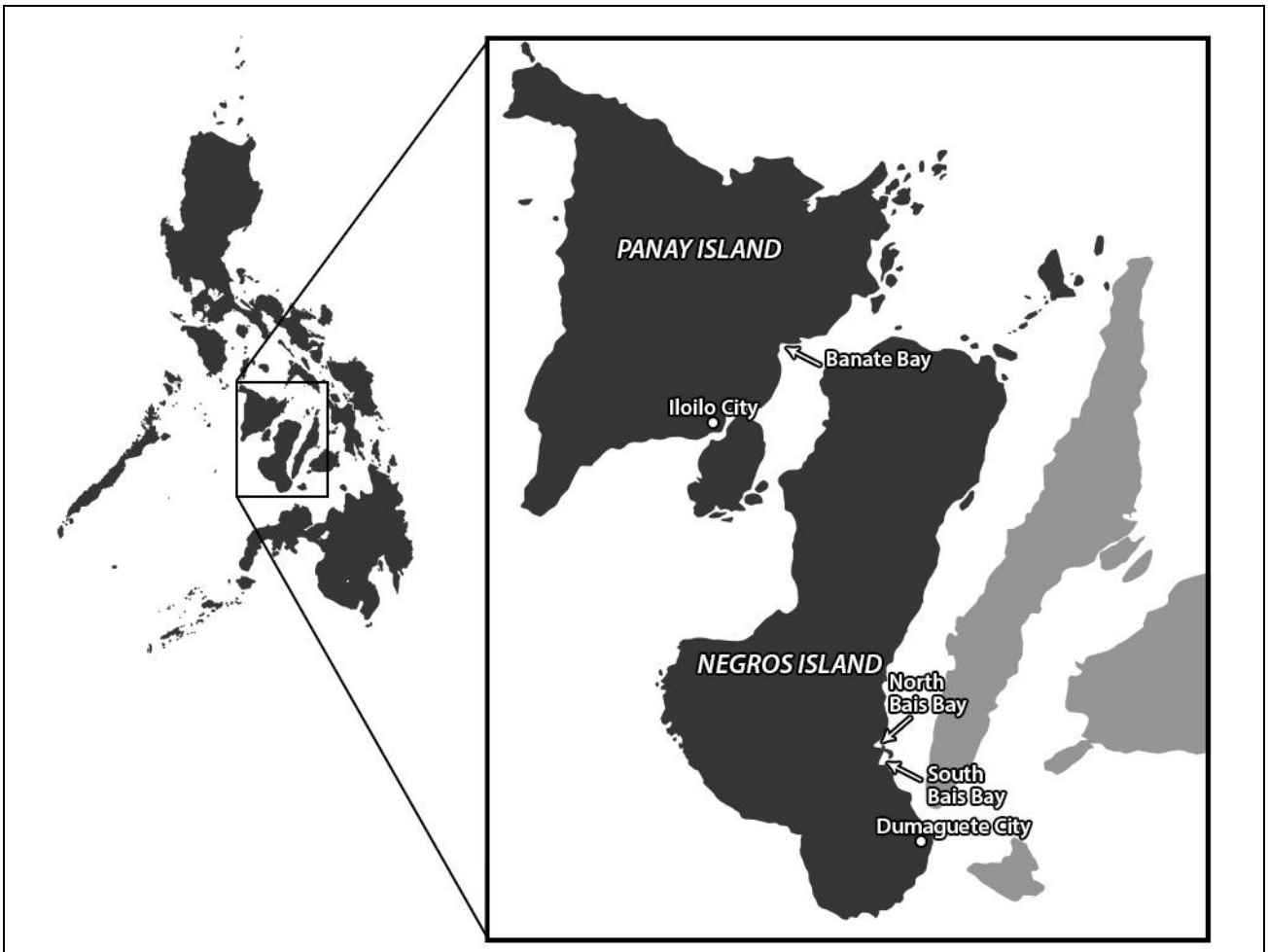

Figure 1. Panay and Negros Islands, Visayas, Philippines indicating the coastal areas where interviews with gleaners were conducted (redrawn by Mr. M.A. Yap from a composite of open source maps).

Profile of respondents

In Negros Oriental Island, a total of 195 respondents were interviewed in the localities adjacent to Dumaguete City, most of whom were men (90 %; Table 1), while 101 persons were interviewed in Bais Bay, the majority being women (71 %; see Table 1). The respondents' age range is wide, from teen-agers to octogenarians, with the majority being 21-40 years old. All the respondents in the localities near Dumaguete City are part-time gleaners, while those in Bais are mainly full-time gleaners (72 %) and some who do not have any other occupation (13 %).

In Panay Island, 21 respondents were interviewed with an average age of 49 and an average number of years fishing/gleaning of 34 years. Respondents started gleaning at an average of 16 years old. Some respondents mentioned that they started gleaning as a past time activity with friends and mostly referred to their parents who taught them the skills needed for gathering.

Table 1. Number, gender and age groups of gleaners interviewed in Negros Oriental Island, Philippines in a 2012 survey.

Item	Cangmating	Agan-an	Bantayan	Piapi	Bais
Female	8	1	0	0	72
Male	22	35	14	14	29
Total	30	36	14	14	101
Age range	15-70	15-80	31-60	31-80	15-80
Mean weighted age	35	42	54	57	40

Catch per unit of effort (CPUE)

The catch per unit of effort (CPUE) was calculated for each gleaner and her/his family members. This is because the catch reported to the interviewer was for the whole family, not just for the parent. The past catch was calculated with the assumption that the effort was the same as in 2012 (at the time of the interview).

Annual catch and value from surveys

The annual catch and income was estimated for Bais Bay and Banate, as: catch * days fishing month^{1} * 12 months. The value of the catch is obtained by assuming that the average price of gleaned shells in Bais Bay is at 41 PHP·kg^{-1} (1 USD·kg^{-1}) and in Banate Bay is at 20 PHP·kg^{-1} (0.50 USD·kg^{-1}).

Results

Negros Oriental Island

The catch is of high diversity, but the scientific names were not acquired; only common names in Cebuano were recorded during the interviews. Parrotfishes (*molmol*), stonefish *(bantol),* different species of damselfish, and rabbitfish (*danggit*) were gleaned. The alga *Caulerpa racemosa* (*lato*) is the common marine plant gleaned for food. The invertebrates collected are mainly gastropods and bivalves and the egg mass (reproductive product; *lukot*) of the sea hare (*Dolabella auricularia*). The most common and abundant invertebrate collected is the conch (*aninikad*; *Strombus urceus*). The catch per gleaning family per day apparently decreased from an average of 0.84 kg of fish, 3.5 kg of invertebrates and 0.35 kg of seaweeds in the 1960s to the current 0.67 kg, 1.9 kg, 0.22 kg, respectively (Table 2). This apparent decline is pronounced in the 'invertebrates' that inhabit intertidal habitats, where the biggest decline is more than half of the 'past' values, e.g., for Agan-an, and the average decline is about half of the 'past' values. The only positive change in 'past' and current values is in the 'fish' category in Cangmating; the current catch per gleaning family increased by 50 % from 1.4 kg to 2.1 kg (Table 2).

In most areas studied, gleaning is an activity that is not monitored by the any government agency.

Agan-an: Gleaning is done by either the mother or father and assisted by about 2 children (mean = 1.8; n = 36). The earliest gleaning experience was in 1963, the latest in 2008, and half of the respondents started gleaning between 1963 and 1980. The harvest is composed of fishes (12 %), invertebrates (67 %), and seaweed (20 %). The implements used are *bolo* (machete), *salok* (scoop), and spear. No *banka* (outrigger boat) is used in gleaning. The number of hours gleaning per day range from 2 to 10 hours per family and on average about 4 hours (3.6; n = 36). The number of days gleaning per month is on average about 4 days (mean = 3.6; range: 1-6 days). Gleaning is done mainly in mud-flats and sea grass beds and

on the reef flat by 50 % of the respondents. The harvest at present remains composed of fishes (11 %), invertebrates (67 %), and seaweed (22 %). Catch per gleaning family has declined from 6 to less than 2 kg day^{-1}, composed 0.34 kg fish, 2.0 kg invertebrates, and 0.27 kg seaweed (Table 2). Half of the respondents glean for consumption of family members and relatives while the other half glean to sell to neighbours, which provide income on average of about three hundred PHP (300 PHP or 8 USD; n = 4).

Table 2. Catch per gleaner (kg family^{-1} day^{-1}) estimated from interviews of coastal inhabitants in Negros Island, Philippines in 2012. 'Past' pertains to the 1960s, 1970s and 1980s while 'Now' pertains to current 2000s situations. NR indicates not reported.

	Cangmating		Agan-an		Bantayan		Piapi		Bais	
	Past	Now	Past	Now	Past	Now	Past	Now	Past	Now
Fish	1.4	2.1	0.85	0.34	0.82	0.46	0.27	0.14	NR	0.29
Invertebrates	4.5	2.9	4.8	2.0	3.7	2.2	3.6	2.1	1.0	0.44
Seaweeds	0.38	0.22	0.41	0.27	0.26	0.17	0.36	0.20	NR	NR
Mixed	–	–	–	–	–	–	–	–	1.85	1.04

Cangmating: Gleaning is done by a parent and children (mean= 1.3; n = 36). Some (14 %) started gleaning in 1966-1970 and less than 10 % began gleaning recently (2001-2005). Many (60 %) started gleaning in 1971-1980 and 1991-2000 with catches composed of 21 % fish, 66 % invertebrates, and 13 % seaweed. The gears used are *salok*, *sundang* (a type of machete), and spear and all glean without a *banka*. The number of hours per day spent on gleaning ranges from 1-10 hours per family. The average number of hours of gleaning time is about 5 hours (mean = 4.5; n = 29). Gleaning is mainly over sea grass beds (72 % of respondents) and reef flat (69 %) and occasionally on mud-flat (31 %). Recent gleaners catch 58 % fish, 34 % invertebrates, and 8 % seaweed. The catch per gleaning family has declined from 6 to less than 3 kg day^{-1}, composed of 2.1 kg fish; 2.9 kg invertebrates; and 0.22 kg seaweed (Table 2). The harvest is mainly for consumption by the family (49 % of catch) and for sharing with relatives (40 % of catch). Eight (8) of the respondents sell part of their harvest but only 3 reported that they sell on average 57 % of their catch to neighbours and earn 225-420 PHP (6-11 USD).

Bantayan: Gleaning is done by the father (all respondents) and children (mean =2.4; n = 14). The earliest reported gleaning among the respondents was in 1970, while the latest one is in 1988. Most of the respondents began gleaning during in 1981-1990. The gears used are *bolo*, *salok*, *sundang*, sticks, and hook and line. Only three (3) respondents use *banka*. The number of gleaning hours was reported at 2-9 hours (mean= 4.3; n = 14) per day and gleaning is done only between 1-4 days each month. Gleaning is on sea grass and reef flat and only 4 respondents glean also over the mud-flat. The catch in the earlier periods was composed of 13 % fish, 70 % invertebrates, and 17 % seaweeds. The present catch is composed of 14 % fish, 65 % invertebrates, and the rest of seaweeds. Catch per gleaning family has declined from 5 to less than 3 kg day^{-1} and is composed of 0.46 kg fish; 2.15 kg invertebrates; and 0.17 kg seaweeds (Table 2). Most of the catch is consumed and shared; only 3 respondents also sell part (50 %) of their harvest and earned 175 PHP (4 USD).

Piapi: Gleaning is done by the father with the assistance of 1-4 members of the family (mean = 2.0; n = 25). Two of the respondents started gleaning in 1970, while four started only during the period 1991-2000. Most (76 %) of the respondents started gleaning in 1971-1990. The respondents recalled that the harvest was composed of 17 % fish, 57 % invertebrates, and 26 % seaweeds. The implements used in gleaning are *salok*, fish-net, and hook-and-line. Most (92 %) of the respondents do not use a craft (*banka*). The gleaners spent, on average, 1-4 hours per gleaning (mean = 3.0; n = 26). Gleaning is on the sea grass bed and reef flat; only 1 respondent reported gleaning on the mud-flat. The catch in earlier periods was composed of 17 % fish, 57 % invertebrates, and 26 % seaweeds. The present catch is composed of 30 % fish, 56 % invertebrates, and 14 % seaweeds. Catch per gleaning family declined from 4 to less than

3 kg day^{-1} composed of 0.13 kg fish; 2.11 kg invertebrates; and 0.20 kg seaweeds (Table 2). Most of the respondents equally consume and share the harvest with relatives; only 3 respondents reported that they consume and sell about half of harvest (53 %) for an income of 275 PHP (7 USD).

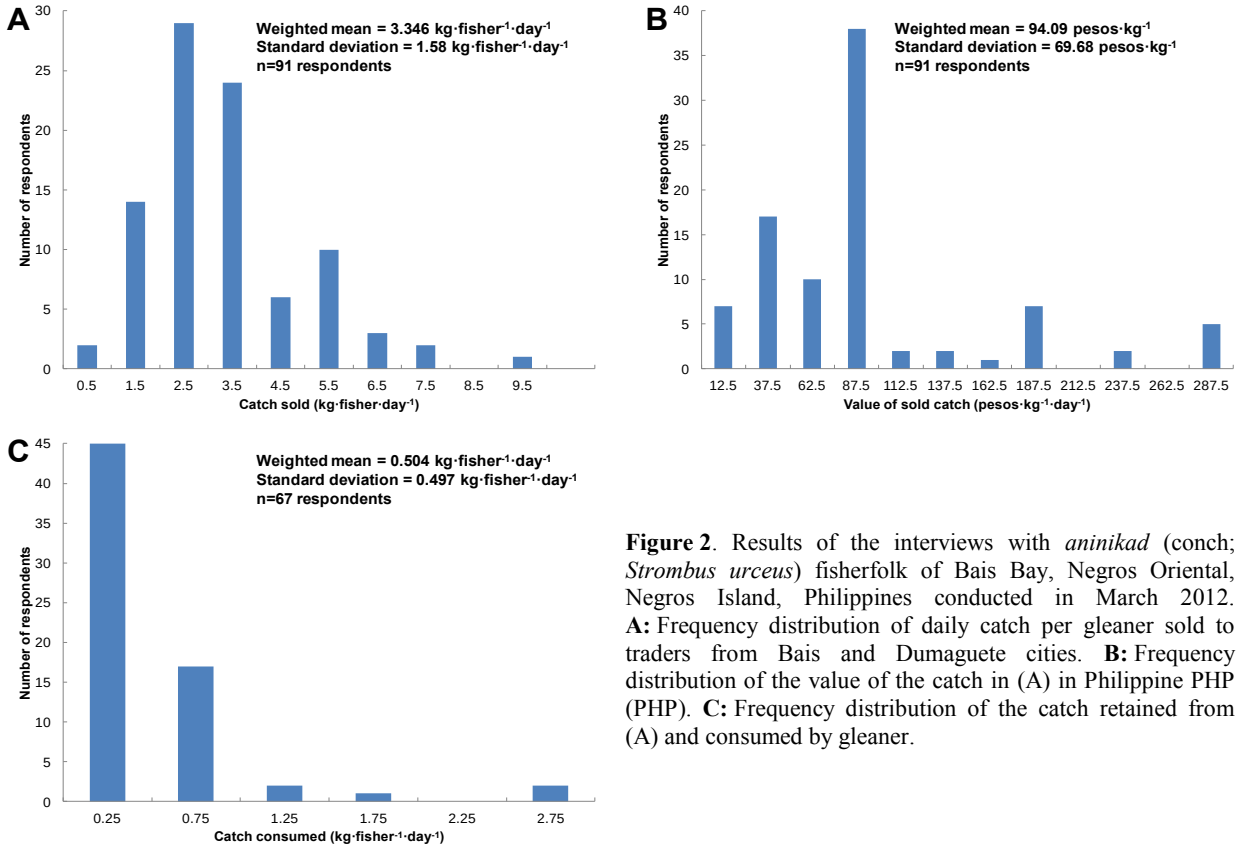

Figure 2. Results of the interviews with *aninikad* (conch; *Strombus urceus*) fisherfolk of Bais Bay, Negros Oriental, Negros Island, Philippines conducted in March 2012. **A:** Frequency distribution of daily catch per gleaner sold to traders from Bais and Dumaguete cities. **B:** Frequency distribution of the value of the catch in (A) in Philippine PHP (PHP). **C:** Frequency distribution of the catch retained from (A) and consumed by gleaner.

Bais Bay: Gleaning is done by either the mother or the father in the family assisted by children (mean = 3.4; n = 101). One of the respondents started gleaning in 1948 and another in 2012, but the majority started gleaning in the 1970s, 1980s, and 1990s. The harvest is composed of only invertebrates which are collected with the use of *salok*, *sundang*, *solakab* (fish trap), *bunlay* (a hoe-like tool), and sticks with *banka* (26 %) or without *banka* (74 %). A family spends on average 4 hours per gleaning (range: 1-15 hours per family per day), and, on average, 12 days a year gleaning (range: 3-30 days a year). Gleaning is done mainly over mud-flat and sea grass bed; only 5 % of respondents reported gleaning over reef flat. The catch in earlier periods was mainly invertebrates (52 %) and mixed species (48 %). The present catch is composed mainly of mixed species of invertebrates (92 %). The catch per gleaning family declined from 3 to less than 2 kg day^{-1} (composed of: 0.29 kg fish; 0.44 kg invertebrates; and 1.0 kg mixed invertebrates; Table 2). Note that in Bais Bay, data on gleaning are collected by the city government.

An estimate of the 2012 catch of gleaned invertebrates by the *aninikad* fishery of Bais Bay following Equation (1) was obtained with the results presented in Figure 2. The annual catch of 0.48 t·gleaner^{-1} was obtained assuming an average of 12 days gleaning per month and a weighted average of 3.4 kg gleaned catch·day^{-1} sold to traders from Bais and Dumaguete cities (range: 0.5-9.0 kg; st. dev.=1.58 kg; n=91). This was valued at a weighted average of 94 PHP·kg^{-1} (2 USD; range: 12-300 PHP or 0.30-7.50 USD; st.

dev.=69.7 PHP or 1.7 USD; n=91), or an annual income of just over 45,300 PHP (1,132 USD) if we assume that the fisher gleans the coast for 12 months of the year. Part of that catch is consumed by the fisher`s family at a weighted average of 0.5 kg·day^{-1} (range: 0.28-3.0 kg; st. dev.=0.50 kg; n=67), or an estimated annual catch of 0.0725 t·fisher^{-1}.

Panay Island

Banate, Iloilo: Gleaning is done by either parent or adult and with other members of the family (mean = 1.6; n = 78). The weighted average age of respondents is 55 years and most of the gleaners have been gleaning/fishing for 34 years; and, on the average, started gleaning at 16 years old. NSCB (2008) recorded 87 full-time gleaners in Banate, with about 4% of the municipality's population engaged in seasonal gleaning. Many implements are used in gleaning, primarily of sea shells in the tidal flats, e.g., *pisaw* (knife with a metal handle), *buna*, *karali* (bait), *panuslok* (poke), rake, and an improvised shrimp trap (Table 3). Gleaning is seasonal; however, the average number of days gleaning and the duration of the activity do not differ markedly during the in-season (3.2 hours for 10 days) and off-season (3.4 hours for 11 days) periods, i.e., at a monthly average of 3 hours for 10 days over 12 months. The in-season catch at an average of 6.5 kg·gleaner^{-1}·day^{-1} is greater than the off-season catch of 1.7 kg·gleaner^{-1}·day^{-1}; the average catch being 4.5 kg·gleaner^{-1}·day^{-1}. The weighted average catch per unit of effort is 1.2 kg/fisher-1/day. There appears to be no consensus on the months which can be considered as in-season for harvesting by hand. However, based on observations, the in-season for gleaning comes in May to August, when there is a relative increase in land to sea run-offs due to the Southwest Monsoon (*habagat*). The off-season period seems to correspond to the dry season in the months of January to April.

Table 3. Implements and their associated catch per unit of effort (kg·day^{-1}·gleaner^{-1}), as used by fishers from Banate, Panay Island, Philippines during in- and off-season fishing/gleaning obtained during an interview conducted in 2012.

	In-season (May to Aug)			Off-season (Jan to Apr)			Average		
Implement	**Hours**	**Days**	**CPUE**	**Hours**	**Days**	**CPUE**	**Hours**	**Days**	**CPUE**
Flashlight, improvised shrimp trap	2.0	7	2.0	2.0	7	0.25	2.6	12	1.5
Hand	2.0	14	10.0	2.0	14	2.0	2.4	10	7.4
Panuslok	2.0	4	2.0	-	-	-	2.3	4	2.7
Pisaw, buna, karali	3.7	10	7.0	3.7	11	7.0	3.7	11	4.3
Rake	3.0	15	6.0	-	-	-	3.0	15	6.0

Shellfish (molluscs and crustaceans) dominates the catch of gleaners with bivalves at 63 % of the catch and shrimps and crabs at 17 %, while fish makes up only 13 % and brachiopods 7 %. The most important species caught, i.e., regular staple for this coastal community and sometimes also for upland communities bartering rice, are the bivalves, *púnaw* (*Marcia hiantina*; Veneridae, Bivalvia) and *litob* (*Anadara inaequivalvis*; Arcidae, Bivalvia), together making up more than 30 % of the catch (16.5 and 15.3 %, respectively; see Table 4). As there was no mention of harvesting for ornamental purposes, we assume that the target species listed in Table 4 are consumed as table food. Marketing and selling depend on amount of the catch, which is sold to either neighbours or to market traders, and some catch are bartered for milled rice or fish. Given an average in-season catch of 6.48 kg·gleaner^{-1}·day^{-1}, 10.3 days·month^{-1}, and 4 in-season months, an annual in-season catch estimate of 267 kg·gleaner^{-1} is obtained. Given an off-season average of 0.50 kg·gleaner^{-1}·day^{-1}, 10.7 days·month^{-1}, and 8 off-season months, an annual off-season catch estimate of 42.8 kg·gleaner^{-1} is obtained. This gives an annual catch estimate of 310 kg·gleaner^{-1}. Considering that there are 87 fishers regularly gleaning alng the coastof Banate, we can estimate that the entire town harvested, in 2012, at least 27 t of invertebrates. Weighted average income from the catch that is sold is estimated at 62.5 PHP·day^{-1} (s.d.=31.40; n=46), or 3.1 kg·day^{-1} if shells are sold at 20 PHP·kg^{-1}. A similar estimation of annual income can be obtained from the annual catch

estimate, i.e., at 6,200 PHP·gleaner^{-1}. The majority of the respondents (94 %) commented on an observed decline in the catch, while 6% mentioned the contrary. This majority singled out population increase in the coastal areas, and the resulting increase in the number of fishers and gleaners as a major factor in the declining catch rates they observed, with erratic seasonality related to climate change also as a possible cause. At least 81 % of the respondents noted an absence of government surveys on the gleaning fishery in the area, with 19% reporting recent BFAR surveys focusing on cultured and high-valued shells cultured in the area and another that profiled fishers in the area for financial assistance given to affected coastal communities by the M/T *Solar II* Oil Spill in Guimaras.

Table 4. Composition of gleaned catch in Banate, Iloilo, Panay Island, Philippines obtained from interviews of 78 coastal fishers in May 2012.

Species	**Family, Class**	**Cebuano name**	**English name**	**%**
Marcia hiantina	Veneridae, Bivalvia	púnaw	hiant venus	16.5
Anadara inaequivalvis	Arcidae, Bivalvia	litub or litob	inequivalve ark	15.3
Portunus pelagicus	Portunidae, Malacostraca	lambay	blue crab	8.24
Lingula unguis	Lingulidae, Inarticulata	-	lamp shell	7.06
Saccostrea echinata	Ostreidae, Bivalvia	-	spiny rock oyster	5.88
Metapenaeus sp.	Penaeidae, Malacostraca	-	Shrimps	4.71
Merisca capsoides	Tellinidae, Bivalvia	-	capsoid tellin	3.53
Pitar citrinus	Veneridae, Bivalvia	-	yellow pitar venus	3.53
Anadara granosa	Arcidae, Bivalvia	litub or litob	granular ark	2.35
Barbatia foliate	Arcidae, Bivalvia	litub or litob	decussate ark	2.35
Others	-	-	-	30.6

Discussion

Gleaners in Oriental Negros and Iloilo provinces landed less than 60 t in 2012. Coastal ecosystems such as bays and mudflats, with extensive intertidal areas that are exposed during low and neap tides (such as in Bais and Banate) are the main source of this catch. Monitoring and management of this important marine resource in extensive gleaning areas are necessary to avoid the loss of this resource.

Management of the resource is crucial because coastal communities subsist it absorbs the impacts of seasonal employment in farming. The gleaned marine organisms are for sustenance (e.g., Ablong *et al.* 1999; LeBlanc 1997) and livelihood. Gleaning is a family activity and it is not confined to women and children only (LeBlanc 1997). The children assist their parents at an early age (6 years) and learn the skills as they become adults. About 2 children per family will probably glean in the area if they do not have the opportunity to study and work in land-based industries. The presence of men in gleaning is an indication of unemployment in land-based activities (e.g., farming, construction). Some are gleaning due to a break in farming in sugar plantations (LeBlanc 1997). The number of gleaners in the coastal area is related to the socio-economic context of the society.

Gleaning is not only for sustenance, but can also be a livelihood. Gleaning in Negros Oriental is done only during the neap tide each month (evidence – number of days per month gleaning). The exception is in Bais and Banate where gleaning is a livelihood rather than for sustenance. The harvest is sold in the markets of adjacent urban areas (e.g., Dumaguete City in Negros and Iloilo City in Panay). Economically viable gleaning reported for mangrove clams in Iloilo (Primavera *et al.* 2002) or sea cucumbers in Davao Gulf (Subaldo, 2011), sea urchins in Bolinao, Pangasinan (Talaue-McManus *et al.* 1995), and large invertebrates in Lagonoy Gulf (Albay; Nieves *et al.* unpub. rep.) are examples of this. The productivity

and the area of the coast are the possible factors that determine whether gleaning is economically viable as an informal sector (LeBlanc 1997).

The composition of the harvest from gleaning is mainly invertebrates (molluscs, sea cucumber) that live on sandy-muddy substrate or attached to corals, and which are pried loose from the habitat by various implements. The molluscs in the catch are diverse (about 30 species were reported in the late 1990s by LeBlanc 1997) and many are juvenile stages. Fishes are rarely taken as these are mobile organisms – unless they are found trapped in tide-pools on the reef flat. The exploitation of these juvenile stages of diverse species and will have impact on the population sizes of these species and to over-fishing in coastal fisheries.

The sustainability of gleaning as a livelihood will have a positive impact on the population and to the tourism industry that caters to tourists demand for seafood and souvenirs. The meat and shells of the harvested molluscs are important in the fishery and in the handicraft industry (LeBlanc 1997).

The meat from shells has a different importance to those who glean for food. This is a source of protein for the immediate family and relatives. When the harvest is substantial (> 1 $kg \cdot gleaner^{-1}$), about 50 % of the catch is sold to neighbours. The small income from this sale is used to buy rice and other basic necessities. The status of the habitats in the coastal area and the population of the exploited molluscs are therefore important in municipal waters to reduce the impact of poverty and on the health of coastal communities.

The catch per effort of gleaning has apparently remained the same in Aga-an and Piapi but not in Cangmating and Bais City. The harvest of invertebrates in Cangmating has declined by almost half; while in the past, it was composed of a small group of of invertebrates, it is now mainly composed of numerous species, none very abundant. In Banate, there was also a perceived decline of the historical and present catches. This decline of catch per effort calls for the conservation of coastal area for gleaning and the monitoring of the exploitation rates as the sustainability of the populations of a diverse group of invertebrates secures the food from the sea for the gleaners and the consumers.

Gleaning in Oriental Negros and Banate, Iloilo differs from that reported in Mabini, Batangas (Palomares *et al.* this vol.), which was mainly recreational, and which is also an important ecosystem service of the intertidal area. The decline of the catch and catch per unit effort in Bais and Banate Bays, which are heavily exploited for food and for income, is more reason to support conservation and management efforts initiated by the local governments (Integrated Coastal Management in Bais City; Banate Bay Resource Management). A donor has offered to provide 1,000 motor boats as part of the Adopt-a-Fisher Program[91]. The intention is good but may have detrimental effects given the lack of structural reforms in the fishery (see Discussion in Cabanban *et al.* this volume).

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[91] http://www.iloilo.gov.ph/the-governor/governor-in-action/792-Iloilo-launches-adopt-a-fisherman-program

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Appendix I: Questionnaire used in the interviews in Negros and Panay Islands

Name (optional): _____Age: _____
Ngalan (opsyonal): _____ _____ *Edad* _____
Address: _____
Position in the family (please underline): a. mother b. father c. child
Position sa pamilya (palihug linyahi) a. mama b. papa c. anak
Number of children in the family: _____
Pila ka anak sa pamilya: ____
Education: _____ Employment: _____
Edukasyon: _____ *Trabaho:* _____
Other business (if any): _____
Laing Business (kung naa): _____

1. How many members of the family are gleaning (please tick) ?
   a. Mother _____
   b. Father _____
   c. children _____ (please write number of children)
   d. all _____
1. Pila mo kabuok sa pamilya ang ga panginhas? (Palihug check)
   a. Mama _____
   b. Papa _____
   c. Mga Anak _____ (palihug isulat kung pila nga anak)
   d. Tanan _____
   e.
2. When did you start gleaning (please write year) _____
   2. Kanus-a mo nag sugod og panginhas (Palihog butang og tuig)? _____
3. How many grams/kilo was your usual catch when you started glearning ? (Please tick and write weight in gram/kilo)
   a. fish _____
   b. parrotfish _____ weight _____
   c. sea cucumber _____ weight _____
   d. sea urchin _____ weight _____
   e. stone-fish _____ weight _____
   f. damselfish _____ weight _____
   g. groupers _____ weight _____
   h. shell _____ weight _____
   i. seaweed _____weight _____
   j. other _____ weight _____
4. 3. Unsa o pila ka gramo/kilo ang sige ninyo makuha katong ga-sugod mo og panginhas? (Palihug check og isulat lung pila ka gramo/kilo).
   a. Isda _____ (Palihug I sulat kung pila ka gramo o kilo)
   b. Molmol _____ timbang _____
   c. Balat (sea cucumber)_____ timbang _____
   d. Salwaki (sea urchin) _____ timbang _____
   e. Bantol (Stone fish) _____timbang _____
   f. Palata (damsel) _____ timbang _____
   g. Kuyog-kuyog (groupers) _____ timbang _____
   h. Maninikad (shell) _____ timbang _____
   i. Gulaman (seaweed) _____ timbang _____
   j. Others _____ timbang _____(Palihug I lista og pila ka gramo o kilo)
5. What is/are your usual method in gleaning ? (please tick)
   a. hand _____
   b. use sticks _____
   c. hook-and-line by the beach _____
   d. hatchet _____
   e. xxxx _____
   f. others (please list) _____
   Unsa ang sige na pama-agi sa pag-panginhas (Palihug og check)?
   a. Kamot _____
   b. gamit og sticks _____
   c. gamit og hook and line gikan sa baybay _____
   d. gamit og hook and line kay og Bangka nga dili di makina _____
   e. sundang _____

f. salok _____
g. lain-lain (palihug og lista kung unsa) _____

6. Do you use vessel when you glean ? (Please tick.)
   a. Yes ____
   b. No ____
7. Ga gamit ba mo og sakayan sa pag-panginhas (Palihug check)?
   a. OO _____
   b. Dili _____
8. How many hours do each member of the family spend time in gleaning ?
   a. mother _____ (number of hours)
   b. father _____(number of hours)
   c. children _____ (please write how many children); _____ (number of hours)
   d. all _____ (number of hours)

Pila ka oras manginhas ang itig miembro sa inyong pamilya?

a. Mama _____ (pila ka oras)
b. Papa _____ (pila ka oras)
c. Mga Anak _____ (palihug isulat kung pila nga anak); _____ (pila ka oras)
d. Tanan _____ (pila ka oras)

Do you glean every day ? Please indicate and write the number of days per month.

a. Yes _____
b. No _____ How many times and number of days per month that you glean ?

9. Ga panginhas ba mo kada adlaw? Palihug check og sulat kung ka pila sa usa ka bulan
   a. OO _____
   b. Dili _____ Pila ka beses og adlaw sa usa ka bulan mo manginhas? _____
10. Asa dapita mo ga panginhas (palihug check)?
    a. Coral reef
    b. Sea grass bed
    c. Reef flat
11. Unsa og pila ka gramo man ang makuha ninyo karon sa panginhas (Palihug check og sulat kung pila ka gramo/kilo)?
    a. Isda _____ (Palihug I sulat kung pila ka gramo o kilo)
    b. Molmol _____ timbang _____
    c. Balat (sea cucumber) _____ timbang _____
    d. Salwaki (sea urchin) _____ timbang _____
    e. Bantol (Stone fish) _____timbang _____
    f. Palata (damsel) _____ timbang _____
    g. Kuyog-kuyog (groupers) _____ timbang _____
    h. Maninikad (shell) _____ timbang _____
    i. Gulaman (seaweed) _____ timbang _____
    j. Others _____ timbang _____ - _____(Palihug I lista og pila ka gramo o kilo)
12. Ang kuha ninyo sa panginhas para lang sa inyong consumo (Palihug check)?
    a. OO _ _____
    b. Dili _____
13. Kung dili tanan para consumo,
    Pila ka gramo ang inyong ginabilin para sa pamilya? _____
    Pila ka gramo ang ginahatag_____ og kay kinsa gihatag _____
    Pila ka gramo ang gi baligya _____ og kay kinsa gi baligya (e.g. neighbors, market) _____
    Pila ang inyong halin sa pagbaligya kada adlaw _____ o kada semana? _____
14. Aduna bay tawo gikan sa LGU o sa BFAR nga ga kuha og data/info gikan ninyo?
    a. OO _____
    b. Wala _____

Kung OO ang tubag sa #12, palihug I sulat ang ngalan sa opisina. _____

A short history of gleaning in Mabini, Batangas (Region IV, Subzone B, Philippines)[92]

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Abstract

In this contribution, we attempted to present a historical overview of gleaning in 10 coastal *barangays* (villages) in Mabini, Batangas, Philippines. The results of our interviews with 111 fishers, 10-84 years of age, indicate a general decreasing trend over 8 decades in the amount of catch, from an average of 2-2.5 kg·hour^{-1}·gleaner^{-1} or an average of 5.2 kg·day^{-1}·gleaner^{-1} in the 1950s to 0.5 kg·hour^{-1}·gleaner^{-1} or less than 2 kg·day^{-1}·gleaner^{-1} in 2012. Furthermore, the distance fishers needed to walk while gathering edible seafood has increased from about 0.5 m to about 30 m along the shoreline in an average of about 4 hours. The catch by gleaning, notably in the 1950s and 1960s, did not contribute much to what was sold; rather, the sole purpose of gleaning then was for subsistence. In addition, during those decades, gleaners picked only what was needed and did not spend time perusing potential saleable items. While gleaning still is a source of subsistence, this has now been reduced to opportunistic gathering often for the purpose of selling (notably seashells), primarily because there is not much left to glean. Moreover, the area left for gleaning has decreased since the construction of levees meant to protect the shoreline owned by diving resorts and private houses, which has effectively cut the access of the local community to the shoreline. Finally, improvement of roads and transportation access to the landing sites and markets in Anilao in the 1980s has made it possible for inhabitants of these communities to go to the market more easily and thus decrease the need for gleaning. The tourism (diving) industry boosted by the establishment of small manageable marine sanctuaries along the Mabini coastline as well as the expatriation of many female and some male members of these communities has resulted in increased per capita income of the area. Thus, we conclude that though still of fundamental value to a coastal community, gleaning evolved from being a survival resource to a lux mainly recreational activity in the last 60 years.

Introduction

Gleaning, in many cultures, is a traditional source of subsistence, e.g., seafood gathered along the shore line without or with very little use of fishing gear (Vunisea 1997; Ablong *et al.* 1999; Whittingham *et al.* 2003; Teh *et al.* 2007). Harvesting of seafood is conducted in a variety of coastal habitats, i.e., reefs, sandy-muddy intertidal areas and mangrove stands (LeBlanc 1997; Freire, *et al.* 1998; Parras, 2001; del Norte-Campos *et al.* 2005; Dolorosa, 2011) usually at low tide (Craig, *et al.* 1993; LeBlanc 1997; Freire, *et al.* 1998; Austin, 2003; Samonte-Tan *et al.* 2007; Brown *et al.* 2010; Aldon, *et al.* 2011). It is a typical activity in fishing communities (Schoppe *et al.* 1998; Lizada, 2010), and in many cases, an essential source of protein. Most often, women with their children and the elderly (Vunisea 1997; Whittingham *et al.* 2003; Gonzales and Savaris, 2005; Aldon *et al.* 2011), and only rarely men (Primavera *et al.* 2002;

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Subaldo, 2011), engage in gleaning. Traditional ecological knowledge facilitates species-specific capture by hand-picking or with simple equipment like sticks or rods (Craig, *et al.* 1993; Vunisea 1997).

There are different activities associated with gleaning. A major one is trading, i.e., gleaning and selling commercially used species, e.g., mollusks, crustaceans and sea cucumbers (Mendoza 1986; Maliao *et al.* 2004; Primavera *et al.* 2002; del Norte-Campos *et al.* 2005; Montenegro *et al.* 2005; Brown *et al.* 2010; Lizada, 2010; Villarta and del Norte-Campos, 2010; Subaldo, 2011). Harvest of a particular species for commercial purposes is based on two things: market appeal and abundance (del Norte-Campos *et al.* 2005). For example, the abalone population of Sagay, Negros Occidental, Philippines, exploited both by a fishery and by gleaners, has a market accepted shell length of 30 mm, i.e., larger than the size of a sexually mature abalone – males mature at 26 mm and females 23 mm (Maliao *et al.* 2004). In Guimaras Island, Semirara (Antique) and in Eastern Panay, also in the Philippines, a wide range of species are gathered (mollusks, crustaceans and a brachiopod), but only those with high catches (mollusks) are brought to the city to be marketed (del Norte-Campos *et al.* 2005; Nievales, 2008; Lizada, 2010). In some cases, catches are bartered for rice and other products (Sampang, 2007).

In addition to subsistence, gleaning is also a form of recreation (Cullen, 2007) and social networking (Gonzales and Savaris, 2005; Sampang, 2007). It provides an opportunity for women to be together away from the house (and thus from chores) and also facilitates the integration of newcomers to the community, indirectly reducing conflict by enhancing a sense of community through cooperation and sharing (Whittingham *et al.* 2003). At times, groups consist of entire families, father, mother and their children from grade school to their early teens (del Norte-Campos *et al.* 2005; Gonzales and Savaris, 2005; Sampang, 2007).

Gleaning can indeed be a source of income (Ablong *et al.* 1999; Santos *et al.* 2003; Beger *et al.* 2005; Gonzales and Savaris, 2005; Lizada 2010). It supplements fishing as the main source of livelihood, but we know little about how it functions because of the emphasis on what is believed to be more valuable near- or offshore fishing (Weeratunge *et al.* 2010). In addition, gleaning is an activity of women and children, and as such, remains unreported and undervalued by government and non-government institutions (Campos *et al.* 1994; Siason, 2001; Santos *et al.* 2003; Weeratunge *et al.* 2010). Children can be asked (and some are forced) to glean to earn income for the family, sometimes to the extent of incurring numerous absences from school, discouraging the youngsters to continue their education (Gonzales and Savaris, 2005). Wives glean mainly to supplement their husbands' income from other fishing activities (Gonzales and Savaris, 2005).

Species groups often harvested are those deemed to be of less value than fish, for example, shells, crustaceans, cephalopods (Schoppe *et al.* 1998; Siason, 2001), sea cucumbers (Brown *et al.* 2010), echinoderms (Cruz-Trinidad, *et al.* 2009) and sometimes ornamental fishes (Gonzales and Savaris, 2005). Mollusks, an important everyday source of protein for most Pacific islanders (Munro 1994), are usually dominant in gleaned catch (del Norte-Campos *et al.* 2005). This is reflected in the words used to describe gleaning in some areas of the Philippines where shellfish is the target species group, e.g., '*paninihi*' in Tagalog (spoken in southern Luzon), derived from the root word '*sihi*', i.e., shellfish; '*kinhas*' or '*panginhas*' in Cebuano, derived from '*kinhason*', i.e., shelled mollusk.

Catch by gleaning forms a major part of subsistence and artisanal fisheries especially in developing countries (del Norte-Campos *et al.* 2005). But because landings of gleaned species are unreported (FAO, 2007), it is difficult to evaluate catch and abundance trends, even of the more valued mollusk and echinoderm species (Munro 1994). A number of studies in some coastal barangays of islands in the central Philippines (Savina, *et al.* 1986; Samonte 1992; Schoppe, *et al.* 1998; Salazar *et al.* 1999; Parras, 2001; Primavera *et al.* 2002; Santos *et al.* 2003; Montenegro *et al.* 2005; Samonte *et al.* 2007; Picardal *et al.* 2011) and in Palawan (Sampang, 2007; Pido *et al.* 2008) provide insights on the importance of

gleaning in Philippine artisanal fisheries. For instance, Cabanban *et al.* (this vol.) provide an estimate of 20 % of the catch as consumed for subsistence and the rest is sold to the shell industry, for which the Visayan Islands are known.

Such studies are rare for the coastal areas of Luzon (Katon *et al.* 1999), apart from along the Verde Island Passage, which is situated in an area that is considered as a marine biodiversity hotspot (Carpenter and Springer, 2005). In this paper, we attempt to construct a historical overview of gleaning in 10 coastal barangays in Mabini, Batangas, to find out if it contributes substantially to the artisanal catch of the region. We also discuss observations of previous studies for other areas, where gleaning is well documented, albeit with different target species and fishing practices.

Materials and Methods

The town of Mabini, Batangas (13° 45' N, 120° 56' E) is situated on the Calumpan Peninsula, 130 km south of Manila (Majanen, 2004). It sits between Balayan and Batangas Bays opposite the island of Maricaban (see Figure 1). It is subdivided into 34 *barangays*, 10 of which are coastal: Anilao, Majuben, San Jose, Solo, Ligaya, Bagalangit, San Teodoro, Mainit and Gasang, with a population of over 43,000 inhabitants (in 2009, the population was at 43,000 inhabitants according to the Office of the Municipal Civil Registrar[93]). The coast is characterized by coral reef, rocky and sandy habitats, with small stretches of sand/mud flats (remnants of mangrove/seagrass/algal beds), on the coastline from Anilao to San Jose and at Mainit.

Eight focus group discussions were conducted with respondents from nine coastal barangays in Mabini on 10-11 May 2012 (see Figure 1) using a questionnaire (see Appendix 1) originally designed by Dr Annadel Cabanban (see Cabanban *et al.* this vol.) and modified to fit the conditions in this region. The questionnaire was made to target responses that characterize specific gleaning activities by decade from the 1950s to the present. The following topics were covered by the questionnaire:

1) what species and how much of these were harvested (to indicate catch by species) and what species are preferred and which ones are common in the area being gleaned;
2) how much time was spent (to indicate effort), how far a distance was covered along and perpendicular to the shore line (to indicate area gleaned) and in which habitat they usually gleaned (to verify if the species information given in (1) is reliable and to indicate if available habitat for gleaning can limit their activities);
3) how much of the harvest was sold, eaten or given away (to indicate consumption and value of harvested species);
4) how the harvest is used (to indicate importance of species, i.e., as food, as ornament, etc.).

A database was developed to accommodate the data obtained from the questionnaire as well as from other published sources. Responses were grouped as frequency histograms on a decadal scale with the mid-year as the base point (e.g., 1950s, with average year at 1955) to obtain average estimates of catch per gleaner per day per decade.

[93] Official website of the town of Mabini, Batangas at http://mabinibatangas.gov.ph/about-us.asp.

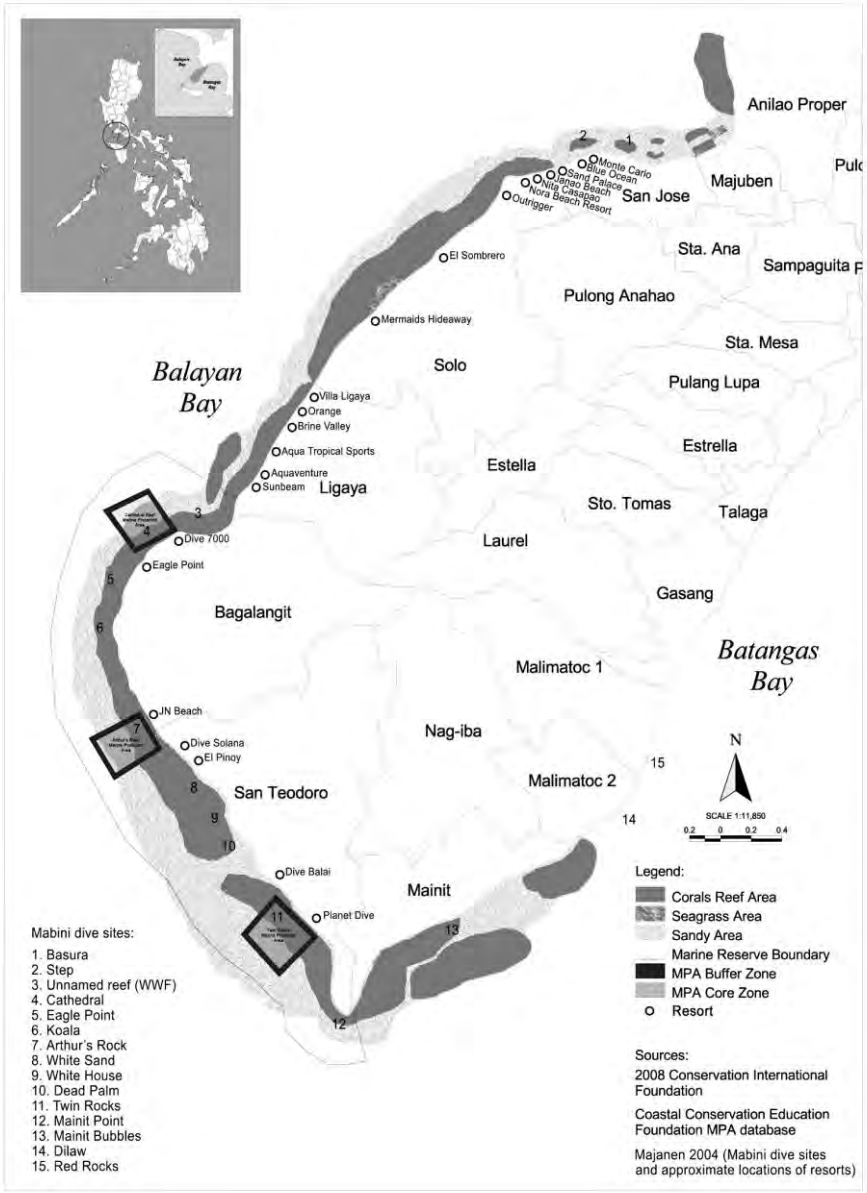

Figure 1. Coastal barangays (political boundaries in light gray line) of Mabini, Batangas, Philippines. Note dominance of coral reef and sandy habitats. The municipality hosts three marine sanctuaries (no-take; black squares), some of which are near or at dive sites (in numbers) or in proximity to resorts (in circles). Note that there are now a few more resorts than noted on this map (according to San Teodoro resident Jay Maclean pers. comm.)

Results

A total of 111 respondents were interviewed, 46 % females and 54 % males, 10-84 years old, mostly (77 %) born and raised with long family histories in Mabini (Figure 2A). Only 19 % of these respondents engage in fishing as their primary livelihood, 51 % are in other jobs (tourism, livestock and agriculture, local government units, etc.), and 30 % do not have jobs (66 % females; Figure 2B). Of these, 86 % engage in gleaning for at least 1 hour per low tide day, 3-5 days a month. Respondents started gleaning at an average age of 7 years. In general, males stopped gleaning as soon as they reached high school

(approximately 13 years old) or started to work (as fisher or elsewhere). Females continued gleaning on the average to 50 years old, and often with their children who are not yet in school (4-7 years old).

Catch from gleaning is mainly consumed for food; some is occasionally used as a toy or as an ornament (Figure 2D) and is rarely sold (Figure 2C). Usually, half of the catch is given away (see Figure 2D) to family and/or neighbours, notably when some of those people cannot go gleaning, usually for health reasons but sometimes because they work or go to school. Sometimes, species are harvested because they are amusing (e.g., sea stars) or because they have never been tasted before (e.g., some littoral gastropods). However, once cooked, these species may not please the taster and are thrown away and considered 'of no use'.

The results presented in Figure 2 span the 8-decade temporal categories used in the questionnaire, i.e., there was agreement between respondents that these observations remain true from when they were young to the present. It is interesting to note that on one hand, the 50-80 age group respondents agreed that in the 1950s and 1960s, people gathered only what they needed for food (and only the species which they preferred, e.g., abalone) because it was easy and it did not cost anything. On the other, the younger respondents indicated that they often would gather whatever is exposed (partly because they do not know what these can be used for) and if of commercial value, they will not think twice to sell. Some respondents indicated that at very few occasions, they gathered specific shells (usually gastropods, e.g., cowry shells) and were paid for their effort.

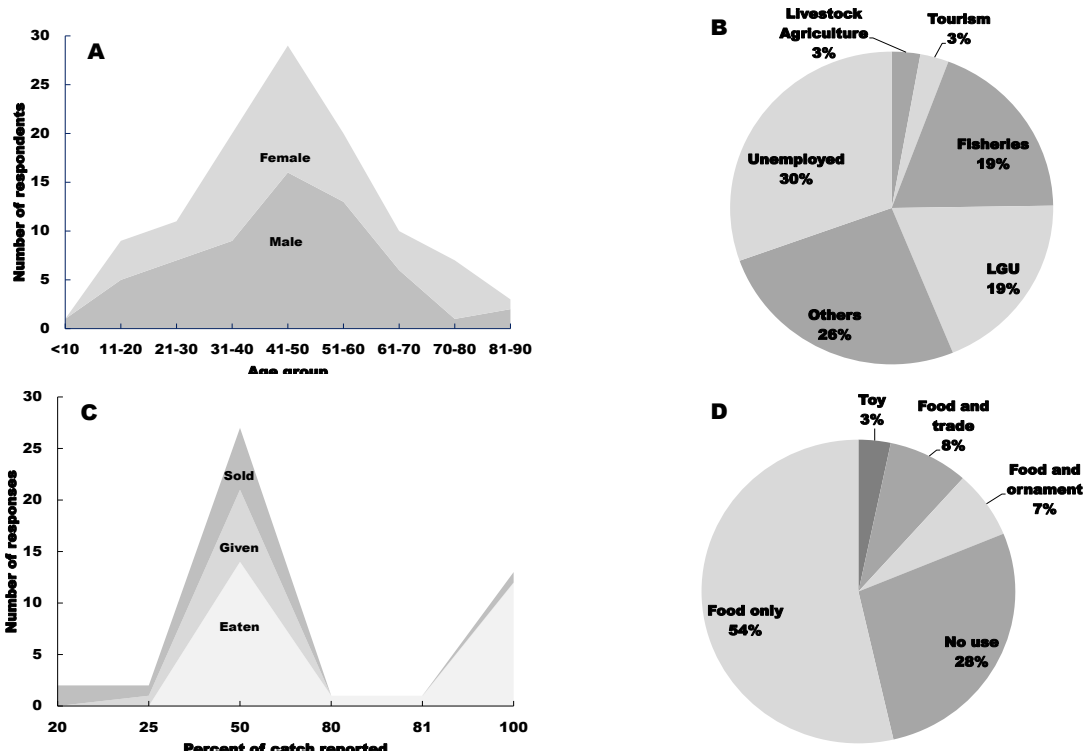

Figure 2. A: Age group of respondents (n=111) from 10 coastal barangays of Mabini, Batangas, Philippines interviewed during focus group discussions on the history of gleaning. B: Livelihood of respondents (LGU=local government unit); note 66 % of unemployed respondents are housewives and children and the 3 % in the tourism industry usually work as boatmen or operators of dive boats. C. Disposition of gleaned catch by respondents; note that selling of gleaned catch is mostly opportunistic. D: Use of gleaned catch by respondents; the category 'of no use' indicates species gleaned because they were available or fun to pick but could not be consumed for food because of their taste.

During 1950-1970, 54 % of the respondents gleaned primarily for food. Harvested products in excess of 50 % (i.e., consumed by the family) were either given away or bartered for other food items, e.g., rice or vegetables, with the neighboring mountain-based (i.e., farming and/or cattle raising) communities. Selling of harvested products was rare and very opportunistic. For instance, one of the oldest respondents, Mr Pablo Mendoza of Barangay Ligaya, recounts that he accepted requests to harvest certain types of seafood when he was a child, e.g., 50 Philippine centavos worth of shells (which would have weighed 2 kg) or 2 PHP worth of *lapu-lapu* (a grouper which would have weighed about 1 kg per piece). Lola B (her name cannot be provided), a 76-year old respondent from Barangay Gasang also mentioned bartering gleaned shells for *bukayo* (a caramelized coconut candy). Selling of harvested products was mentioned only in 1 barangay (Solo) and only recently (1990-present). In the 1990s, some Solo respondents indicated that a liter of gleaned shells (approximately 2 kg) was sold for 20 PHP. At present, a handful of shells (approximately 0.5 kg) will sell for 30 PHP.

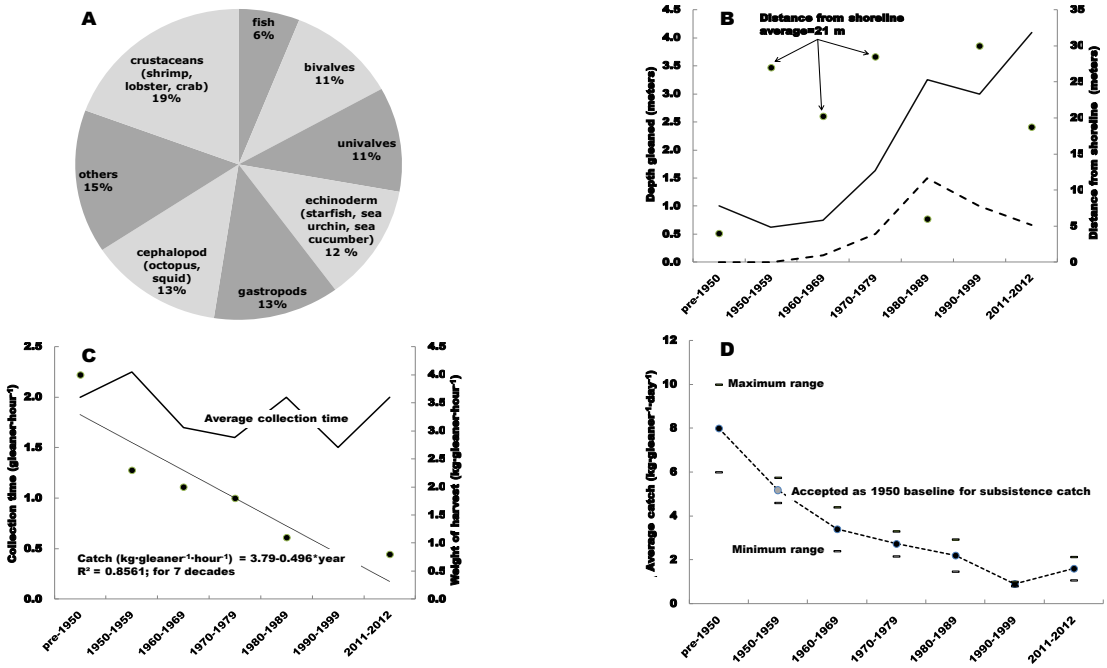

Figure 3. Summary of the catch by gleaning of coastal inhabitants in Mabini, Batangas, Philippines (Region IV, Subzone B) obtained from structured interviews of 111 respondents in 2012. A: Species composition of the gleaned catch showing importance of shell animals in the subsistence catch. B: Depth of water waded (dots) and distance walked from shoreline (solid line: maximum; broken line: minimum). C: Time spent harvesting (solid line) and the weight of harvest ($kg \cdot gleaner^{-1} \cdot hour^{-1}$) indicating a decrease in the catch given the same time spent harvesting. Year here is the middle year of a decade, 1955 for the 1950s, 1965 for the 1960s, etc. D: Average catch ($kg \cdot gleaner^{-1} \cdot day^{-1}$) with minimum and maximum values indicating a 1950 baseline of 5.2 $kg \cdot gleaner^{-1} \cdot day^{-1}$.

There is overall agreement between respondents that the catch composition of a harvest depends on the habitat. That is, gastropod species are dominant in both rocky and sandy habitats, squid and cnidarian (sea anemone) species are rare in rocky habitats and sea cucumber and sea snake species are rare in sandy habitats. Gleaning is rare in reef habitats, e.g., only when the tide is very low and the reef is exposed, are fish, sea urchins, crabs and other reef associated species accessible. And if gleaning did happen in reef habitats, it is usually in waters deeper than 1 m and involved swimming or skin diving (usually aided with a mask). Mollusks (gastropods, bivalves, univalves and cephalopods) are preferred by respondents in all

10 barangays, making up half of the average gleaned catch (Figure 3A). Coastal habitat also limits the surface area of the exposed shoreline, and thus, of the surface area that is available for gleaning. Respondents agree that conditions have deteriorated over the last 3 decades with respect to the distance walked and the amount of gleaned catch. A gleaner now has to go more than 30 m from the shoreline to catch consumable seafood (Figure 3B), and, for the same amount of time spent gleaning (e.g., in an hour), the catch has decreased by almost 90 % (Figure 3C). Considering the maximum and minimum amount of time spent per gleaning day and the average harvest per gleaner per hour, we estimated a high of more than 5 $kg \cdot gleaner^{-1} \cdot day^{-1}$ during the 1950s and a low of less than 2 $kg \cdot gleaner^{-1} \cdot day^{-1}$ in 2012 (Figure 3D). Assuming an average of 5 gleaning days in a month, a gleaner will likely go out collecting for food on 60 days in a year. In the 1950s, a gleaner would have brought home a little more than 0.3 t of edible seafood to share with family and neighbors in a year, while in 2012, the take home catch would be just a little over 0.1 t, a decrease in catch of about 70 %.

Discussion

Mabini municipality's current economy is made up of income from the following sources, in decreasing order of importance: Overseas Filipino Worker (OFW) remittances, manufacturing, tourism, agriculture, services, cottage industry and mining (see footnote 1). However, Mabini was traditionally (and probably remains) a fishing-based community, relying on part of the Batangas Bay which in 2002, contributed over 17,700 t (10 %) of the total marine municipal fish catch from the province of Batangas (A.C. Hamoy-Obusan, WWF-Philippines pers. comm.).

The rich marine fauna of Mabini is evident in amateur spear fisher photos taken in the 1960s (courtesy of Robert Yin[94], underwater photographer) showing large groupers, lobsters and other reef associated fishes (carangids and snappers) from Anilao and the Batangas Pier (Figure 4). In the 1970s, fish pens ('*baklad*') catching hundreds of tonnes of large pelagic species, including marlins and tunas were installed along the Mabini coastline (Pablo Mendoza, an octogenarian resident of Ligaya, Mabini pers. comm.). A few of these baklads still existed in the 1980s according to Jay Maclean and Roger Pullin, former senior staff members of the International Center for Living Aquatic Resources Management. One of these fish pens was near Seafari resort in San Jose, and another was installed on the opposite shore in Anilao proper. The presence of several offshore diving spots in the area introduced tourism (White *et al.* 2005) and Mabini rose to become one of the most popular and accessible diving areas in the Philippines (Saguin, 2008). By the 1980s, Mabini was suffering from an excess of migrant fishers and a range of destructive fishing methods (e.g., blast fishing) that jeopardized the booming dive tourism industry (personal observation, by M.L.D. Palomares, who was on field work in Balayan Bay for her M.Sc. thesis in the mid-1980s). A concerted effort to save the reefs of Mabini was launched in 1988 by Haribon Foundation and continued by a series of initiatives organized by international NGOs (World Wildlife Fund Philippines, Conservation International Philippines) in the 1990s and 2000s, respectively, with the first marine sanctuary established in 1991 (White *et al.* 2005). A suite of conservation projects followed, including seeding of giant clams, *Tridacna gigas*, by the Haribon Foundation in the 1990s, setting up of buoys for dive boats in the early 2000s by the Bantay-Dagat (Aida Mendoza, Bantay-Dagat pers. comm.) funded by Conservation International, and consecutive beach cleaning initiatives organized by some dive resorts and dive clubs employing the help of groups of divers enthusiastic about saving the marine life that inspire them to dive in these waters.

This unique history shows that the fisher community of Mabini evolved from coastal gleaners/farmers/cattle herders to offshore industrial fishers to fish pen operators to dive/tourist boat operators and dive masters and/or overseas/migrant workers. The discontinuation of gleaning as a primary food gathering activity, largely the opposite of their Visayan Islands counterparts (see Cabanban *et al.* this

[94] http://www.robertyin.com/

vol.), is seen as a result of several factors, enumerated here in decreasing order of perceived importance: 1) loss of access to shoreline; 2) increasing number of gleaners/gatherers due to migrant fishers (including gathering for fun by game fishing and beach tourists) and thus decrease in the amount of available resource; and finally 3) improved economic status (mainly due to foreign remittances by expatriated family members). Another limiting factor to gleaning, not mentioned by the respondents, is the small tidal range of this coastline, i.e., the intertidal areas and beach fronts are narrow and the fringing reefs cover small areas with drop-offs to 300 m in Balayan Bay. Though still existing, gleaning for food has become a treasured past time, especially by older women who wish to get their feet wet with excursions to the beach at least once a year reminiscing the good old days of their childhood. This and the continuing efforts to maintain the small yet effective marine sanctuaries (see Figure 1) punctuating the Mabini coastline over the last 3 decades led to a partial recovery of the denuded coral reefs of the late 1980s. These reefs are now the Mecca of divers (local and foreign), underwater photography enthusiasts and even more recently, of marine biologists aspiring to discover new species of mollusks (e.g., nudibranchs; see photos by Dr T. Gosliner of the California Academy of Sciences[95]).

Figure 4. Spear fishers, snorkelers and divers sampling fish off the Mabini coastline (photos courtesy of Robert Yin). Center photo: Divers in an outrigger boat off Mabini (c. 1966). The length of the lobster (most probably the ornate lobster, *Panulirus ornatus*[96]) seems to be as long as the woman's or about 60 cm in total length weighing 8.6 kg[97]. Clockwise from top: 1) Spear fisher with divers in Anilao, Mabini, Batangas. 2) Landings of outrigger (artisanal) fishing boats in Batangas Pier (c. 1966); note regular sizes of snappers (front, Lutjanidae, likely of the genus *Lutjanus*) and jacks (two rightmost individuals probably of the genus *Carangoides*), also just a little bit less than a meter probably weighing 15-20 kg a piece[98]. 3) Spear fishing divers and their grouper catch in Anilao (c. 1965). If the average height of a Filipino man is 1.6 m[99], then the total length of this grouper is 0.8 m.

[95] http://www.calacademy.org/blogs/expedition/?p=381.
[96] http://www.sealifebase.org/summary/Panulirus-versicolor.html.
[97] Estimated from length-weight relationships for Brazilian stocks of *Panulirus argus* (a=0.0529, b=2.91, W=7.9 kg; Fonteles-Filho *et al.* 1988), *P. echinatus* (a=0.0369 and 0.0301; b=2.965 and 3.18, W=6.9 and 13.6 kg; Pinheiro *et al.* 2003) and *P. laevicauda* (a=0.098, b=2.70, 6.2 kg; Fonteles-Filho *et al.* 1988) available from SeaLifeBase (www.sealifebase.org; Palomares and Pauly 2013).
[98] Weight estimations based on data in FishBase (www.fishbase.org; Froese and Pauly 2013) for the family Lutjanidae (see http://www.fishbase.de/PopDyn/LWRelationshipList_family.php?ID=1407&GenusName=Lutjanus&SpeciesName=argentimaculatus&fc=323).
[99] See average human heights table by country at http://en.wikipedia.org/wiki/Template:Average_height_around_the_world.

The issues besetting this coastline shifted from catch per unit of effort to solid waste management with discards by the numerous dive and beach resorts now polluting the reefs, leaving the most affected areas susceptible to crown-of-thorns starfish attacks[100]. The loss of and changes in the coastal habitats brought about by coastal tourism will be the next hurdle. If the people and local government of Mabini plan their moves well, we might dream of turtles, dolphins, reef and whale sharks and the occasional Napoleon wrasse (fauna that M.L.D. Palomares observed in the early 1980s, but which disappeared later in that decade) coming back to these coasts.

Friends who have houses by the coast and who frequently snorkel and dive these waters report some of this lost fauna returning. On two occasions in the last nine months, Jay and Margie Maclean report that a small pod of dolphins stayed for several hours near their place (between dive sites 8 and 9 in Figure 1) and that sea turtles and whale sharks are now being sighted. In November 2013, Jay Maclean reports that sea turtles nested and laid eggs on their beach front and that a small group of manta rays were sighted near Arthur's Rock (dive site 7 in Figure 1). That is indeed rather exciting for residents like the Maclean and the Mendoza families whose lives revolve around marine life, on one hand as marine biologists and conservation advocates, and on the other as dive tourism operators.

It seems like the balance between sustainable use and protected areas via marine sanctuaries is finally being reached and paying off. It might well be that the particular set of factors affecting the Mabini marine ecosystem gives our story a positive note, an addition to the increasing number of success stories associated with marine protected areas. However, the Mabini story, is not typical of coastal ecosystems in the Philippines, where poverty among fisher communities is still the rule rather than the exception.

Acknowledgments

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Reconstructed marine fisheries catches of the Philippines, 1950-2010[101]

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Abstract

This contribution synthesizes the results of the other contributions in this report, and estimates additional time series such that the total reconstructed catch of the Philippines marine fisheries covering the period 1950-2010 can be presented. Overall, the annual reconstructed catches in the Philippine EEZ were about 0.24 million t·year^{-1} in the early 1950s, which increased and then plateaued in the late 1970s at around 0.9 million t·year^{-1}. Expansion into more offshore, pelagic stocks in the late 1980s then enabled a new growth phase, which led to about 2.4 million t·year^{-1} being reached in 2010. Overall, this is 0.96 times the catch reported by FAO on behalf of the Philippines; while the adjusted reported FAO catch estimated from the reconstructed catch is 0.86 times that of the reported FAO catch. The industrial sector (including so-called 'baby trawlers' and unreported catch) contributed 66 % of the catch, the rest consisting of artisanal fisheries (23 %) and subsistence (11 %), recreational fisheries and industrial discards being minimal (0.6 %). Overfishing is ubiquitous, as is 'fishing down', but efforts are made to counter these, notably through a multitude of marine protected areas, a tool pioneered in the Philippines.

While our reconstructed estimates do not differ strongly from the official estimates, they are based on completely different assumptions about the balance between the industrial and artisanal catch (the latter being re-estimated from the bottom up). Therefore, if the new catch estimates are considered realistic, they should imply a serious re-examination of the Philippine fisheries statistics system.

Introduction

The Philippine fisheries statistics are extremely complex, in terms of their geography, the many species that are exploited, the different gears that are used and even in terms of the literature devoted to this subject. Thus, there are hundreds of papers discussing one of their many aspects or detailing the species caught or the gears used at certain locations, many more than cited in this report. However, there are extremely few, if any reliable accounts, that cover comprehensively the country's fishing industry. Moreover, while usually extremely detailed and available in multiple forms, the fisheries statistics of the Philippines leave much to be desired with regards to their reliability, notwithstanding their apparent precision (e.g., millions of tonnes are routinely reported with a precision to the fraction of a kilogram).

The fundamental unreliability of the catch statistics of the Philippines is due to the catches of one sector, the ill-named "commercial" fisheries being linked through fixed ratios to the equally ill-named "municipal" catch such that if the former increase, so does the latter. While our attempt at re-evaluating the fisheries catches of the Philippines cannot reliably estimate how much has historically been caught since 1950, we have attempted to overcome the worst consequences of the linkage between the industrial ('commercial') and artisanal ('municipal') catches in the Philippines, by estimating artisanal catches independently from the industrial catch (see Parducho and Palomares, this vol.; Palomares and Parducho,

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this vol.; Cabanban *et al.* this vol.; Parducho and Palomares, this vol.). Also, we have taken this opportunity to partly correct the officially reported industrial catches by accounting for:

1. Unreported domestic industrial catch;
2. Industrial catches reported from Philippine waters, but likely taken in Indonesian, Papua New Guinean or Malaysian waters;
3. Non-marketable part of the industrial catch that is better counted as subsistence catch;
4. A small fraction of discards, for demersal and tuna fisheries; and
5. Industrial catches taken by so-called baby trawlers and considered as 'municipal' (i.e., artisanal) catch under current regulations[102].

After these corrections, we added estimates of artisanal catch based on separate analyses of 4 'subzones' of the Philippines (Figure 1), of subsistence catch based on studies of gleaning (e.g., Palomares *et al.* Cabanban *et al.* this vol.) and estimates of 'home fish' taken by artisanal and industrial fishers (i.e., catch retained for self and family consumption), and a first estimate of recreational catches. Jointly, these estimates generated a total catch which, as we shall see, is 4% less than that reported by the FAO.

We present the component time series, and the total catch of the Philippines after briefly outlining the methods used to estimate artisanal and subsistence catches detailed elsewhere in this report and after presenting the method used to adjust the industrial catch, as mentioned above.

Material and Methods

Regarding item (1) above, we downloaded the nominal marine catch for the Philippines (1950-2010) from the Bureau of Agricultural Statistics (BAS) and the Bureau of Fisheries and Aquatic Resources (BFAR) and from the Food and Agriculture Organization of the United Nations (FAO) websites (FAO FishStat; see http://www.fao.org/fishery/statistics/software/fishstat/en). We eliminated non-fish vertebrates (marine mammals, seabirds, sea turtles), corals and algae from the Philippines and FAO data sets and compared them to evaluate the effectiveness of the transfer from the Philippine authorities to the FAO.

To accommodate item (2) above, we added 30 % to all Philippines reported 'commercial' (industrial) catches to account for underreported catches (Davies *et al.* 2009; Palomares and Pauly, this vol.). The industrial catch landed in Subzone D (i.e., bordering Sabah, East Kalimantan, Sulawesi and the Maluku) is known to include tuna caught outside of the Philippine EEZ (see Barut and Garvilles 2006; Palma and Tsamenyi 2008). Given estimates of foreign tuna catch (by Philippine flagged vessels fishing with or without access agreements; see BFAR/WCPFC 2012) at 27,408 t (2006), 49 876 t (2008) and 68,000 t (2009; see BFAR 2012), we 'shaved off' 24-33% of skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacores*) and bigeye tuna (*Thunnus obesus*) landed in Subzone D for the period 1980-1990, i.e., the period when Filipino fishers from this subzone most likely expanded to waters outside of the Philippine EEZ (see Vera and Hipolito 2006; BFAR/WCPFC 2012). The shaved-off catch was allocated to Indonesia (70 %), Papua New Guinea (20 %) and Malaysia (10 %), and was assumed to consist of 50 % skipjack, 40 % yellowfin, and 10 % bigeye tuna (Table 1; see also Aprieto 1995).

To avoid the double counting of non-marketable fish implied in (3), the small amount of such fish was subtracted from the national reported 'commercial' (industrial) catch. Regarding (4), discards as unreported catch were estimated as 1 % of the unreported tuna catch (Bailey *et al.* 1996) and 3% of the unreported demersal catch (Selorio *et al.* 2008).

[102] In line with Martín (2012), we consider all gear dragged across the bottom or through the water as 'industrial' (i.e., large-scale) rather than 'artisanal'.

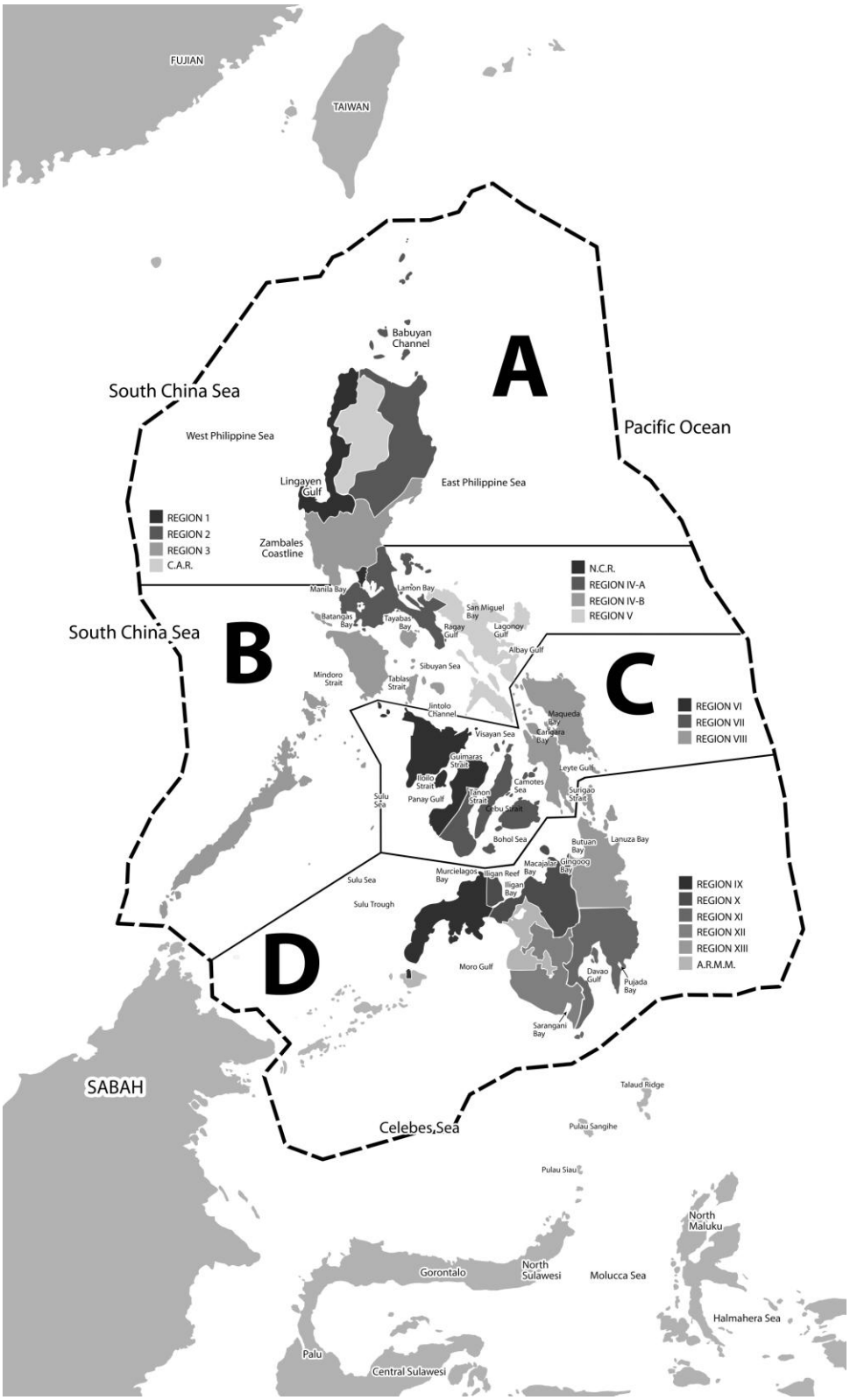

Figure 1. The Philippines, its Exclusive Economic Zone (EEZ) and the 4 subzones into which the EEZ was subdivided to obtain 4 independent and subsequently pooled estimates of artisanal catch of the Philippines (see text; redrawn by Mr. Mike Yap from a composite of several open source maps).

Table 1. Subset of the officially reported commercial (industrial) tuna catch (in $t \cdot 10^3$) of the Philippines that are here assumed to have been taken outside of the Philippine EEZ, in Sabah (Malaysia), Eastern Indonesia and Western Papua New Guinea, but landed in Subzone D (see Figure 1).

	Skipjack			Yellowfin			Bigeye			
Year	**PNG**	**Indonesia**	**Sabah**	**PNG**	**Indonesia**	**Sabah**	**PNG**	**Indonesia**	**Sabah**	**Total**
1980	0.57	1.99	0.28	0.45	1.59	0.23	0.11	0.40	0.06	5.69
1981	0.50	1.75	0.25	0.40	1.40	0.20	0.10	0.35	0.05	4.99
1982	0.81	2.82	0.40	0.65	2.26	0.32	0.16	0.56	0.08	8.06
1983	1.03	3.61	0.52	0.83	2.89	0.41	0.21	0.72	0.10	10.32
1984	1.26	4.40	0.63	1.01	3.52	0.50	0.25	0.88	0.13	12.57
1985	1.17	4.08	0.58	0.93	3.26	0.47	0.23	0.82	0.12	11.66
1986	1.07	3.76	0.54	0.86	3.01	0.43	0.21	0.75	0.11	10.74
1987	0.98	3.44	0.49	0.79	2.75	0.39	0.20	0.69	0.10	9.83
1988	0.89	3.12	0.45	0.71	2.50	0.36	0.18	0.62	0.09	8.92
1989	1.48	5.19	0.74	1.19	4.15	0.59	0.30	1.04	0.15	14.82
1990	1.78	6.25	0.89	1.43	5.00	0.71	0.36	1.25	0.18	17.84
1991	2.12	7.43	1.06	1.70	5.95	0.85	0.42	1.49	0.21	21.24
1992	1.55	5.42	0.77	1.24	4.33	0.62	0.31	1.08	0.15	15.48
1993	1.25	4.37	0.62	1.00	3.49	0.50	0.25	0.87	0.12	12.48
1994	1.80	6.31	0.90	1.44	5.05	0.72	0.36	1.26	0.18	18.03
1995	2.38	8.32	1.19	1.90	6.66	0.95	0.48	1.66	0.24	23.78
1996	2.67	9.33	1.33	2.13	7.46	1.07	0.53	1.87	0.27	26.65
1997	3.79	13.27	1.90	3.03	10.62	1.52	0.76	2.65	0.38	37.92
1998	2.09	7.32	1.05	1.67	5.86	0.84	0.42	1.46	0.21	20.93
1999	2.16	7.55	1.08	1.72	6.04	0.86	0.43	1.51	0.22	21.56
2000	2.22	7.76	1.11	1.77	6.21	0.89	0.44	1.55	0.22	22.18
2001	2.38	8.33	1.19	1.90	6.66	0.95	0.48	1.67	0.24	23.80
2002	3.92	13.72	1.96	3.14	10.98	1.57	0.78	2.74	0.39	39.20
2003	5.23	18.32	2.62	4.19	14.65	2.09	1.05	3.66	0.52	52.34
2004	5.85	20.49	2.93	4.68	16.39	2.34	1.17	4.10	0.59	58.54
2005	2.19	7.68	1.10	1.75	6.14	0.88	0.44	1.54	0.22	21.93
2006	5.28	18.49	2.64	4.23	14.79	2.11	1.06	3.70	0.53	52.82
2007	4.37	15.28	2.18	3.49	12.23	1.75	0.87	3.06	0.44	43.66
2008	3.97	13.91	1.99	3.18	11.13	1.59	0.79	2.78	0.40	39.74
2009	6.21	21.73	3.10	4.97	17.38	2.48	1.24	4.35	0.62	62.09
2010	4.62	16.17	2.31	3.70	12.93	1.85	0.92	3.23	0.46	46.19

Regarding item (5), i.e., correcting for 3 GT 'baby trawlers' being counted as 'municipal' (artisanal) gear which, because they drag a net, must be considered as an industrial gear (Martín 2012), we complemented the reported 'municipal' catch of baby trawlers by a linear increase from zero in 1950 (when dug out trawls were developed in Manila Bay; Caces-Borja 1966; see also Smith and Pauly 1983) to the 1978 reported catch (see Appendix A). Then, we assumed that the prohibition of active gears in 'municipal' waters in 1998 (Article II, Chapter 6, Section 90 of Republic Act 8550; see also Carandang *et al.* 2013), and the 5-year closures of the trawl and purse seine fisheries in 1981 in the waters of Bohol, Cebu and Negros Oriental (Fisheries Administrative Orders 130-132), in 1982 in Palawan (Fisheries Administrative Order 137), and in 1983 in Batangas (Fisheries Administrative Order 142), implied that baby trawl operations were also illegal. These prohibitions and closures imply an exponential decline in baby trawl annual catches (which we assume at 20%), because, if followed at all, would have been implemented only gradually.

The estimation of artisanal catch by subzone was discussed in Parducho and Palomares (this vol.) for subzones A and D, Palomares and Parducho (this vol.) for subzone B, and Cabanban *et al.* (this vol.) for subzone C and does not need reiterating here. Suffice to say that it is based on catch per fisher estimates

multiplied by the number of fishers per subzone and thus is completely independent of official fisheries statistics.

The subsistence catch consisting of reef gleaning estimates and a fraction of the take-home catch of artisanal and industrial fishers (see item (3) above) also did not depend on officially reported data. A description of how the take-home catch was estimated is available in Cabanban *et al.* (this vol.).

Finally, the marine recreational fisheries catches of the Philippines are described in Espedido *et al.* (this vol.) and the time series of catch estimated therein was simply added to the other time series described above.

Results and Discussion

Figure 2 shows the reconstructed total catches (in solid gray line), the officially reported marine catches on behalf of the Philippines by the FAO (broken gray line) and the EEZ-adjusted catches of the reported FAO catches superimposed on the area graph of the industrial, artisanal, subsistence and recreational sectors and the discards of the industrial sector. The reconstructed catches are lower than the FAO statistics by an average of 4% and with peak differences in the 1970s-1980s (-14%). We can hypothesize that the peak differences in the 1970s-1980s occur due to the raising factor (described in Palomares *et al.* this volume) adopted by BFAR in the 1970s and subsequently by BAS in the 1990s applied to a sample data that were probably not representative of the Philippine catches during that period. Note that this period was marked by government budget cuts which affected the fisheries statistics collection program. The reconstructed catches are higher in the late 1990s to the 2000s by 2%, which, as can be deduced from the EEZ-adjusted catch curve, is due to the addition of unreported and discarded catches. We list some facts from recent sources which might shed light on why our reconstructed catches have this behavior, i.e.:

- Palma (2007) outlines the problems of unreported, unregulated and illegal catches in the Philippines, which occurs in both the artisanal and industrial sectors;
- The industrial fishery (large purse seines) targets oceanic tuna, while the handline artisanal fishery targets both oceanic and neritic tunas (BFAR 2012);
- The artisanal fishing fleet (handlining pumpboats), on the other hand, is potentially composed of more than 2,500 unregistered vessels, i.e., traditional/local fishers (Palma 2007) either selling their catch directly to foreign vessels or likely infringing on international waters and landing their catch in the Mindanao ports;
- The Philippine distant water fleet, mostly based in the southern Philippines, targets tuna (yellowfin and skipjack), billfishes and other large pelagic species including sharks (as bycatch), reef fishes (for the live fish trade), corals and marine mammals, with illegal foreign catch estimates in Philippine waters reaching 80,000 t per year (Palma and Tsamenyi 2008);
- The Western Central Pacific Fisheries Commission lists 625 vessels fishing in the region, which does not include other industrial vessels fishing exclusively in Philippine waters (BFAR 2012), and whose catch may not be monitored by the WCPFC or by the BFAR;
- There are 150,370 registered fishing vessels in the Sulawesi Sea, 4% of which are large industrial vessels mostly flying the Philippine flag, whose catch are landed in Zamboanga, Davao and General Santos City (i.e., 3 of the 8 regional fish ports in the Philippines). The tuna canneries in General Santos City alone get 70% of their tuna from Philippine waters and the rest from Indonesian waters (Palma and Tsamenyi 2008), likely landed in General Santos City;
- Foreign vessels land their catches in the Davao Fish Port Complex, which is an alternative transhipment point in Asia (Palma and Tsamenyi 2008);

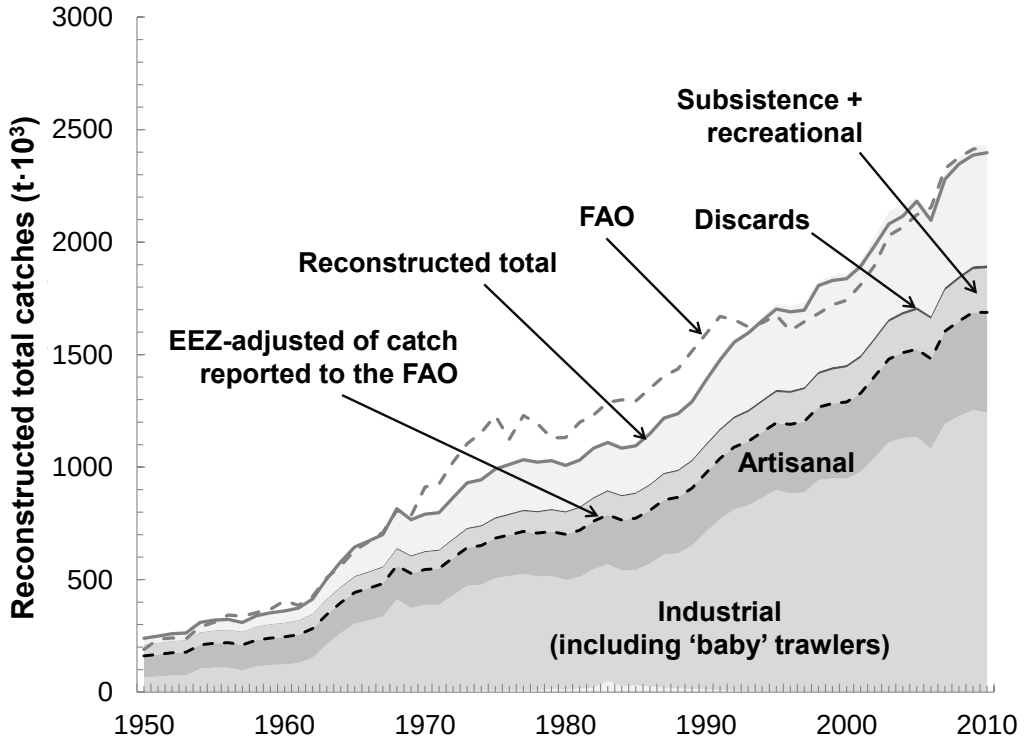

Figure 2. Reconstructed Philippine marine capture fisheries catches (1950-2010) compared with nominal marine catch for the Philippines reported by the Bureau of Fisheries and Aquatic Resources (BFAR; 1950-1979) and Bureau of Agricultural Statistics (BAS; 1980-2010) to the Food and Agriculture Organization of the United Nations and superimposed on area graphs of the component fisheries.

- BFAR/WCPFC (2012) reports that the differences in catch estimates after reconcialiation of the different estimates from the national data sources are due to "*the diverse municipal fisheries [...] explained as possible bias in the probability surveys due to very low coverage. The workshop participants noted that while the industrial fleet estimates are now becoming more reliable, there is still a major problem in determining and validating the estimates of the small-scale municipal fisheries that needs to be resolved in the near future*."
- Landings from the fish ports mentioned above figure into the national statistics, which are submitted as is to the FAO (BFAR/WCPFC 2012).

These various facts indicate that: (i) our estimation of tuna catches from international waters is justified, but might be a conservative estimate given that foreign vessels land tuna in Philippine fish ports monitored regularly by the Philippine government; and (ii) our estimation of the unreported catch might be lower than what happens in reality because we only accounted for unreported catches from the Philippine industrial fleet assuming a 30% markup and did not account for illegal catches by foreign vessels and unregulated catches by Filipino pumpboats. It may thus be that our reconstructed catch is a rather conservative estimate.

Note that the trends of the FAO and reconstructed catches resemble each other from the 1950s-1960s and the late 1990s onwards. This similarity is only fortuitous, as these time series are built based on completely different assumptions, i.e., the artisanal catches were not based on the 'municipal' catches reported by BFAR.

The industrial sector, which is composed of the BFAR/BAS reported industrial landings plus the reconstructed baby trawl catches based on BFAR/BAS reported 'municipal landings', dominates the total catches (66%). Discards, which are usually prominent in other countries, are virtually inexistent (0.54%) in Philippine fisheries. Recreational fisheries, though practiced, represent an even smaller sector (0.01%) and were thus added to the subsistence sector (11%) for ease of presentation.

Figure 3A presents the summary of the taxonomic composition of the catch. However, because the marine catch of the Philippines is extremely diverse – there are more than 100 species and species groups caught in the Philippines (which is, after all, at the global center of marine diversity; Carpenter and Springer 2005) – we have abstained from presenting a species-level taxonomic resolution, and used broader taxa instead. Pelagic fisheries dominate the total reconstructed catches, with large volumes of round scads consistently dominating from the 1950s onwards. Slipmouths (Family Leiognathidae) ranked 2nd until the 1970s and were increasingly replaced by Indian sardines from the 1990s onwards. The catch of tuna species (notably of skipjack) increased from the 1990s onwards, most likely a direct result of the increased use of fish aggregating devices (Aprieto 1995; Floyd and Pauly 1984) in conjunction with the increased ability of smaller outrigger boats to travel faster and farther into the open seas. Note that fish aggregating devices also had the effect of aggregating juvenile pelagic fishes, tuna and non-tuna alike (Babaran 2006), thus, enabling the catch of smaller pelagic species such as anchovies, sardines, mackerels and fusiliers at high levels. Detailed data on species composition of the catch will be available from the *Sea Around Us* database.

Figure 3B complements Figure 3A, with an analysis of the mean trophic level of the reconstructed industrial catch, i.e., for which landings data were disaggregated to the species-level. This analysis implies that the presence of the 'fishing down the food web' phenomenon (Pauly *et al.* 1998) is strong for tuna catches and clearly discernable in the non-tuna catches (see also Pauly and Palomares 2005; Pauly *et al.* 2000). Note the apparent cycles in increase and decline of the trophic level of the catch, which we tentatively attribute to successive phases of offshore expansion.

Tuna was considered a "second class" fish by Filipinos in the 1950s (Avery 1952) and was targeted mostly by hand liners (Aprieto 1995), probably to satisfy the American taste (Avery 1952). Species likely targeted in the 1950s would be inshore species like bigeye (*Thunnus obesus*; trophic level=TL=4.5, s.e.=0.8), eastern little (*Euthynnus affinis*; TL=4.5, s.e.=0.8), frigate (*Auxis thazard*; TL=4.3, s.e.=0.7) and bullet tuna (*Auxis rochei*; TL=4.1, s.e.=0.6; Barut 2007). Thus, the mean trophic level of the tuna industrial catch at this time was between 4.3 and 4.4. The 1960s were marked by the introduction of effective fishing gears (e.g., trawls and purse seines; see Lewis 2004) resulting from BFAR sanctioned research and surveys in the 1950s (Warfel and Manacop 1950; Ronquillo *et al.* 1960). In the 1970s, Presidential Decree No 704[103] sanctioned the development of the fishing industry by increasing the number of trawling operations and improving the 'fisheries loan and guarantee fund', i.e., fisheries subsidies. The tuna fishery grew to about 245 vessels operated by 55 companies, using lights at night and employing fish aggregating devices harvesting not only tuna but also small pelagic fish species like sardines (see Lewis 2004), increasing the catch of yellowfin (*Thunnus albacares*; TL=4.3, s.e.=0.7) and skipjack tuna (*Katsuwonus pelamis*; TL=3.8, s.e.=0.6). Similar trends occurred in the demersal fisheries, which led to the overexploitation and growth overfishing of most nearshore stocks as recorded in Manila Bay (Silvestre *et al.* 1987; Muñoz 1991), San Miguel Bay (Smith and Pauly 1983; Lim *et al.* 1995; Soliman and Dioneda 1997), Panguil Bay (Dickson 1987), and Lagonoy Gulf (Soliman *et al.* 2009).

[103] http://www.bfar.da.gov.ph/pages/legislation/presdecree704.html

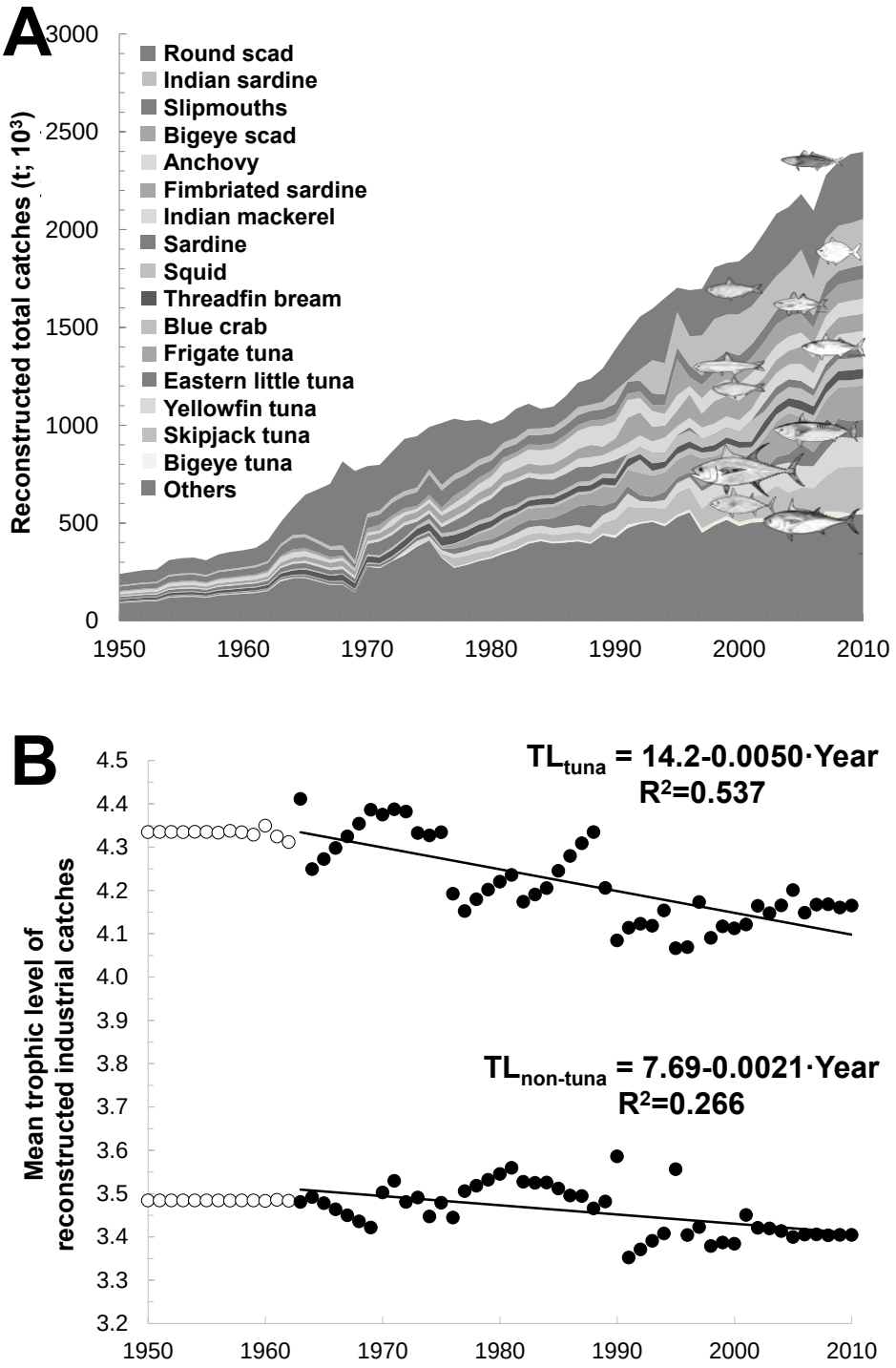

Figure 3. Two views of the reconstructed Philippine marine capture fisheries catches (1950-2010). A. Showing the top 12 species and species groups and the five tuna species, making 90% of the catch. Note the increasing contribution of pelagic fisheries. The same data, disaggregated by species may be found on www.seaaroundus.org. B. Mean trophic level of the reconstructed Philippine marine industrial fisheries catch (i.e., sum of reported landings, estimated underported catches and discards and baby trawl catches reconstructed from nationally reported 'municipal' landings), and distinguishing between tuna and non-tuna catches, i.e., between offshore and inshore ecosystems, respectively.

The trend toward offshore expansion, which led to an increase of the contribution of pelagic fishes to the Philippine catch, also led to a blurring of the distinction between domestic and foreign catches by Philippine vessels. We have attempted here to correct for the latter effect, but we expect that our attempt to separate these catches remains imperfect. We have also not attempted to investigate the legal basis – if any – of foreign fishing by Philippine vessels in the EEZ of neighbouring countries. We note however, the bilateral access agreements between the Philippines and Indonesia, which permitted "*255 fishing vessels and 300 Filipino lightboats*" to fish in a defined area of the Indonesian EEZ was established in 2002 and, which, for all intents and purposes, is still honored in spite of its ending in 2007 (APEC 2008). Similarly, this account does not cover illegal fishing by other countries in the waters deemed to belong to the Philippine EEZ, although it is evident that at least one country not only has multiple vessels operating in the Western part of the Philippine EEZ (Pauly *et al.* 2013), but contests the Philippine claim of an EEZ in the South China Sea.

We conclude this by reiterating that the catch reconstruction presented in this report has not led to a definite account of the historic fisheries catches of the Philippines. Rather, we hope to have provided, along with clear definitions for describing the marine fisheries of the Philippines, an alternative methodology for estimating their catches. We hope that these definitions and methodology will be found useful, and contribute to a much-needed reform of the Philippine fisheries statistical system.

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Appendix A: National statistics for industrial and artisanal marine capture fisheries by subzone and by region (in $t \cdot 10^3$) obtained from fisheries reports by the Bureau of Fisheries and Aquatic Resources and by the Bureau of Agricultural Statistics.

Zone Region	63	64	69	70	71	72	73	74	75	76	77	81	82	84	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
Industrial																																	
A																																	
I	2	2	1	1	1	1	1	2	1	1	2	2	2	2	7	4	4	5	4	2	3	1	2	92	2	2	2	3	3	4	4	4	6
II	0	0	1	1	1	1	2	1	1	1	1	1	2	2	8	6	4	6	6	4	3	4	6	7	8	13	14	14	16	16	16	16	19
III	0	0					1	1	1	1	0	8	8	8	9	10	11	8	6	6	9	8	8	10	9	11	12	14	12	11	11	10	10
B																																	
NCR	17	13	23	20	16	18	31	21	52	23	18	154	165	134	184	197	209	234	223	234	249	269	238	207	210	160	146	141	161	153	141	118	72
IV	112	140	927	234	248	254	196	191	138	30	76	57	55	53	54	61	49	69	68	81	96	100	103	114	117	145	135	190	129	131	123	129	136
V	8	13	8	9	11	23	24	20	42	41	38	40	43	36	40	45	31	17	19	21	25	20	21	27	24	22	22	32	36	42	42	53	50
C																																	
VI	8	14	5	5	8	8	7	5	10	8	11	117	120	120	224	129	133	88	150	160	150	122	120	123	114	123	130	132	118	121	116	115	111
VII	1	2	0	1	2	2	3	15	15	8	12	19	22	42	30	35	71	108	71	64	160	54	59	70	62	62	64	61	60	58	58	63	47
VIII	5	7	4	3	2	7	8	14	17	16	13	11	9	10	15	14	36	37	38	32	118	26	28	26	29	31	32	36	38	46	51	57	67
D																																	
IX	8	7	10	9	9	16	11	19	13	32	10	55	68	66	82	85	110	110	151	160	135	173	173	279	189	162	166	170	196	212	219	257	230
X	1	1	1	1	0	3	1	9	2	2	4	4	4	6	6	7	4	6	9	29	45	22	18	19	20	20	21	25	37	40	41	41	39
XI	0	1	5	4	7	4	5	5	5	6	6	24	27	35	14	46	56	61	51	45	38	47	69	79	106	143	148	151	12	12	10	11	15
XII	0	0	2	2	2	2	1	0	4	6	8	1	1	1	0	0	0	1	5	9	5	5	4	10	6	10	11	11	144	179	203	10	187
XIII				0						0	0											5	4	4	5	5	5	5	5	5	5	6	6
ARMM		3		0	0	3	1			11	30											29	25	36	35	40	41	61	76	80	81	83	84
Artisanal																																	
A																																	
I												12	10	10	20	22	18	22	19	19	19	19	17	18	23	22	23	22	25	27	28	29	31
II												15	11	8	7	9	10	9	6	8	5	7	7	7	10	12	14	14	16	18	15	15	16
III												13	16	16	21	24	25	27	16	9	11	9	6	7	8	8	9	10	12	14	14	26	24
B																																	
NCR												6	8	8	8	9	10	10	9	7	5	5	4	4	5	4	4	4	3	2	2	5	6
IV												97	133	154	137	149	149	161	173	151	148	145	136	145	143	155	153	154	175	196	220	215	413
V												111	79	87	86	89	66	72	73	57	58	61	65	73	73	72	73	86	91	99	98	103	109
C																																	
VI												117	131	150	178	151	170	180	150	165	162	152	145	135	117	124	124	124	126	124	125	132	130
VII												49	26	24	23	26	20	20	30	31	31	39	41	48	41	45	47	45	52	50	50	52	53
VIII												36	35	32	35	37	27	32	29	27	33	37	41	31	36	35	37	42	42	50	53	84	74
D																																	
IX												153	168	200	195	212	240	203	226	205	180	164	128	129	113	116	122	129	28	125	122	169	112
X												55	57	72	76	75	78	83	73	57	54	16	15	16	16	15	17	21	27	29	30	33	34
XI												34	32	31	56	59	51	62	54	57	53	35	39	50	46	48	47	49	28	30	29	32	30
XII												18	13	23	35	24	27	27	25	16	6	6	6	5	6	6	6	7	24	26	26	29	28
XIII																						67	58	64	58	61	64	63	58	62	84	64	63
ARMM																					28	27	30	36	41	44	44	50	58	61	63	61	70

Appendix B: National statistics for number of fishers by subzone and by sector (in $t \cdot 10^3$) obtained from Census of Fisheries and Census of Population and Housing reports of the National Statistics Office.

Zone	A			B			C			D		
Year	Industrial	Artisanal	Subsistence	Industrial	Artisanal	Subsistence	Industrial	Artisanal	Subsistence	Industrial	Artisanal	Subsistence
1950	6	10	12	18	26	25	34	37	28	17	21	18
1951	7	10	12	19	27	25	35	38	29	17	22	19
1952	7	11	13	19	28	26	36	39	30	18	22	20
1953	7	11	13	20	29	27	37	40	31	18	23	20
1954	8	11	13	21	30	28	38	41	31	19	24	21
1955	8	12	13	22	31	29	39	42	32	20	25	22
1956	8	12	14	22	31	30	40	42	33	20	26	23
1957	9	13	14	23	32	31	41	43	34	21	26	23
1958	9	13	14	24	33	32	42	44	34	22	27	24
1959	9	13	14	25	34	33	43	45	35	23	28	25
1960	10	14	14	26	36	34	44	46	36	23	29	26
1961	10	14	15	27	37	35	46	47	37	24	30	27
1962	10	15	15	28	38	36	47	49	38	25	31	28
1963	11	15	15	29	39	37	48	50	39	26	32	29
1964	11	16	16	30	40	38	49	51	40	27	33	30
1965	12	16	16	31	41	39	51	52	41	28	34	31
1966	12	17	16	32	43	40	52	53	42	29	35	32
1967	13	17	16	33	44	42	54	54	43	30	37	33
1968	13	18	17	34	45	43	55	55	44	31	38	34
1969	14	18	17	36	47	44	57	57	45	32	39	35
1970	14	19	17	37	48	46	58	58	46	33	40	36
1971	15	19	17	38	50	47	60	59	47	34	42	38
1972	16	20	18	40	51	49	61	61	48	36	43	39
1973	16	21	18	41	53	50	63	62	49	37	44	40
1974	17	21	18	43	54	52	65	63	50	38	46	42
1975	17	22	19	44	56	53	67	65	52	39	47	43
1976	18	22	19	46	58	55	68	66	53	41	49	44
1977	19	23	19	48	60	57	70	68	54	42	51	46
1978	20	24	19	49	61	59	72	69	55	44	52	48
1979	20	25	20	51	63	60	74	71	57	45	54	49
1980	21	25	20	53	65	62	76	72	58	47	56	51
1981	22	26	20	55	67	64	78	74	60	49	58	53
1982	23	27	21	57	69	66	81	75	61	50	59	55
1983	24	28	21	59	72	68	83	77	62	52	61	56
1984	25	29	21	61	74	70	85	79	64	54	63	58
1985	26	30	21	63	76	73	87	81	66	56	65	60
1986	26	31	22	65	78	75	90	82	67	58	68	63
1987	28	32	22	68	81	77	92	84	69	60	70	65
1988	29	32	22	70	83	80	95	86	70	62	72	67
1989	30	34	23	73	86	82	97	88	72	64	75	69
1990	31	35	23	75	88	85	100	90	74	66	77	72
1991	32	36	23	78	91	87	103	92	76	69	80	74
1992	33	37	23	81	94	90	105	94	77	71	82	77
1993	34	38	24	84	97	93	108	96	79	74	85	79

Zone	A			B			C			D		
Year	Industrial	Artisanal	Subsistence	Industrial	Year	Industrial	Artisanal	Subsistence	Industrial	Year	Industrial	Artisanal
1994	36	39	24	87	100	96	111	98	81	76	88	82
1995	37	40	24	90	103	99	114	100	83	79	91	85
1996	38	42	24	93	106	102	117	103	85	82	94	88
1997	40	43	25	97	109	105	121	105	87	85	97	91
1998	41	44	25	100	113	108	124	107	89	88	100	94
1999	43	46	25	104	116	112	127	110	91	91	103	97
2000	44	47	25	108	120	115	131	112	94	94	107	101
2001	46	48	26	112	123	119	134	114	96	97	110	104
2002	48	50	26	116	127	123	138	117	98	101	114	108
2003	49	51	26	120	131	126	142	120	101	104	117	112
2004	51	53	26	124	135	130	146	122	103	108	121	115
2005	53	55	26	129	139	135	150	125	106	112	125	119
2006	55	56	27	133	144	139	154	128	108	116	129	124
2007	57	58	27	138	148	143	158	131	111	120	134	128
2008	59	60	27	143	152	148	162	133	113	124	138	132
2009	61	62	27	148	157	152	166	136	116	128	143	137
2010	64	64	27	153	162	157	171	139	119	133	147	142

Appendix C: Reconstructed total catches (in $t \cdot 10^3$) by sector and by (if applicable) subzone obtained from results of artisanal and subsistence fisheries reconstructions discussed in chapters 4-9, recreational fisheries reconstruction discussed in chapter 10 and the industrial fisheries reconstruction discussed in chapter 11.

Sector	Unre-ported	Dis-carded	Indus-trial	Baby trawl	Recrea-tional	Artisanal non-tuna				Artisanal tuna				Subsistence				Shaving tuna
Zone / Year						A	B	C	D	A	B	C	D	A	B	C	D	
1950	27.75	0.84	0.00	64.7	0.13	6.03	17.01	18.39	16.65	2.63	8.15	13.34	13.81	6.84	9.70	8.61	5.47	0.24
1951	29.58	0.89	0.30	69.0	0.13	6.19	17.48	18.64	17.21	2.69	8.36	13.53	14.25	6.85	9.92	8.81	5.65	0.25
1952	31.42	0.95	0.59	73.3	0.13	6.35	17.96	18.89	17.79	2.75	8.59	13.73	14.71	6.86	10.15	9.01	5.84	0.26
1953	31.24	0.94	0.89	72.9	0.13	6.52	18.46	19.15	18.38	2.82	8.82	13.92	15.18	6.87	10.38	9.22	6.04	0.26
1954	44.24	1.33	1.18	103.2	0.13	6.69	18.97	19.41	19.00	2.88	9.05	14.12	15.67	6.88	10.62	9.44	6.24	0.31
1955	45.95	1.39	1.48	107.2	0.13	6.86	19.50	19.67	19.63	2.95	9.30	14.32	16.17	6.89	10.86	9.66	6.45	0.32
1956	45.71	1.38	1.78	106.7	0.12	7.04	20.04	19.94	20.29	3.02	9.55	14.53	16.69	6.89	11.11	9.88	6.66	0.32
1957	40.26	1.21	2.07	93.9	0.12	7.23	20.59	20.21	20.97	3.09	9.80	14.74	17.23	6.90	11.37	10.11	6.89	0.31
1958	47.95	1.45	2.37	111.9	0.12	7.42	21.16	20.48	21.67	3.16	10.06	14.95	17.78	6.91	11.63	10.35	7.12	0.34
1959	50.49	1.52	2.66	117.8	0.12	7.61	21.75	20.76	22.39	3.24	10.33	15.16	18.35	6.91	11.90	10.59	7.35	0.35
1960	51.44	1.55	2.96	120.0	0.12	7.81	22.35	21.04	23.14	3.31	10.61	15.38	18.94	6.91	12.17	10.84	7.60	0.36
1961	53.84	1.62	3.26	125.6	0.11	8.01	22.97	21.32	23.92	3.39	10.89	15.59	19.55	6.92	12.45	11.09	7.85	0.37
1962	64.30	1.94	3.55	150.0	0.11	8.22	23.60	21.61	24.71	3.47	11.18	15.82	20.18	6.92	12.74	11.35	8.11	0.41
1963	89.46	2.70	3.85	208.7	0.11	8.44	24.26	21.90	25.54	3.55	11.48	16.04	20.82	6.92	13.03	11.61	8.38	0.50
1964	110.61	3.34	4.14	258.1	0.11	8.66	24.93	22.19	26.39	3.63	11.79	16.27	21.49	6.92	13.33	11.88	8.66	0.58
1965	128.60	3.88	4.44	300.1	0.11	8.88	25.62	22.49	27.27	3.72	12.11	16.50	22.18	6.92	13.63	12.16	8.95	0.64
1966	134.96	4.08	4.74	314.9	0.11	9.12	26.32	22.80	28.18	3.81	12.43	16.73	22.89	6.92	13.95	12.44	9.25	0.67
1967	141.82	4.29	5.03	330.9	0.10	9.35	27.05	23.10	29.12	3.89	12.76	16.97	23.62	6.92	14.26	12.73	9.56	0.70
1968	174.34	5.28	5.33	406.8	0.10	9.60	27.80	23.41	30.09	3.99	13.10	17.21	24.38	6.92	14.59	13.03	9.88	0.82
1969	158.03	4.78	5.62	368.7	0.10	9.85	28.56	23.73	31.10	4.08	13.45	17.46	25.16	6.92	14.93	13.33	10.21	0.77
1970	163.66	4.93	5.92	381.9	0.10	10.10	29.35	24.05	32.13	4.17	13.81	17.70	25.97	6.91	15.27	13.64	10.55	0.79
1971	163.83	4.94	6.22	382.3	0.10	10.37	30.16	24.37	33.20	4.27	14.18	17.96	26.80	6.91	15.62	13.95	10.90	0.80
1972	182.04	5.49	6.51	424.8	0.10	10.64	30.99	24.70	34.31	4.37	14.56	18.21	27.66	6.90	15.98	14.28	11.26	0.87
1973	199.48	5.95	6.81	465.4	0.10	10.91	31.85	25.03	35.45	4.47	14.95	18.47	28.54	6.89	16.34	14.61	11.63	0.93
1974	201.72	5.98	7.10	470.7	0.09	11.20	32.73	25.36	36.63	4.58	15.34	18.73	29.46	6.88	16.72	14.95	12.02	0.94
1975	213.69	6.36	7.40	498.6	0.09	11.49	33.63	25.70	37.85	4.68	15.75	18.99	30.40	6.87	17.10	15.30	12.42	0.99
1976	217.80	6.47	7.70	508.2	0.09	11.79	34.55	26.05	39.11	4.79	16.17	19.26	31.37	6.86	17.49	15.65	12.84	1.01
1977	222.07	6.33	7.99	518.2	0.09	12.09	35.50	26.40	40.41	4.90	16.60	19.53	32.37	6.85	17.89	16.01	13.26	1.03
1978	216.79	6.11	8.28	505.8	0.09	12.41	36.48	26.75	41.76	5.02	17.05	19.81	33.41	6.84	18.30	16.38	13.70	1.02
1979	214.61	5.98	15.17	500.7	0.09	12.73	37.49	27.11	43.14	5.13	17.50	20.09	34.48	6.82	18.72	16.76	14.16	1.03

Sector	Unre-ported	Dis-carded	Indus-trial	Baby trawl	Recrea-tional	Artisanal non-tuna				Artisanal tuna				Subsistence				Shaving tuna
Zone Year						A	B	C	D	A	B	C	D	A	B	C	D	
1980	209.35	5.77	10.23	488.5	0.09	13.06	38.52	27.47	44.58	5.25	17.96	20.37	35.58	6.81	19.15	17.15	14.63	1.01
1981	212.04	5.77	16.42	494.8	0.08	13.40	39.58	27.84	46.06	5.38	18.44	20.66	36.71	6.79	19.59	17.55	15.12	1.03
1982	225.55	6.13	19.76	526.3	0.08	13.74	40.66	28.21	47.59	5.50	18.93	20.95	37.89	6.77	20.03	17.96	15.62	1.08
1983	222.56	5.99	49.51	519.3	0.08	14.10	41.78	28.58	49.17	5.63	19.44	21.24	39.10	6.75	20.49	18.37	16.14	1.11
1984	220.00	5.86	26.35	513.3	0.08	14.46	42.93	28.97	50.81	5.76	19.95	21.54	40.35	6.73	20.96	18.80	16.67	1.08
1985	219.42	5.77	30.40	512.0	0.08	14.84	44.11	29.35	52.49	5.89	20.48	21.85	41.63	6.71	21.44	19.23	17.23	1.10
1986	234.10	6.07	24.89	546.2	0.08	15.22	45.32	29.74	54.24	6.03	21.03	22.15	42.96	6.69	21.93	19.68	17.80	1.15
1987	253.37	6.46	20.38	591.2	0.08	15.62	46.57	30.14	56.04	6.17	21.59	22.46	44.33	6.66	22.43	20.13	18.39	1.22
1988	257.14	6.47	16.68	600.0	0.08	16.02	47.84	30.54	57.90	6.31	22.16	22.78	45.75	6.64	22.94	20.60	19.00	1.24
1989	273.06	7.20	13.66	637.1	0.08	16.43	49.16	30.95	59.82	6.46	22.75	23.10	47.20	6.61	23.47	21.07	19.63	1.29
1990	300.24	7.97	11.18	700.6	0.07	16.86	50.51	31.36	61.80	6.61	23.35	23.42	48.71	6.58	24.00	21.56	20.28	1.39
1991	325.64	8.38	9.16	759.8	0.07	17.29	51.89	31.77	63.85	6.76	23.97	23.75	50.26	6.55	24.55	22.06	20.95	1.48
1992	344.94	9.16	7.50	804.9	0.07	17.74	53.31	32.20	65.97	6.92	24.61	24.08	51.86	6.52	25.11	22.57	21.65	1.56
1993	353.30	9.66	6.14	824.4	0.07	18.20	54.78	32.62	68.15	7.08	25.26	24.42	53.52	6.49	25.69	23.09	22.37	1.60
1994	368.28	10.00	5.02	859.3	0.07	18.67	56.28	33.06	70.41	7.24	25.93	24.76	55.22	6.45	26.27	23.62	23.11	1.65
1995	382.81	10.16	4.11	893.2	0.07	19.15	57.82	33.49	72.74	7.41	26.62	25.11	56.98	6.41	26.87	24.17	23.88	1.70
1996	376.75	9.97	3.37	879.1	0.07	19.64	59.40	33.94	75.15	7.58	27.32	25.46	58.79	6.37	27.49	24.72	24.67	1.69
1997	379.14	9.61	2.76	884.7	0.07	20.15	61.03	34.39	77.64	7.75	28.04	25.81	60.66	6.33	28.11	25.29	25.49	1.70
1998	403.09	10.62	2.26	940.5	0.07	20.67	62.70	34.84	80.21	7.93	28.79	26.18	62.59	6.29	28.76	25.88	26.33	1.81
1999	406.61	10.75	1.85	948.8	0.06	21.20	64.41	35.30	82.87	8.11	29.55	26.54	64.59	6.25	29.41	26.47	27.20	1.83
2000	405.64	10.69	1.51	946.5	0.07	21.74	66.18	35.77	85.61	8.30	30.33	26.91	66.64	6.20	30.08	27.08	28.10	1.84
2001	418.52	11.19	1.24	976.5	0.06	22.30	67.99	36.24	88.44	8.49	31.13	27.29	68.76	6.15	30.77	27.71	29.03	1.89
2002	446.65	11.53	1.01	1042.2	0.06	22.87	69.85	36.72	91.37	8.69	31.96	27.67	70.95	6.10	31.47	28.34	30.00	1.98
2003	475.56	11.83	0.83	1109.6	0.06	23.46	71.75	37.20	94.39	8.89	32.80	28.05	73.20	6.05	32.19	29.00	30.99	2.08
2004	483.59	11.67	0.68	1128.4	0.06	24.07	73.72	37.69	97.51	9.09	33.67	28.44	75.53	6.00	32.92	29.66	32.02	2.12
2005	485.99	12.97	0.56	1134.0	0.06	24.68	75.73	38.19	100.73	9.30	34.56	28.84	77.93	5.94	33.67	30.35	33.08	2.18
2006	463.14	11.14	0.46	1080.7	0.06	25.32	77.80	38.69	104.06	9.52	35.47	29.24	80.40	5.89	34.44	31.05	34.17	2.10
2007	510.89	12.75	0.37	1192.1	0.06	25.97	79.92	39.20	107.50	9.74	36.41	29.64	82.96	5.83	35.23	31.76	35.30	2.28
2008	525.52	13.26	0.31	1226.2	0.06	26.63	82.10	39.72	111.05	9.96	37.37	30.05	85.59	5.77	36.03	32.49	36.47	2.35
2009	537.40	13.30	0.25	1253.9	0.06	27.32	84.34	40.24	114.72	10.19	38.36	30.47	88.31	5.70	36.85	33.24	37.68	2.39
2010	532.33	13.29	0.20	1242.1	0.05	28.02	86.64	40.77	118.50	10.42	39.37	30.89	91.11	5.64	37.69	34.00	38.92	2.40

Appendix D: Results of percentage species composition by decade ($t \cdot 10^3$) obtained from national statistics for industrial and artisanal marine capture fisheries reported by region and by species groups.

Industrial	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Milkfish	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.006	0.006	0.007	0.008	0.007
Gizzard shad	0.447	0.477	0.506	0.504	0.712	0.740	0.742	0.642	0.775	0.836	0.776	0.908	1.139	0.959	2.459	2.604	2.465	2.309	2.492	1.945
Flatfish	0.540	0.575	0.611	0.608	0.861	0.894	0.888	0.784	0.935	0.974	1.010	1.054	1.202	1.844	2.147	2.061	1.706	1.313	1.024	0.393
Sea catfish	0.019	0.020	0.022	0.021	0.030	0.031	0.032	0.027	0.033	0.036	0.031	0.040	0.052	0.023	0.130	0.129	0.113	0.094	0.086	0.051
Lizard fish	2.763	2.946	3.129	3.111	4.404	4.578	4.555	4.001	4.789	5.033	5.069	5.460	6.372	8.510	12.17	11.85	10.02	7.989	6.696	3.238
Moray eel	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.004	0.006	0.002	0.012	0.018	0.022	0.027	0.039	0.039
Grouper	0.612	0.653	0.694	0.689	0.978	1.015	1.002	0.897	1.059	1.081	1.202	1.155	1.248	2.614	1.737	1.698	1.446	1.166	0.998	0.510
Sea bass	0.010	0.010	0.011	0.011	0.015	0.016	0.016	0.014	0.017	0.018	0.018	0.019	0.022	0.031	0.039	0.044	0.048	0.050	0.057	0.063
Fusilier	2.188	2.333	2.478	2.461	3.491	3.626	3.591	3.191	3.785	3.911	4.185	4.201	4.692	8.320	7.522	7.424	6.404	5.275	4.692	2.629
Snapper	0.667	0.710	0.755	0.751	1.061	1.103	1.103	0.958	1.156	1.235	1.174	1.350	1.640	1.602	3.527	3.443	2.922	2.345	1.990	0.994
Threadfin bream	2.501	2.666	2.832	2.815	3.987	4.141	4.120	3.628	4.322	4.553	4.632	4.855	5.804	8.027	10.01	11.64	12.22	12.84	15.79	14.29
Siganid	0.120	0.128	0.136	0.134	0.191	0.199	0.195	0.177	0.206	0.206	0.248	0.217	0.216	0.632	0.178	0.177	0.155	0.129	0.118	0.070
Whiting	0.157	0.168	0.179	0.177	0.252	0.261	0.255	0.235	0.271	0.265	0.338	0.277	0.261	0.939	0.092	0.099	0.094	0.090	0.098	0.079
Perchlet/Glassfish	0.022	0.024	0.025	0.025	0.036	0.037	0.036	0.033	0.039	0.039	0.044	0.042	0.044	0.102	0.055	0.052	0.042	0.031	0.022	0.006
Surgeon fish	0.484	0.516	0.548	0.545	0.772	0.801	0.797	0.703	0.837	0.877	0.902	0.939	1.101	1.616	1.896	2.078	2.048	2.013	2.303	1.931
Parrot fish/Wrasse	0.004	0.004	0.004	0.004	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.010	0.011	0.011	0.033	0.056	0.081	0.128	0.141
Slipmouth	6.195	6.605	7.016	6.975	9.875	10.26	10.20	8.981	10.73	11.25	11.45	12.18	14.13	19.82	26.24	25.79	22.12	18.05	15.79	8.520
Mojarra	0.087	0.093	0.099	0.098	0.140	0.145	0.142	0.130	0.150	0.148	0.184	0.155	0.150	0.495	0.085	0.085	0.075	0.064	0.060	0.037
Goatfish	0.047	0.050	0.053	0.053	0.076	0.078	0.077	0.070	0.081	0.081	0.099	0.084	0.084	0.262	0.049	0.067	0.082	0.098	0.135	0.136
Goby	0.035	0.038	0.040	0.040	0.057	0.058	0.058	0.052	0.060	0.063	0.072	0.059	0.081	0.165	0.016	0.231	0.465	0.722	1.175	1.326
Moonfish	0.179	0.190	0.202	0.201	0.285	0.296	0.294	0.259	0.309	0.325	0.328	0.352	0.413	0.552	0.774	0.786	0.704	0.614	0.599	0.402
Sickle fish	0.007	0.008	0.008	0.008	0.011	0.012	0.012	0.010	0.012	0.013	0.013	0.014	0.016	0.023	0.028	0.033	0.035	0.036	0.045	0.040
Spade fish	0.026	0.027	0.029	0.029	0.041	0.042	0.042	0.038	0.044	0.044	0.052	0.047	0.048	0.127	0.049	0.048	0.041	0.034	0.030	0.017
Flathead	0.009	0.009	0.010	0.010	0.014	0.015	0.015	0.013	0.015	0.016	0.016	0.017	0.021	0.028	0.035	0.041	0.043	0.045	0.056	0.051
Rudder fish	0.006	0.007	0.007	0.007	0.010	0.011	0.011	0.009	0.011	0.012	0.012	0.012	0.015	0.021	0.026	0.030	0.031	0.033	0.041	0.037
Croaker	2.139	2.280	2.422	2.408	3.410	3.544	3.521	3.103	3.705	3.875	3.971	4.192	4.834	7.030	8.827	8.631	7.345	5.920	5.064	2.584
Porgy	0.070	0.074	0.079	0.078	0.111	0.115	0.115	0.101	0.121	0.126	0.128	0.137	0.159	0.221	0.298	0.288	0.241	0.190	0.154	0.068
Therapon/Grunt	0.237	0.253	0.269	0.266	0.379	0.393	0.385	0.352	0.409	0.403	0.501	0.422	0.408	1.344	0.228	0.241	0.227	0.212	0.228	0.176
Red bulls eye	0.135	0.144	0.153	0.152	0.216	0.224	0.223	0.196	0.234	0.246	0.250	0.262	0.314	0.434	0.541	0.629	0.660	0.694	0.853	0.773
Lactarid	0.049	0.052	0.055	0.055	0.077	0.080	0.080	0.070	0.084	0.088	0.090	0.094	0.113	0.156	0.194	0.226	0.237	0.249	0.307	0.278
Butterfly fish	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.007	0.001	0.002	0.004	0.005	0.008	0.009
Diana	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
Red sea harder	0.077	0.082	0.087	0.086	0.122	0.127	0.126	0.111	0.132	0.139	0.142	0.149	0.178	0.246	0.307	0.357	0.374	0.393	0.483	0.438
Hardtail	0.054	0.058	0.062	0.061	0.087	0.090	0.089	0.080	0.094	0.096	0.107	0.102	0.110	0.237	0.144	0.151	0.142	0.131	0.139	0.106
Big-eyed Scad	1.286	1.371	1.456	1.449	2.047	2.129	2.129	1.849	2.230	2.389	2.262	2.596	3.200	3.042	6.745	7.006	6.474	5.883	6.097	4.498
Round scad	15.82	16.87	17.91	17.82	25.22	26.17	26.13	22.92	27.23	29.16	28.93	30.35	39.00	46.26	62.81	94.59	121.9	151.9	215.9	222.2
Rainbow runner	0.166	0.177	0.188	0.187	0.264	0.275	0.274	0.240	0.287	0.303	0.302	0.328	0.387	0.493	0.749	0.745	0.650	0.546	0.501	0.300
Leather jacket	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.000	0.002	0.012	0.022	0.034	0.054	0.060
Crevalle	0.230	0.245	0.260	0.259	0.366	0.381	0.379	0.333	0.398	0.420	0.420	0.454	0.537	0.689	1.022	1.045	0.946	0.836	0.833	0.579
Mullet	0.074	0.079	0.084	0.083	0.117	0.122	0.123	0.104	0.129	0.142	0.117	0.159	0.207	0.060	0.553	0.517	0.410	0.291	0.186	0.014
Threadfin	0.017	0.018	0.019	0.019	0.027	0.028	0.028	0.025	0.029	0.029	0.036	0.030	0.029	0.099	0.013	0.013	0.012	0.010	0.010	0.006

Industrial	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Milkfish	0.008	0.006	0.010	0.010	0.001	0.025	0.007	0.104	0.078	0.054	0.029	0.005	0.010	0.007	0.004	0.006	0.008	0.010	0.012	0.057
Gizzard shad	4.754	4.034	16.306	6.549	5.282	2.123	12.60	4.701	4.553	4.477	4.329	4.342	8.329	5.859	3.469	4.824	6.590	8.778	10.45	6.578
Flatfish	1.273	1.412	1.443	1.753	0.373	0.776	0.339	0.324	0.344	0.370	0.389	0.422	0.341	0.917	1.482	1.205	0.991	0.763	0.448	0.407
Sea catfish	0.074	0.019	0.145	0.041	0.047	0.093	0.315	0.024	0.066	0.109	0.150	0.197	0.143	0.170	0.196	0.163	0.139	0.114	0.076	0.175
Lizard fish	9.581	9.627	6.894	5.917	6.198	13.007	11.48	11.09	10.46	9.994	9.373	9.097	7.641	7.087	6.572	5.984	5.765	5.629	5.008	5.346
Moray eel	0.002	0.504	0.009	1.330	0.637	0.149	0.141	0.054	0.072	0.091	0.109	0.131	0.708	0.451	0.201	0.184	0.178	0.175	0.158	0.192
Grouper	3.229	2.354	2.707	1.848	6.062	5.707	7.641	2.412	3.440	4.514	5.505	6.715	1.312	1.276	1.245	1.131	1.086	1.057	0.936	2.117
Sea bass	0.053	0.041	0.113	0.020	0.007	0.371	0.058	0.123	0.113	0.104	0.094	0.088	0.185	0.135	0.088	0.074	0.065	0.055	0.040	0.017
Fusilier	5.587	7.299	6.882	14.91	11.86	12.23	11.65	7.803	7.616	7.548	7.359	7.443	7.536	9.541	11.53	10.37	9.845	9.432	8.188	11.20
Snapper	3.676	2.905	2.411	2.322	4.590	3.209	3.369	1.350	1.448	1.569	1.662	1.819	2.502	2.157	1.828	1.783	1.857	1.981	1.952	1.316
Threadfin bream	14.84	14.85	16.38	18.28	18.31	18.84	22.32	21.73	18.95	16.48	13.77	11.54	9.041	10.17	11.31	10.21	9.732	9.379	8.205	8.059
Siganid	0.473	0.266	0.163	0.172	0.057	0.302	0.033	0.352	0.279	0.210	0.139	0.072	0.051	0.188	0.324	0.523	0.770	1.074	1.318	0.580
Whiting	0.019	0.001	0.117	4.785	0.120	0.558	0.411	1.937	1.780	1.651	1.496	1.396	0.484	1.215	1.933	1.655	1.472	1.289	0.979	0.518
Perchlet/Glassfish	1.896	0.006	5.193	0.100	0.024	0.065	1.242	1.910	1.874	1.868	1.831	1.862	2.819	1.831	0.873	0.863	0.911	0.986	0.986	1.331
Surgeon fish	2.257	1.614	0.837	2.767	2.112	0.810	0.012	0.019	0.222	0.426	0.622	0.843	0.825	0.948	1.070	1.075	1.153	1.268	1.288	1.309
Parrot fish/Wrasse	0.355	0.092	0.147	0.071	0.321	0.059	0.016	0.037	0.109	0.182	0.251	0.330	0.231	0.601	0.965	0.871	0.829	0.798	0.696	0.561
Slipmouth	25.93	25.49	31.67	31.74	35.49	53.10	43.12	39.59	37.12	35.24	32.81	31.58	26.82	27.04	27.35	23.75	21.53	19.39	15.42	17.67
Mojarra	0.115	0.041	4.737	0.090	0.002	0.014	0.044	0.048	0.111	0.175	0.236	0.306	0.532	1.004	1.469	1.188	0.969	0.735	0.416	0.242
Goatfish	0.283	0.064	0.171	0.474	5.388	8.436	6.384	5.170	5.946	6.807	7.551	8.587	9.726	8.848	8.023	7.498	7.448	7.542	7.014	7.809
Goby	0.687	0.771	1.737	1.638	0.785	0.183	0.015	0.011	0.060	0.109	0.156	0.209	0.301	0.180	0.062	0.092	0.130	0.177	0.214	0.069
Moonfish	1.014	0.767	2.754	2.792	4.291	3.620	3.205	3.796	3.392	3.045	2.650	2.351	2.052	2.460	2.867	2.836	2.995	3.241	3.241	3.943
Sickle fish	0.042	0.042	0.047	0.051	0.052	0.054	0.061	0.063	0.056	0.066	0.066	0.038	0.099	0.073	0.048	0.037	0.029	0.019	0.007	0.005
Spade fish	0.003	0.003	0.009	0.010	0.012	0.030	0.014	0.023	0.033	0.045	0.055	0.068	0.044	0.053	0.063	0.066	0.075	0.086	0.091	0.065
Flathead	0.052	0.053	0.058	0.063	0.066	0.068	0.070	0.090	0.068	0.054	0.143	0.007	0.012	0.442	0.864	0.727	0.630	0.530	0.376	1.619
Rudder fish	0.038	0.038	0.042	0.047	0.048	0.048	0.056	0.060	0.046	0.064	0.066	0.007	0.129	0.078	0.029	0.026	0.025	0.025	0.022	0.019
Croaker	7.860	6.576	5.992	6.835	6.051	8.114	5.255	3.475	3.149	2.875	2.556	2.329	2.321	2.497	2.677	2.287	2.027	1.766	1.331	0.877
Porgy	0.219	0.085	0.152	0.841	1.746	1.254	0.329	0.529	0.873	1.227	1.559	1.953	1.813	1.978	2.146	1.879	1.724	1.578	1.285	1.884
Therapon/Grunt	0.117	0.305	0.162	0.375	0.461	0.910	1.118	1.452	1.427	1.425	1.399	1.426	0.697	0.755	0.814	0.814	0.869	0.951	0.962	0.431
Red bulls eye	0.802	0.802	0.890	0.982	0.987	1.045	1.158	1.185	1.152	1.181	1.173	1.114	1.351	1.283	1.222	1.215	1.290	1.403	1.411	0.493
Lactarid	0.288	0.289	0.319	0.352	0.359	0.367	0.418	0.448	0.362	0.461	0.503	0.122	0.812	0.693	0.580	0.516	0.483	0.455	0.386	0.279
Butterfly fish	0.017	0.121	0.024	0.007	0.197	0.046	0.022	0.017	0.022	0.026	0.030	0.036	0.001	0.153	0.302	0.308	0.335	0.374	0.385	0.007
Diana	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005
Red sea harder	0.454	0.454	0.504	0.556	0.558	0.593	0.655	0.669	0.659	0.664	0.656	0.666	0.721	0.706	0.672	0.737	0.730	0.684	1.100	0.652
Hardtail	0.286	0.106	0.642	0.271	0.285	0.479	0.647	0.389	0.440	0.497	0.546	0.616	1.619	1.548	1.485	1.654	1.946	2.325	2.547	1.295
Big-eyed Scad	11.22	14.41	8.518	10.58	7.229	11.05	10.32	19.55	17.57	15.88	13.95	12.52	10.24	12.65	15.05	14.70	15.32	16.35	16.12	16.13
Round scad	117.6	111.8	113.1	132.9	130.5	109.7	154.1	140.9	131.0	123.3	113.6	108.2	133.5	113.4	94.12	95.06	102.5	113.2	115.6	159.1
Rainbow runner	0.687	0.632	0.810	2.199	2.676	3.625	0.482	1.037	1.183	1.346	1.486	1.684	0.748	1.049	1.347	1.268	1.269	1.297	1.219	1.221
Leather jacket	0.026	0.025	0.012	0.005	0.018	0.006	0.052	0.044	0.041	0.040	0.037	0.036	0.322	0.217	0.115	0.234	0.376	0.549	0.694	0.218
Crevalle	1.535	0.575	1.301	2.356	8.418	12.35	8.144	2.852	3.238	3.671	4.040	4.566	6.435	7.357	8.283	7.518	7.214	7.009	6.197	3.724
Mullet	0.006	0.098	0.051	0.131	0.020	0.016	0.174	0.675	0.817	0.969	1.105	1.284	1.143	0.976	0.817	0.867	0.979	1.130	1.201	0.729
Threadfin	1.250	1.404	3.161	2.981	1.428	0.334	0.007	0.001	0.023	0.046	0.067	0.091	0.078	0.043	0.009	0.185	0.385	0.625	0.837	0.158

Industrial	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Milkfish	0.005	0.052	0.019	0.002	0.010	0.033	0.061	0.176	0.006	0.005	0.005	0.005	0.021	0.019	0.017	0.019	0.016	0.019	0.020	0.019	0.020
Gizzard shad	5.988	3.917	3.350	3.222	4.147	5.844	24.57	15.12	4.973	4.312	3.678	4.163	76.62	72.19	62.80	71.92	60.09	69.40	72.44	72.27	72.43
Flatfish	0.116	0.238	0.210	0.267	0.219	0.227	0.268	0.370	0.440	0.480	0.500	0.448	0.712	0.671	0.584	0.668	0.558	0.645	0.673	0.671	0.673
Sea catfish	0.684	0.706	0.673	0.657	0.791	0.990	0.993	0.365	0.458	0.513	0.464	0.433	0.306	0.288	0.250	0.287	0.240	0.277	0.289	0.288	0.289
Lizard fish	6.946	7.132	7.191	5.093	5.130	6.596	6.351	4.394	5.295	5.971	3.891	3.574	7.337	6.913	6.013	6.886	5.754	6.645	6.937	6.920	6.935
Moray eel	0.194	0.218	0.184	0.043	0.040	0.154	0.013	0.243	0.325	0.385	0.244	0.229	0.122	0.115	0.100	0.114	0.095	0.110	0.115	0.115	0.115
Grouper	2.154	2.427	0.947	1.137	1.966	1.357	1.079	1.479	2.316	2.876	1.633	1.624	3.189	3.141	2.902	3.291	3.341	3.402	3.616	3.718	3.630
Sea bass	0.122	0.034	0.551	2.154	1.158	2.105	2.267	0.210	0.333	0.351	0.204	0.182	0.316	0.298	0.259	0.297	0.248	0.287	0.299	0.298	0.299
Fusilier	1.998	5.539	7.891	6.630	4.508	6.761	6.802	6.282	8.574	7.351	5.724	5.625	5.396	5.669	5.316	7.158	4.988	6.212	6.596	6.356	6.483
Snapper	1.473	1.607	1.556	3.119	1.515	1.391	1.322	1.060	2.140	2.080	1.155	1.113	1.894	1.933	2.252	2.248	2.268	2.415	2.496	2.575	2.531
Threadfin bream	8.452	7.653	10.12	12.01	9.779	12.82	12.05	6.326	6.425	7.211	7.201	6.048	11.90	12.92	13.51	20.31	19.57	19.05	21.25	21.49	20.89
Siganid	0.110	0.316	0.492	0.698	0.330	0.444	0.339	1.231	1.608	1.610	1.251	1.515	0.878	1.032	1.064	1.212	1.217	1.246	1.324	1.359	1.329
Whiting	0.311	0.443	0.997	0.730	1.420	2.040	1.862	2.229	2.619	2.840	3.270	2.847	1.234	1.163	1.011	1.158	0.968	1.118	1.167	1.164	1.166
Perchlet/Glassfish	1.568	1.196	1.510	1.288	1.160	0.858	0.602	0.303	0.390	0.317	0.277	0.254	0.732	0.690	0.600	0.687	0.574	0.663	0.692	0.690	0.692
Surgeon fish	0.173	0.476	0.873	0.986	0.640	0.735	0.794	1.778	2.330	2.298	1.910	1.914	1.386	1.306	1.136	1.301	1.087	1.255	1.310	1.307	1.310
Parrot fish/Wrasse	0.353	1.240	1.025	0.562	0.693	0.892	0.705	0.442	0.574	0.491	0.408	0.367	0.575	0.614	0.638	0.585	0.751	0.706	0.737	0.789	0.754
Slipmouth	22.74	24.38	27.97	35.94	27.68	36.12	35.26	20.46	36.01	41.03	39.81	35.51	35.01	33.96	33.08	38.83	30.85	36.59	38.21	37.79	38.09
Mojarra	0.021	0.660	1.130	1.150	1.226	1.592	1.488	1.518	1.799	1.940	2.166	2.359	0.668	0.629	0.547	0.627	0.524	0.605	0.631	0.630	0.631
Goatfish	7.406	8.202	7.804	9.651	8.413	12.69	11.87	4.893	5.773	6.128	6.050	5.461	10.44	9.716	9.854	11.49	9.454	10.97	11.48	11.42	11.45
Goby	0.170	0.141	0.210	0.137	0.084	0.232	0.242	0.482	0.628	0.569	0.461	0.553	0.158	0.149	0.130	0.149	0.124	0.144	0.150	0.149	0.150
Moonfish	4.899	7.394	6.153	3.275	3.944	3.205	3.742	8.541	9.947	10.69	9.950	10.39	4.045	3.811	3.316	3.797	3.172	3.664	3.824	3.815	3.824
Sickle fish	0.002	0.126	0.013	0.032	0.017	0.002	0.002	0.002	0.003	0.003	0.002	0.002	0.012	0.012	0.010	0.012	0.010	0.011	0.012	0.012	0.012
Spade fish	0.003	0.003	0.013	0.019	0.018	0.006	0.006	0.005	0.006	0.006	0.004	0.004	0.026	0.024	0.021	0.024	0.020	0.023	0.024	0.024	0.024
Flathead	0.041	0.014	0.062	0.020	0.213	0.310	0.296	0.010	0.012	0.013	0.015	0.014	0.128	0.121	0.105	0.120	0.101	0.116	0.121	0.121	0.121
Rudder fish	0.063	0.014	0.030	0.125	0.050	0.068	0.065	0.755	0.884	0.961	1.124	0.984	0.165	0.155	0.135	0.154	0.129	0.149	0.156	0.155	0.155
Croaker	0.377	1.096	2.148	3.617	3.987	4.701	4.324	1.374	1.697	1.712	1.875	1.679	4.041	3.807	3.312	3.793	3.169	3.660	3.820	3.811	3.820
Porgy	2.657	3.785	3.109	3.980	2.858	3.948	3.667	0.229	0.289	0.296	0.253	0.241	2.377	2.205	2.137	2.387	1.971	2.314	2.400	2.392	2.404
Therapon/Grunt	0.335	0.859	1.564	3.765	2.672	2.313	2.314	0.366	0.457	0.460	0.311	0.294	0.924	0.870	0.757	0.867	0.724	0.836	0.873	0.871	0.873
Red bulls eye	1.361	2.281	1.621	5.249	0.453	5.748	5.757	1.186	0.340	1.868	1.185	1.115	1.046	0.985	0.857	0.982	0.820	0.947	0.989	0.986	0.989
Lactarid	0.078	0.034	0.004	0.012	0.012	0.025	0.001	0.113	0.142	0.150	0.167	0.172	0.102	0.096	0.083	0.095	0.080	0.092	0.096	0.096	0.096
Butterfly fish	0.020	0.176	0.031	0.019	0.005	0.006	0.027	0.016	0.005	0.005	0.004	0.004	0.037	0.035	0.030	0.035	0.029	0.033	0.035	0.035	0.035
Diana	0.001	0.004	0.000	0.000	0.020	0.043	0.004	0.001	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Red sea harder	0.419	0.793	0.446	0.084	0.455	0.194	0.021	0.060	0.020	0.017	0.015	0.017	0.138	0.130	0.113	0.129	0.108	0.125	0.130	0.130	0.130
Hardtail	2.297	3.506	3.591	3.180	2.505	3.658	1.532	6.498	3.855	4.420	4.308	5.633	1.823	1.718	1.494	1.711	1.430	1.651	1.724	1.720	1.723
Big-eyed Scad	18.55	14.49	15.94	14.32	16.54	156.7	20.59	35.56	27.80	29.01	31.59	34.04	36.05	37.05	36.20	38.10	31.80	37.79	38.72	38.75	38.99
Round scad	206.9	249.4	274.4	238.5	284.3	98.27	195.2	184.4	217.4	218.9	224.7	232.7	217.1	238.2	216.1	226.4	176.1	220.2	223.7	221.6	225.2
Rainbow runner	0.328	0.482	0.599	0.880	0.991	0.600	0.887	1.775	2.183	2.325	1.956	1.772	1.229	1.158	1.007	1.153	0.963	1.113	1.162	1.159	1.161
Leather jacket	0.036	0.801	0.718	1.516	2.746	1.562	0.827	0.622	1.177	0.915	1.038	0.932	0.468	0.441	0.384	0.439	0.367	0.424	0.443	0.442	0.443
Crevalle	5.628	6.121	8.689	12.676	8.546	10.66	10.44	8.645	10.58	11.37	11.60	10.35	13.56	13.17	13.95	16.32	13.54	15.60	16.35	16.28	16.32
Mullet	0.619	0.940	0.584	0.666	0.960	0.789	1.034	1.695	0.910	2.313	2.070	1.853	1.811	2.038	2.190	2.445	2.089	2.396	2.493	2.498	2.498
Threadfin	0.284	0.446	0.184	0.288	4.776	0.171	0.172	0.131	0.162	0.165	0.164	0.151	0.288	0.272	0.236	0.271	0.226	0.261	0.273	0.272	0.273

Industrial	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Dolphin fish	0.032	0.035	0.037	0.037	0.052	0.054	0.053	0.047	0.056	0.059	0.060	0.063	0.075	0.104	0.130	0.151	0.159	0.167	0.205	0.186
Silverside	0.032	0.034	0.037	0.036	0.051	0.054	0.053	0.046	0.056	0.060	0.057	0.066	0.079	0.079	0.171	0.162	0.133	0.100	0.074	0.023
Garfish	0.150	0.160	0.170	0.169	0.241	0.250	0.243	0.225	0.259	0.250	0.329	0.260	0.234	0.959	0.007	0.011	0.014	0.018	0.026	0.027
Halfbeak	0.021	0.022	0.023	0.023	0.033	0.034	0.034	0.029	0.036	0.039	0.033	0.044	0.057	0.023	0.146	0.138	0.113	0.084	0.062	0.018
Barracuda	0.052	0.056	0.059	0.058	0.083	0.086	0.085	0.077	0.090	0.090	0.107	0.095	0.097	0.266	0.088	0.093	0.088	0.081	0.087	0.067
Sergeant fish	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.004	0.005	0.007	0.008	0.008	0.008	0.010	0.009
Leaf fish	0.015	0.016	0.017	0.017	0.024	0.024	0.024	0.022	0.025	0.027	0.029	0.025	0.036	0.060	0.016	0.114	0.220	0.336	0.543	0.609
Pomfret	0.030	0.032	0.034	0.034	0.048	0.049	0.049	0.043	0.051	0.053	0.057	0.057	0.064	0.115	0.098	0.106	0.104	0.101	0.114	0.094
Flying fish	0.022	0.023	0.024	0.024	0.034	0.036	0.036	0.031	0.037	0.041	0.036	0.045	0.057	0.032	0.139	0.136	0.116	0.094	0.080	0.041
Smooth scad	0.005	0.005	0.005	0.005	0.007	0.008	0.007	0.007	0.008	0.008	0.008	0.009	0.011	0.015	0.018	0.021	0.022	0.023	0.029	0.026
Big-eye	0.010	0.011	0.012	0.012	0.016	0.017	0.017	0.015	0.018	0.019	0.019	0.020	0.024	0.033	0.041	0.048	0.051	0.053	0.065	0.059
Tarpon	0.010	0.011	0.012	0.011	0.016	0.017	0.016	0.015	0.018	0.017	0.022	0.018	0.017	0.060	0.006	0.008	0.010	0.011	0.015	0.015
Ten Pounder	0.037	0.040	0.042	0.042	0.060	0.062	0.062	0.054	0.065	0.068	0.069	0.074	0.086	0.117	0.162	0.157	0.133	0.105	0.088	0.041
Wolf herring	0.014	0.015	0.016	0.016	0.022	0.023	0.023	0.020	0.024	0.025	0.026	0.027	0.032	0.044	0.055	0.064	0.067	0.071	0.087	0.079
Round Herring	1.047	1.117	1.186	1.179	1.670	1.735	1.726	1.520	1.810	1.907	1.940	2.034	2.431	3.363	4.194	4.875	5.126	5.369	6.608	6.034
Fimbriated Sardine	2.708	2.888	3.067	3.049	4.318	4.485	4.462	3.930	4.680	4.931	5.017	5.258	6.286	8.693	10.85	12.61	13.23	13.91	17.10	15.49
Indian Sardine	2.531	2.699	2.866	2.850	4.035	4.191	4.170	3.672	4.374	4.608	4.688	4.914	5.875	8.125	10.14	11.79	12.37	13.00	15.98	14.48
Deep-bodied Sardine	0.084	0.089	0.095	0.094	0.134	0.139	0.138	0.122	0.145	0.152	0.155	0.163	0.194	0.269	0.335	0.390	0.409	0.430	0.529	0.479
Big-eyed Sardine	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.006	0.008	0.009	0.010	0.010	0.013	0.011
Anchovy	3.304	3.523	3.742	3.718	5.269	5.475	5.430	4.806	5.721	5.943	6.230	6.413	7.259	11.75	12.51	12.11	10.15	7.978	6.503	2.900
Big-eyed Herring	0.074	0.079	0.084	0.084	0.119	0.123	0.123	0.108	0.129	0.136	0.138	0.145	0.173	0.239	0.298	0.347	0.364	0.383	0.470	0.426
Sprat	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.004	0.005	0.006	0.007	0.008	0.008	0.010	0.009
Spanish Mackerel	0.226	0.241	0.256	0.254	0.360	0.374	0.372	0.328	0.390	0.411	0.418	0.438	0.524	0.725	0.903	1.055	1.100	1.152	1.455	1.262
Frigate Tuna	0.245	0.261	0.277	0.276	0.390	0.406	0.404	0.355	0.423	0.446	0.454	0.475	0.568	0.787	0.981	1.139	1.201	1.255	1.537	1.426
Skipjack	0.283	0.302	0.320	0.320	0.449	0.468	0.475	0.398	0.494	0.556	0.428	0.625	0.842	0.025	2.385	2.258	1.829	1.354	0.967	0.243
Eastern Little Tuna	1.017	1.084	1.152	1.145	1.622	1.684	1.676	1.476	1.758	1.852	1.884	1.974	2.360	3.266	4.071	4.732	4.982	5.207	6.412	5.887
Sailfish	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.004	0.004	0.005	0.004
Swordfish	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.005	0.002	0.004	0.007	0.010	0.015	0.016
Marlin	0.021	0.022	0.023	0.023	0.033	0.034	0.034	0.030	0.036	0.037	0.038	0.040	0.048	0.066	0.082	0.096	0.100	0.106	0.130	0.118
Indo-Pacific Mackerel	0.943	1.006	1.068	1.062	1.504	1.562	1.554	1.368	1.630	1.717	1.747	1.831	2.189	3.027	3.777	4.391	4.608	4.844	5.953	5.396
Indian Mackerel	1.413	1.506	1.600	1.591	2.252	2.339	2.328	2.050	2.441	2.572	2.617	2.743	3.279	4.535	5.658	6.578	6.903	7.256	8.918	8.083
Japanese Mackerel	0.168	0.179	0.190	0.189	0.267	0.278	0.276	0.243	0.290	0.305	0.311	0.325	0.389	0.538	0.671	0.781	0.819	0.861	1.058	0.959
Hairtail	0.987	1.052	1.117	1.111	1.571	1.633	1.631	1.421	1.710	1.821	1.758	1.979	2.398	2.549	4.928	5.006	4.494	3.926	3.846	2.596
Mackerel	0.811	0.865	0.920	0.910	1.299	1.347	1.311	1.213	1.396	1.354	1.770	1.407	1.280	5.106	0.126	0.149	0.159	0.170	0.212	0.195
Shark	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.003	0.004	0.004	0.005	0.004	0.005	0.009	0.007	0.008	0.009	0.009	0.012	0.011
Skates and Rays	0.008	0.008	0.009	0.009	0.012	0.013	0.013	0.011	0.013	0.014	0.015	0.015	0.018	0.026	0.027	0.038	0.048	0.059	0.082	0.084
Puffer fish	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.006	0.006	0.007	0.006
Trigger fish	0.024	0.025	0.027	0.027	0.038	0.039	0.039	0.034	0.041	0.043	0.044	0.046	0.055	0.076	0.095	0.110	0.115	0.121	0.149	0.135
Sea horse	0.006	0.007	0.007	0.007	0.010	0.010	0.010	0.009	0.011	0.011	0.011	0.012	0.014	0.020	0.025	0.029	0.030	0.032	0.039	0.035
White shrimps	1.856	1.979	2.102	2.090	2.960	3.076	3.055	2.695	3.215	3.360	3.458	3.627	4.180	6.202	7.493	7.448	6.490	5.428	4.959	2.942
Tiger prawn	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.004
Endeavor prawn	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.004	0.005	0.007	0.008	0.009	0.008	0.010	0.012
Acetes	0.023	0.024	0.026	0.026	0.036	0.038	0.037	0.033	0.039	0.041	0.042	0.044	0.053	0.073	0.091	0.106	0.111	0.117	0.143	0.130
Sea Mantis	0.029	0.031	0.033	0.032	0.046	0.048	0.047	0.042	0.050	0.052	0.053	0.056	0.067	0.092	0.115	0.134	0.140	0.147	0.181	0.164
Assorted shells	0.055	0.058	0.062	0.062	0.087	0.091	0.090	0.080	0.095	0.099	0.102	0.106	0.125	0.182	0.216	0.239	0.238	0.236	0.273	0.232
Squid	0.699	0.745	0.791	0.786	1.114	1.157	1.150	1.014	1.209	1.267	1.299	1.364	1.586	2.302	2.834	2.908	2.646	2.355	2.370	1.672
Crab	0.176	0.188	0.199	0.198	0.281	0.292	0.289	0.257	0.304	0.314	0.340	0.334	0.374	0.699	0.548	0.602	0.596	0.589	0.677	0.572

Industrial	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Dolphin fish	0.193	0.192	0.215	0.236	0.232	0.258	0.277	0.261	0.325	0.255	0.194	0.536	0.041	0.022	0.003	0.002	0.002	0.001	0.001	0.017
Silverside	0.036	0.507	0.028	0.178	0.007	0.028	0.170	0.065	0.073	0.082	0.089	0.100	0.277	0.503	0.725	0.629	0.569	0.510	0.404	0.243
Garfish	0.040	0.023	0.002	0.006	0.002	0.238	0.049	0.428	0.334	0.246	0.155	0.068	0.087	0.047	0.007	0.054	0.107	0.172	0.228	0.192
Halfbeak	0.155	0.462	0.042	0.040	0.096	0.204	0.031	0.146	0.152	0.160	0.165	0.176	0.196	0.153	0.112	0.100	0.094	0.088	0.075	0.087
Barracuda	0.108	0.176	0.244	0.530	0.737	1.617	0.658	1.181	1.251	1.341	1.408	1.528	2.476	3.251	4.020	3.475	3.131	2.795	2.192	2.316
Sergeant fish	0.010	0.010	0.011	0.012	0.012	0.013	0.014	0.015	0.015	0.012	0.016	0.016	0.004	0.033	0.061	0.101	0.151	0.212	0.262	0.115
Leaf fish	0.316	0.354	0.798	0.009	0.463	0.108	0.103	0.014	0.014	0.014	0.014	0.014	0.045	0.103	0.160	0.121	0.088	0.051	0.006	0.010
Pomfret	0.143	0.218	0.309	1.296	1.331	1.141	1.062	1.086	0.937	0.805	0.660	0.539	0.292	0.270	0.250	0.302	0.377	0.473	0.539	0.080
Flying fish	0.076	0.165	0.239	0.779	0.539	0.016	0.161	0.313	0.246	0.184	0.119	0.057	0.100	0.326	0.547	0.420	0.315	0.198	0.054	0.618
Smooth scad	0.027	0.027	0.030	0.033	0.034	0.034	0.039	0.043	0.033	0.043	0.050	0.005	0.080	0.076	0.073	0.068	0.068	0.069	0.064	0.042
Big-eye	0.061	0.061	0.068	0.075	0.075	0.080	0.089	0.090	0.089	0.090	0.088	0.090	0.098	0.094	0.092	0.103	0.088	0.104	0.161	0.027
Tarpon	0.218	0.244	0.016	0.005	0.018	0.004	0.106	0.032	0.030	0.029	0.027	0.026	0.004	0.011	0.018	0.026	0.036	0.048	0.057	0.004
Ten Pounder	0.003	0.147	0.084	0.061	0.239	0.056	0.053	0.048	0.040	0.032	0.025	0.018	0.088	0.060	0.033	0.035	0.040	0.046	0.049	0.017
Wolf herring	0.082	0.082	0.091	0.100	0.100	0.107	0.118	0.119	0.120	0.121	0.111	0.129	0.133	0.091	0.050	0.111	0.184	0.271	0.345	0.004
Round Herring	6.137	6.232	7.105	7.081	8.009	9.008	5.679	12.81	11.70	10.79	9.707	8.977	6.666	8.723	10.76	11.19	12.40	14.05	14.71	10.08
Fimbriated Sardine	16.06	16.06	17.84	19.67	19.75	20.97	23.16	23.65	23.34	23.42	23.25	23.60	25.20	25.37	23.83	24.79	28.30	23.18	32.66	39.35
Indian Sardine	15.01	15.01	16.67	18.38	18.45	19.60	21.66	22.08	21.84	21.91	21.60	22.25	23.56	23.09	23.48	22.60	23.82	29.39	23.64	26.68
Deep-bodied Sardine	0.497	0.497	0.552	0.608	0.611	0.648	0.717	0.731	0.721	0.726	0.716	0.729	0.790	0.767	0.740	0.813	0.767	0.791	1.215	0.548
Big-eyed Sardine	0.012	0.012	0.013	0.015	0.015	0.016	0.017	0.017	0.017	0.017	0.017	0.018	0.019	0.018	0.019	0.018	0.019	0.023	0.020	0.020
Anchovy	7.211	5.792	16.16	8.647	7.273	9.645	9.014	13.73	14.40	15.29	15.93	17.17	26.40	29.39	32.41	32.26	34.28	37.33	37.57	45.88
Big-eyed Herring	0.442	0.442	0.491	0.541	0.543	0.577	0.637	0.650	0.642	0.645	0.637	0.653	0.694	0.685	0.678	0.675	0.721	0.786	0.787	0.842
Sprat	0.009	0.009	0.010	0.011	0.011	0.012	0.013	0.014	0.013	0.013	0.013	0.014	0.014	0.014	0.014	0.014	0.015	0.017	0.016	0.018
Spanish Mackerel	1.316	1.477	1.256	1.640	2.410	0.122	2.834	5.625	5.306	5.072	4.758	4.618	1.661	2.697	3.718	3.303	3.085	2.895	2.444	4.252
Frigate Tuna	1.427	1.426	1.757	1.559	1.747	2.681	5.086	10.69	18.31	26.15	33.49	42.18	35.41	38.90	42.45	38.10	36.06	34.42	29.75	66.96
Skipjack	0.091	0.176	0.097	1.144	2.147	2.510	8.201	22.80	20.80	19.14	17.18	15.84	27.70	26.73	25.88	24.81	25.37	26.52	25.58	32.54
Eastern Little Tuna	5.914	6.054	7.041	6.548	7.961	9.401	3.416	14.50	13.63	12.97	12.11	11.70	12.83	14.85	16.88	33.18	52.74	76.55	96.36	22.27
Sailfish	0.005	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.007	0.006	0.007	0.009	0.004	0.009	0.014	0.018	0.024	0.031	0.035	0.042
Swordfish	0.004	0.021	0.009	0.002	1.245	0.291	0.161	0.001	0.002	0.002	0.003	0.004	0.314	0.156	0.002	0.079	0.167	0.272	0.365	0.470
Marlin	0.122	0.122	0.135	0.149	0.150	0.159	0.176	0.179	0.177	0.178	0.176	0.179	0.195	0.187	0.181	0.203	0.181	0.198	0.316	0.085
Indo-Pacific Mackerel	5.593	5.592	6.215	6.847	6.870	7.327	8.045	8.201	8.262	7.989	8.027	8.869	7.617	9.076	10.53	9.913	9.924	10.14	9.531	7.662
Indian Mackerel	8.378	8.377	9.308	10.26	10.30	10.96	12.06	12.31	12.30	12.03	12.11	12.92	11.92	13.75	15.57	16.23	18.03	20.49	21.48	25.99
Japanese Mackerel	0.994	0.994	1.103	1.219	1.221	1.295	1.446	1.450	1.435	1.511	1.346	1.465	1.855	0.976	0.122	0.153	0.197	0.252	0.292	0.057
Hairtail	5.406	5.760	4.440	4.467	2.447	1.190	1.292	2.244	2.192	2.175	2.123	2.149	3.820	3.890	3.972	3.332	2.876	2.406	1.687	3.014
Mackerel	2.809	4.040	1.003	1.984	1.841	3.521	1.446	0.556	0.484	0.421	0.351	0.294	0.562	0.396	0.235	0.326	0.446	0.593	0.707	0.437
Shark	0.345	0.388	0.038	0.124	0.098	0.062	0.016	0.012	0.107	0.202	0.294	0.397	0.370	0.258	0.149	0.238	0.349	0.486	0.595	0.587
Skates and Rays	0.016	0.002	0.012	0.184	0.118	15.33	0.164	0.065	0.102	0.141	0.177	0.220	0.284	0.224	0.167	0.271	0.400	0.559	0.686	0.958
Puffer fish	0.007	0.007	0.007	0.008	0.008	0.008	0.010	0.011	0.008	0.011	0.012	0.001	0.024	0.013	0.004	0.008	0.013	0.019	0.024	0.065
Trigger fish	0.140	0.140	0.156	0.172	0.173	0.182	0.202	0.208	0.200	0.207	0.208	0.187	0.244	0.233	0.222	0.269	0.336	0.421	0.479	0.087
Sea horse	0.037	0.037	0.041	0.045	0.045	0.048	0.053	0.054	0.053	0.053	0.052	0.054	0.058	0.056	0.058	0.056	0.054	0.077	0.058	0.046
White shrimps	8.096	9.937	9.700	8.003	10.54	12.60	10.94	5.591	4.764	4.018	3.212	2.518	4.287	3.808	3.353	2.590	1.954	1.255	0.381	2.366
Tiger prawn	0.002	0.003	0.009	0.081	0.033	0.022	0.061	0.844	0.643	0.454	0.260	0.072	0.185	0.272	0.359	1.344	2.482	3.855	5.044	1.819
Endeavor prawn	0.007	0.011	0.027	0.258	0.105	0.068	0.127	0.182	0.232	0.285	0.333	0.394	0.159	0.293	0.426	0.474	0.558	0.667	0.731	0.242
Acetes	0.135	0.135	0.149	0.165	0.166	0.175	0.194	0.199	0.192	0.199	0.199	0.182	0.232	0.222	0.213	0.286	0.382	0.502	0.591	0.247
Sea Mantis	0.170	0.170	0.189	0.208	0.208	0.225	0.243	0.246	0.264	0.229	0.234	0.335	0.127	0.279	0.428	0.366	0.324	0.283	0.213	0.188
Assorted shells	0.225	0.209	0.214	0.217	0.198	0.190	0.187	0.167	0.142	0.120	0.095	0.074	0.054	0.031	0.009	0.016	0.024	0.034	0.042	0.107
Squid	4.573	4.469	5.605	5.554	7.204	10.74	8.799	8.939	8.865	8.929	8.848	9.098	8.696	8.955	9.240	8.793	8.914	9.236	8.819	8.269
Crab	2.112	1.360	2.013	1.620	2.684	2.590	1.833	1.425	2.284	3.172	4.001	4.991	2.289	3.134	3.971	3.227	2.655	2.044	1.201	0.607

Industrial	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dolphin fish	0.056	0.029	0.029	0.142	0.026	0.024	0.024	0.011	0.016	0.014	0.015	0.017	0.032	0.030	0.026	0.030	0.025	0.029	0.030	0.030	0.030
Silverside	0.059	0.087	0.242	0.023	0.280	0.348	0.332	0.015	0.019	0.017	0.015	0.029	0.146	0.138	0.120	0.137	0.115	0.133	0.138	0.138	0.138
Garfish	0.310	0.132	0.808	0.268	0.153	0.317	0.219	0.426	0.654	0.730	0.502	0.471	0.206	0.194	0.169	0.193	0.162	0.187	0.195	0.194	0.195
Halfbeak	0.050	0.160	0.178	0.396	0.164	0.634	0.256	0.237	0.323	0.341	0.364	0.393	0.177	0.166	0.145	0.166	0.139	0.160	0.167	0.167	0.167
Barracuda	3.187	3.635	3.302	3.813	3.083	3.903	4.059	2.476	3.912	4.310	3.160	3.104	1.958	1.845	1.605	1.838	1.536	1.773	1.851	1.847	1.851
Sergeant fish	0.004	0.118	0.017	0.785	0.291	0.135	0.131	0.656	0.888	0.833	0.693	0.665	0.179	0.169	0.147	0.168	0.140	0.162	0.169	0.169	0.169
Leaf fish	0.001	0.045	0.492	0.411	0.167	0.331	0.342	0.199	0.235	0.217	0.050	0.069	0.090	0.085	0.074	0.085	0.071	0.082	0.085	0.085	0.085
Pomfret	0.562	0.704	1.317	1.315	0.919	0.933	0.894	0.323	0.338	0.330	0.277	0.261	0.596	0.562	0.489	0.560	0.468	0.540	0.564	0.563	0.564
Flying fish	1.581	1.810	1.434	1.897	1.142	2.789	3.436	22.01	11.16	14.29	6.914	6.567	11.62	13.73	12.09	8.327	8.416	10.28	9.710	10.17	10.21
Smooth scad	0.337	0.285	0.021	0.245	0.161	0.211	0.196	0.864	1.068	1.134	1.276	1.327	0.230	0.217	0.189	0.216	0.181	0.208	0.218	0.217	0.218
Big-eye	0.154	0.462	0.654	0.244	0.327	0.562	0.541	0.594	0.788	0.779	0.715	0.728	0.203	0.191	0.166	0.190	0.159	0.184	0.192	0.191	0.192
Tarpon	0.057	0.088	0.001	0.015	0.009	0.033	0.096	0.805	0.341	0.385	0.349	0.376	0.093	0.088	0.076	0.087	0.073	0.084	0.088	0.088	0.088
Ten Pounder	0.004	0.001	0.012	0.006	0.008	0.005	0.005	0.081	0.106	0.124	0.091	0.080	0.046	0.043	0.038	0.043	0.036	0.042	0.044	0.044	0.044
Wolf herring	0.046	0.128	0.362	0.252	0.108	0.038	0.013	0.030	0.040	0.048	0.035	0.034	0.058	0.055	0.048	0.054	0.045	0.053	0.055	0.055	0.055
Round Herring	4.605	2.628	11.47	7.991	15.39	18.40	18.05	2.207	17.13	21.20	10.38	19.02	7.095	7.457	6.918	8.147	5.597	7.349	7.573	7.324	7.528
Fimbriated Sardine	0.064	84.93	76.71	47.74	25.75	35.35	69.78	22.66	59.89	55.72	50.15	48.58	32.54	34.00	34.19	50.55	45.25	46.35	51.22	51.21	50.30
Indian Sardine	47.97	7.911	45.37	127.1	121.2	146.1	108.8	151.0	158.4	142.9	162.2	143.0	135.2	121.6	137.7	193.8	134.8	165.9	177.7	170.9	174.0
Deep-bodied Sardine	0.792	3.460	3.137	1.455	0.371	0.953	0.738	1.183	1.515	1.735	1.248	1.569	0.571	0.538	0.468	0.536	0.448	0.517	0.540	0.538	0.540
Big-eyed Sardine	0.037	0.014	0.022	0.104	0.001	0.058	31.45	5.795	0.043	0.040	0.009	0.012	1.171	1.103	0.960	1.099	0.918	1.061	1.107	1.105	1.107
Anchovy	23.52	24.54	23.28	27.38	22.44	33.82	0.07	34.54	32.69	37.94	38.33	36.46	31.24	26.80	26.64	28.08	23.34	27.80	28.48	28.48	28.68
Big-eyed Herring	0.952	1.081	1.245	1.168	0.986	0.957	0.548	0.499	0.443	0.386	0.420	0.655	0.259	0.244	0.212	0.243	0.203	0.235	0.245	0.244	0.245
Sprat	0.020	0.019	0.031	0.025	0.007	0.069	0.004	0.001	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Spanish Mackerel	0.899	1.462	2.198	1.172	1.138	1.750	2.330	1.592	2.021	2.042	1.666	1.614	2.251	2.609	2.799	4.857	4.923	4.492	5.152	5.235	5.028
Frigate Tuna	41.34	50.49	60.30	55.28	47.93	46.36	48.99	84.36	61.07	60.54	59.44	55.84	93.58	107.3	132.6	77.66	105.5	112.8	106.6	116.7	113.7
Skipjack	63.89	74.57	63.93	53.83	54.10	90.30	88.62	67.16	88.92	79.23	82.96	75.30	77.29	106.7	108.6	60.33	123.7	104.9	104.5	120.2	111.4
Eastern Little Tuna	7.651	13.38	21.48	16.64	29.67	20.48	17.53	14.65	17.74	18.28	20.91	19.19	24.86	25.28	29.95	36.94	49.54	41.66	46.33	49.55	46.47
Sailfish	0.004	0.023	0.068	0.245	0.218	0.064	0.066	0.037	0.267	0.055	0.052	0.053	0.039	0.037	0.032	0.037	0.031	0.036	0.037	0.037	0.037
Swordfish	0.009	0.159	0.292	0.304	0.725	0.776	0.824	0.649	0.816	0.831	0.627	0.656	0.251	0.237	0.206	0.236	0.197	0.228	0.238	0.237	0.238
Marlin	0.243	1.830	0.282	0.193	0.318	0.210	0.285	0.131	0.191	0.233	0.181	0.163	0.144	0.136	0.118	0.135	0.113	0.130	0.136	0.136	0.136
Indo-Pacific Mackerel	7.250	7.716	9.439	16.85	16.68	12.80	12.82	10.35	13.11	13.96	14.57	14.52	17.04	19.17	21.44	25.52	22.49	24.75	26.19	26.30	26.12
Indian Mackerel	39.37	39.44	27.90	26.57	43.95	15.56	18.44	25.26	27.29	28.29	29.72	29.59	28.59	29.96	28.66	41.50	34.76	37.38	40.92	40.50	40.17
Japanese Mackerel	0.047	0.168	1.568	0.739	0.773	0.534	0.512	1.939	0.665	0.594	0.532	0.531	0.402	0.378	0.329	0.377	0.315	0.364	0.380	0.379	0.380
Hairtail	6.219	6.581	7.212	7.091	3.975	4.447	3.825	3.084	5.091	4.234	5.569	2.456	3.076	3.205	3.288	4.156	4.613	4.307	4.719	4.902	4.708
Mackerel	0.073	0.796	0.743	0.707	1.647	0.648	0.369	1.318	1.611	1.737	1.223	1.487	1.178	1.109	0.965	1.105	0.923	1.067	1.113	1.111	1.113
Shark	0.226	0.263	0.268	0.300	0.272	0.145	0.094	0.082	0.121	0.128	0.097	0.119	0.153	0.144	0.125	0.144	0.120	0.139	0.145	0.144	0.145
Skates and Rays	0.382	0.174	0.323	0.511	0.642	0.450	0.315	0.179	0.235	0.248	0.221	0.233	0.806	0.760	0.661	0.757	0.632	0.730	0.762	0.761	0.762
Puffer fish	0.200	0.038	0.061	0.244	0.455	0.124	0.119	0.044	0.056	0.047	0.044	0.050	0.051	0.048	0.042	0.048	0.040	0.046	0.048	0.048	0.048
Trigger fish	0.086	0.729	0.267	0.135	0.129	0.134	0.126	0.022	0.059	0.053	0.054	0.035	0.097	0.092	0.080	0.091	0.076	0.088	0.092	0.092	0.092
Sea horse	0.157	0.001	0.001	0.000	0.001	0.001	0.004	0.002	0.001	0.001	0.001	0.001	0.005	0.005	0.004	0.005	0.004	0.005	0.005	0.005	0.005
White shrimps	1.334	0.385	0.294	0.423	0.402	0.290	0.214	1.387	0.451	0.438	0.334	0.201	4.404	4.149	3.609	4.133	3.453	3.988	4.163	4.154	4.162
Tiger prawn	0.365	0.066	0.044	0.011	0.007	0.006	0.008	0.018	0.022	0.024	0.026	0.064	0.347	0.327	0.284	0.325	0.272	0.314	0.328	0.327	0.328
Endeavor prawn	0.349	0.518	0.428	0.376	0.282	0.384	0.245	1.159	0.492	0.491	0.379	0.283	0.258	0.243	0.212	0.242	0.202	0.234	0.244	0.243	0.244
Acetes	2.218	2.296	4.006	8.736	12.633	8.284	7.934	2.632	6.049	7.808	9.026	8.401	7.329	5.508	4.999	4.477	4.565	5.009	5.058	5.246	5.179
Sea Mantis	0.163	0.099	0.152	0.550	0.516	0.592	0.304	1.408	1.819	1.680	1.815	2.072	0.392	0.369	0.321	0.368	0.308	0.355	0.371	0.370	0.371
Assorted shells	8.173	0.031	0.002	0.025	0.034	0.004	0.004	0.122	0.040	0.035	0.030	0.034	0.278	0.262	0.228	0.261	0.218	0.252	0.263	0.263	0.263
Squid	7.932	8.065	7.593	9.881	10.59	13.19	12.51	9.760	13.31	14.55	14.45	70.05	15.40	14.37	14.26	15.23	12.91	15.11	15.55	15.59	15.65
Crab	0.613	1.002	0.810	0.881	0.948	1.605	1.376	1.710	1.572	1.543	1.435	0.980	1.338	1.484	1.585	1.618	1.606	1.715	1.779	1.829	1.800

Industrial	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Eel	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.005	0.004	0.003	0.002
Silver bar	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.002	0.003	0.004	0.006	0.006
Herring	0.686	0.731	0.777	0.773	1.093	1.137	1.132	0.992	1.190	1.252	1.252	1.362	1.594	2.051	3.120	2.989	2.466	1.888	1.455	0.534
Cavalla	0.636	0.678	0.720	0.716	1.013	1.053	1.051	0.917	1.103	1.171	1.140	1.272	1.529	1.709	3.103	3.114	2.750	2.346	2.214	1.400
Cigar fish	0.023	0.025	0.026	0.026	0.037	0.038	0.038	0.034	0.040	0.042	0.044	0.045	0.051	0.083	0.084	0.091	0.087	0.084	0.093	0.075
Macolor	0.052	0.055	0.059	0.058	0.082	0.086	0.086	0.074	0.090	0.097	0.090	0.106	0.131	0.109	0.297	0.282	0.229	0.170	0.122	0.032
Nemipterid	2.320	2.473	2.627	2.611	3.699	3.844	3.817	3.370	4.015	4.194	4.338	4.514	5.207	7.885	9.116	9.300	8.396	7.392	7.326	5.043
Big-eye Tuna	0.124	0.132	0.140	0.139	0.198	0.205	0.201	0.183	0.213	0.211	0.259	0.222	0.219	0.676	0.152	0.162	0.155	0.147	0.161	0.129
Yellowfin Tuna	0.509	0.543	0.577	0.572	0.815	0.845	0.827	0.755	0.878	0.870	1.065	0.913	0.902	2.781	0.625	0.668	0.638	0.606	0.664	0.529
Albacore	0.013	0.014	0.015	0.015	0.021	0.022	0.021	0.019	0.023	0.023	0.026	0.024	0.027	0.058	0.034	0.037	0.037	0.036	0.042	0.036
Bonito	0.206	0.220	0.233	0.233	0.328	0.341	0.345	0.293	0.356	0.401	0.331	0.427	0.608	0.175	1.373	1.808	2.119	2.461	3.313	3.262
Chub Mackerel	0.584	0.623	0.661	0.657	0.931	0.966	0.961	0.850	1.006	1.060	1.098	1.108	1.355	2.002	2.019	2.904	3.631	4.430	6.200	6.302
Silver perch	0.004	0.004	0.005	0.005	0.007	0.007	0.007	0.006	0.007	0.007	0.009	0.007	0.007	0.026	0.000	0.002	0.003	0.005	0.009	0.010
Sardine	2.920	3.113	3.307	3.288	4.655	4.837	4.810	4.236	5.054	5.304	5.412	5.704	6.685	9.457	11.97	12.60	11.85	11.01	11.76	9.052
Misc. marine orgs.	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.004	0.007	0.004	0.010	0.015	0.022	0.034	0.037
Artisanal Zone A																				
Gizzard shad	0.044	0.045	0.046	0.047	0.048	0.050	0.051	0.052	0.054	0.055	0.056	0.058	0.059	0.061	0.063	0.064	0.066	0.068	0.069	0.071
Flatfish	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.018
Lizard fish	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038
Grouper	0.112	0.115	0.118	0.121	0.124	0.127	0.131	0.134	0.137	0.141	0.145	0.148	0.152	0.156	0.160	0.165	0.169	0.173	0.178	0.182
Fusilier	0.105	0.107	0.110	0.113	0.116	0.119	0.122	0.126	0.129	0.132	0.136	0.139	0.143	0.147	0.150	0.154	0.158	0.162	0.167	0.171
Snapper	0.121	0.125	0.128	0.131	0.135	0.138	0.142	0.145	0.149	0.153	0.157	0.161	0.165	0.170	0.174	0.179	0.183	0.188	0.193	0.198
Threadfin bream	0.232	0.238	0.244	0.251	0.257	0.264	0.271	0.278	0.285	0.293	0.300	0.308	0.316	0.324	0.333	0.342	0.351	0.360	0.369	0.379
Siganid	0.068	0.070	0.072	0.074	0.076	0.077	0.080	0.082	0.084	0.086	0.088	0.090	0.093	0.095	0.098	0.100	0.103	0.106	0.108	0.111
Whiting	0.090	0.092	0.095	0.097	0.100	0.103	0.105	0.108	0.111	0.114	0.117	0.120	0.123	0.126	0.129	0.133	0.136	0.140	0.143	0.147
Perchlet/Glassfish	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017
Surgeon fish	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.032	0.032	0.033	0.034	0.035	0.036	0.037	0.038
Parrot fish	0.032	0.033	0.034	0.035	0.036	0.036	0.037	0.038	0.039	0.040	0.041	0.043	0.044	0.045	0.046	0.047	0.048	0.050	0.051	0.052
Slipmouth	0.229	0.235	0.241	0.247	0.254	0.260	0.267	0.274	0.281	0.289	0.296	0.304	0.312	0.320	0.328	0.337	0.346	0.355	0.364	0.374
Mojarra	0.015	0.015	0.016	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.022	0.023	0.023	0.024
Goatfish	0.155	0.159	0.164	0.168	0.172	0.177	0.181	0.186	0.191	0.196	0.201	0.206	0.212	0.217	0.223	0.229	0.235	0.241	0.247	0.254
Goby	0.072	0.074	0.076	0.078	0.080	0.082	0.084	0.086	0.088	0.091	0.093	0.096	0.098	0.101	0.103	0.106	0.109	0.111	0.114	0.117
Spade fish	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Croaker	0.086	0.088	0.090	0.093	0.095	0.098	0.100	0.103	0.106	0.108	0.111	0.114	0.117	0.120	0.123	0.127	0.130	0.133	0.137	0.140
Porgy	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.023	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.029	0.029
Therapon/Grunt	0.065	0.067	0.069	0.071	0.072	0.074	0.076	0.078	0.080	0.082	0.085	0.087	0.089	0.091	0.094	0.096	0.099	0.101	0.104	0.107
Red bulls eye	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Hardtail	0.047	0.048	0.049	0.050	0.052	0.053	0.055	0.056	0.057	0.059	0.060	0.062	0.064	0.065	0.067	0.069	0.071	0.072	0.074	0.076
Big-eyed Scad	0.127	0.131	0.134	0.138	0.141	0.145	0.149	0.153	0.157	0.161	0.165	0.169	0.174	0.178	0.183	0.188	0.193	0.198	0.203	0.208
Round scad	0.090	0.092	0.094	0.097	0.099	0.102	0.105	0.107	0.110	0.113	0.116	0.119	0.122	0.125	0.129	0.132	0.135	0.139	0.143	0.146
Rainbow runner	0.013	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018	0.018	0.019	0.019	0.020	0.021	0.021	0.022
Leather jacket	0.093	0.096	0.098	0.101	0.103	0.106	0.109	0.112	0.115	0.118	0.121	0.124	0.127	0.131	0.134	0.137	0.141	0.145	0.149	0.152
Crevalle	0.039	0.040	0.041	0.042	0.044	0.045	0.046	0.047	0.048	0.050	0.051	0.052	0.054	0.055	0.056	0.058	0.059	0.061	0.062	0.064
Mullet	0.184	0.189	0.194	0.199	0.204	0.209	0.215	0.220	0.226	0.232	0.238	0.244	0.251	0.257	0.264	0.271	0.278	0.285	0.293	0.300

Industrial	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Eel	0.038	0.042	0.014	0.013	0.050	0.043	0.018	0.006	0.072	0.139	0.203	0.275	0.007	0.005	0.003	0.004	0.006	0.008	0.009	0.006
Silver bar	0.002	0.052	0.118	0.111	0.053	0.041	0.063	0.090	0.067	0.046	0.024	0.003	0.005	0.004	0.002	0.003	0.004	0.005	0.006	0.004
Herring	1.026	1.207	2.638	3.336	3.050	5.476	1.174	0.451	0.393	0.342	0.285	0.239	0.456	0.321	0.191	0.265	0.362	0.482	0.574	0.355
Cavalla	4.969	3.769	4.252	4.949	5.504	6.975	3.227	8.138	7.544	7.073	6.490	6.145	3.605	4.736	5.857	5.504	5.502	5.612	5.264	3.062
Cigar fish	0.061	0.003	0.054	0.037	0.081	0.033	0.031	0.012	0.010	0.009	0.008	0.006	0.012	0.009	0.005	0.007	0.010	0.013	0.015	0.009
Macolor	0.082	0.094	0.550	0.495	0.494	0.062	0.085	0.012	0.013	0.015	0.016	0.018	0.034	0.024	0.014	0.020	0.027	0.036	0.042	0.026
Nemipterid	13.38	13.03	16.43	20.03	23.20	21.79	6.966	2.678	2.334	2.028	1.693	1.417	2.708	1.906	1.131	1.572	2.147	2.860	3.405	2.105
Big-eye Tuna	0.257	0.577	0.273	0.670	1.043	1.501	2.093	2.260	2.539	2.856	3.123	3.511	3.436	3.663	3.898	3.467	3.244	3.051	2.583	3.287
Yellowfin Tuna	1.057	2.375	1.122	5.355	8.875	7.653	8.614	9.305	10.45	11.76	12.86	14.45	14.14	15.08	16.05	14.27	13.35	12.56	10.63	13.53
Albacore	0.161	0.029	0.046	0.476	0.228	0.053	0.051	0.398	0.297	0.202	0.105	0.011	0.020	0.014	0.008	0.012	0.016	0.021	0.025	0.016
Bonito	5.400	3.321	5.457	8.662	6.931	4.173	2.253	0.866	0.755	0.656	0.547	0.458	0.876	0.617	0.366	0.508	0.694	0.925	1.101	0.681
Chub Mackerel	16.43	15.63	15.43	20.24	28.16	16.47	29.76	16.90	12.99	9.317	5.523	1.892	3.616	2.546	1.510	2.099	2.868	3.819	4.547	2.811
Silver perch	0.005	0.006	0.013	0.012	0.006	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
Sardine	25.65	34.50	30.21	31.08	11.45	14.45	15.54	27.01	31.05	35.55	39.43	44.83	45.51	39.90	34.56	32.37	32.23	32.72	30.53	46.27
Misc. marine orgs.	0.045	0.051	0.064	0.078	0.087	0.100	0.120	0.132	0.140	0.150	0.157	0.171	0.187	0.205	0.223	0.348	0.505	0.697	0.851	0.263
Artisanal Zone A																				
Gizzard shad	0.073	0.075	0.077	0.079	0.080	0.084	0.085	0.085	0.097	0.086	0.084	0.139	0.047	0.077	0.109	0.117	0.126	0.135	0.145	0.110
Flatfish	0.018	0.018	0.019	0.019	0.020	0.021	0.021	0.022	0.022	0.022	0.025	0.024	0.019	0.036	0.053	0.047	0.040	0.032	0.024	0.106
Lizard fish	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046	0.050	0.046	0.048	0.063	0.034	0.055	0.076	0.078	0.079	0.081	0.082	0.056
Grouper	0.187	0.192	0.197	0.202	0.207	0.214	0.218	0.222	0.236	0.230	0.233	0.284	0.210	0.239	0.269	0.270	0.270	0.271	0.271	0.261
Fusilier	0.175	0.181	0.184	0.190	0.197	0.195	0.207	0.220	0.187	0.247	0.264	0.074	0.446	0.321	0.190	0.173	0.156	0.138	0.119	0.226
Snapper	0.203	0.209	0.214	0.219	0.226	0.231	0.237	0.245	0.248	0.254	0.272	0.259	0.270	0.330	0.393	0.410	0.427	0.447	0.465	0.345
Threadfin bream	0.389	0.398	0.409	0.420	0.429	0.445	0.452	0.458	0.494	0.476	0.475	0.613	0.414	0.468	0.524	0.498	0.469	0.440	0.407	0.371
Siganid	0.114	0.117	0.120	0.123	0.128	0.126	0.134	0.146	0.120	0.157	0.184	0.034	0.280	0.274	0.269	0.292	0.315	0.340	0.366	0.381
Whiting	0.151	0.155	0.159	0.163	0.166	0.173	0.175	0.176	0.196	0.181	0.178	0.263	0.131	0.166	0.203	0.196	0.188	0.180	0.170	0.146
Perchlet/Glassfish	0.018	0.018	0.019	0.019	0.020	0.020	0.020	0.021	0.022	0.021	0.024	0.023	0.021	0.034	0.047	0.040	0.031	0.023	0.014	0.015
Surgeon fish	0.039	0.040	0.041	0.042	0.043	0.043	0.046	0.048	0.042	0.054	0.057	0.021	0.092	0.068	0.043	0.068	0.095	0.124	0.154	0.154
Parrot fish	0.054	0.055	0.056	0.058	0.060	0.061	0.063	0.065	0.064	0.068	0.073	0.062	0.080	0.089	0.097	0.124	0.151	0.180	0.210	0.205
Slipmouth	0.383	0.393	0.403	0.414	0.426	0.435	0.447	0.463	0.463	0.484	0.516	0.463	0.550	0.620	0.694	0.744	0.795	0.850	0.906	0.829
Mojarra	0.025	0.025	0.026	0.027	0.028	0.028	0.029	0.031	0.028	0.031	0.039	0.017	0.043	0.064	0.087	0.092	0.098	0.104	0.110	0.118
Goatfish	0.260	0.267	0.274	0.281	0.288	0.297	0.303	0.308	0.326	0.324	0.323	0.384	0.315	0.320	0.325	0.365	0.406	0.450	0.494	0.377
Goby	0.120	0.123	0.127	0.130	0.133	0.138	0.140	0.141	0.154	0.148	0.143	0.198	0.124	0.129	0.133	0.176	0.220	0.267	0.316	0.446
Spade fish	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.002	0.008	0.007	0.006	0.005	0.004	0.003	0.002	0.006
Croaker	0.144	0.147	0.152	0.156	0.158	0.166	0.167	0.167	0.189	0.171	0.167	0.261	0.112	0.151	0.193	0.167	0.140	0.112	0.081	0.123
Porgy	0.030	0.031	0.032	0.032	0.033	0.035	0.035	0.035	0.039	0.036	0.036	0.052	0.026	0.034	0.042	0.033	0.024	0.014	0.004	0.021
Therapon/Grunt	0.109	0.112	0.115	0.118	0.121	0.125	0.127	0.129	0.140	0.133	0.133	0.176	0.111	0.132	0.154	0.168	0.182	0.197	0.212	0.188
Red bulls eye	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.004	0.011	0.000	0.001	0.001	0.001	0.001	0.001	0.002	0.002
Hardtail	0.078	0.080	0.082	0.084	0.087	0.089	0.091	0.094	0.097	0.097	0.102	0.106	0.099	0.116	0.134	0.132	0.129	0.126	0.123	0.107
Big-eyed Scad	0.214	0.219	0.225	0.231	0.236	0.244	0.248	0.252	0.272	0.261	0.261	0.339	0.223	0.258	0.295	0.357	0.422	0.491	0.562	0.406
Round scad	0.150	0.154	0.158	0.162	0.167	0.170	0.174	0.183	0.180	0.188	0.210	0.170	0.213	0.281	0.353	0.386	0.420	0.457	0.494	0.531
Rainbow runner	0.022	0.023	0.023	0.024	0.024	0.025	0.026	0.026	0.028	0.027	0.026	0.035	0.025	0.022	0.019	0.020	0.020	0.021	0.021	0.036
Leather jacket	0.156	0.161	0.164	0.169	0.175	0.174	0.185	0.195	0.167	0.221	0.230	0.074	0.397	0.261	0.117	0.176	0.237	0.301	0.369	0.306
Crevalle	0.066	0.067	0.069	0.071	0.073	0.075	0.076	0.079	0.083	0.078	0.089	0.095	0.061	0.127	0.196	0.213	0.231	0.251	0.270	0.253
Mullet	0.308	0.316	0.325	0.333	0.340	0.352	0.360	0.363	0.391	0.382	0.371	0.484	0.349	0.335	0.321	0.364	0.409	0.458	0.508	0.405

Industrial	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Eel	0.006	0.002	0.001	0.001	0.002	0.002	0.010	0.006	0.002	0.002	0.002	0.002	0.014	0.013	0.012	0.013	0.011	0.013	0.014	0.013	0.014
Silver bar	0.004	0.001	0.001	0.001	0.001	0.002	0.007	0.004	0.001	0.001	0.001	0.001	0.010	0.009	0.008	0.009	0.008	0.009	0.009	0.009	0.009
Herring	0.540	0.102	0.088	0.001	0.053	0.155	0.653	0.397	0.131	0.113	0.097	0.109	0.905	0.853	0.742	0.850	0.710	0.820	0.856	0.854	0.856
Cavalla	1.554	2.704	3.717	2.829	3.374	4.684	4.340	2.073	2.557	3.369	2.767	2.885	2.197	2.946	2.907	3.974	3.701	3.774	4.126	4.161	4.078
Cigar fish	0.010	0.003	0.002	0.002	0.003	0.004	0.017	0.010	0.003	0.003	0.003	0.003	0.024	0.022	0.019	0.022	0.018	0.021	0.022	0.022	0.022
Macolor	0.027	0.007	0.006	0.006	0.008	0.011	0.048	0.029	0.010	0.008	0.007	0.008	0.066	0.062	0.054	0.062	0.052	0.060	0.062	0.062	0.062
Nemipterid	2.158	0.596	0.517	0.493	0.654	0.907	3.811	2.316	0.762	0.661	0.564	0.638	5.281	4.975	4.328	4.956	4.141	4.783	4.992	4.981	4.991
Big-eye Tuna	6.602	10.04	4.580	3.182	4.657	6.025	6.338	13.80	7.648	9.036	8.764	8.918	11.42	15.99	13.48	11.08	14.49	13.96	14.26	15.36	14.73
Yellowfin Tuna	27.18	41.34	18.85	13.10	19.17	24.80	26.09	56.81	31.48	37.20	36.08	36.71	47.02	65.82	81.73	43.49	62.66	67.14	62.40	69.05	67.19
Albacore	0.016	0.004	0.004	0.004	0.005	0.007	0.028	0.017	0.006	0.005	0.004	0.005	0.039	0.037	0.032	0.037	0.031	0.035	0.037	0.037	0.037
Bonito	0.698	0.193	0.167	0.159	0.211	0.293	1.233	0.749	0.246	0.214	0.182	0.206	1.708	1.609	1.400	1.603	1.339	1.547	1.615	1.611	1.614
Chub Mackerel	2.882	0.796	0.690	0.659	0.873	1.211	5.090	3.093	1.018	0.882	0.753	0.852	7.052	6.644	5.780	6.619	5.530	6.387	6.667	6.651	6.666
Silver perch	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Sardine	79.41	2.133	1.850	1.765	2.339	3.244	13.64	8.289	2.727	2.364	2.017	2.283	18.90	17.80	15.49	17.73	14.82	17.11	17.86	17.82	17.86
Misc. marine orgs.	0.242	1.117	0.604	0.366	0.423	0.377	0.364	1.599	1.036	1.189	0.847	0.795	0.341	0.322	0.280	0.320	0.268	0.309	0.323	0.322	0.323
Artisanal Zone A																					
Gizzard shad	0.107	0.120	0.078	0.033	0.046	0.026	0.025	0.261	0.142	0.163	0.172	0.189	0.132	0.161	0.160	0.172	0.165	0.175	0.180	0.182	0.188
Flatfish	0.128	0.084	0.006	0.004	0.009	0.017	0.017	0.002	0.002	0.002	0.002	0.002	0.042	0.052	0.051	0.055	0.053	0.056	0.057	0.058	0.060
Lizard fish	0.050	0.067	0.012	0.049	0.112	0.079	0.085	0.096	0.075	0.082	0.082	0.079	0.079	0.097	0.096	0.103	0.099	0.105	0.108	0.110	0.113
Grouper	0.281	0.271	0.243	0.213	0.161	0.218	0.220	0.331	0.296	0.358	0.395	0.407	0.117	0.171	0.185	0.197	0.186	0.199	0.204	0.207	0.214
Fusilier	0.236	0.181	0.547	0.246	0.355	0.085	0.092	0.405	0.375	0.475	0.540	0.563	0.168	0.342	0.263	0.304	0.412	0.342	0.371	0.395	0.388
Snapper	0.355	0.369	0.356	0.114	0.225	0.206	0.214	0.557	0.951	1.210	1.398	1.471	0.085	0.128	0.135	0.246	0.330	0.248	0.289	0.304	0.294
Threadfin bream	0.376	0.402	0.476	0.837	1.405	1.495	1.441	0.998	2.084	0.300	0.294	0.298	0.781	0.841	0.813	1.092	1.241	1.099	1.204	1.243	1.242
Siganid	0.369	0.395	0.167	0.393	0.522	0.466	0.491	2.628	0.495	2.444	2.427	2.353	0.866	0.747	0.722	0.599	0.589	0.671	0.651	0.670	0.699
Whiting	0.158	0.147	0.618	0.276	0.236	0.267	0.213	0.583	0.460	0.502	0.519	0.594	0.356	0.437	0.435	0.467	0.449	0.474	0.487	0.494	0.510
Perchlet/Glassfish	0.014	0.023	0.036	0.021	0.026	0.109	0.106	0.377	0.029	0.030	0.031	0.033	0.055	0.068	0.068	0.073	0.070	0.074	0.076	0.077	0.080
Surgeon fish	0.180	0.110	0.004	0.015	0.018	0.001	0.001	0.029	0.264	0.247	0.247	0.240	0.128	0.158	0.156	0.168	0.162	0.170	0.175	0.178	0.183
Parrot fish	0.211	0.177	0.128	0.140	0.109	0.101	0.106	0.167	0.907	0.177	0.194	0.199	0.068	0.057	0.063	0.140	0.177	0.132	0.158	0.164	0.159
Slipmouth	0.838	0.835	0.423	0.300	0.557	0.624	0.629	0.161	0.168	0.171	0.162	0.162	0.493	0.562	0.575	0.725	0.710	0.704	0.751	0.759	0.776
Mojarra	0.106	0.120	0.011	0.034	0.055	0.035	0.033	0.177	0.096	0.094	0.094	0.094	0.092	0.113	0.113	0.121	0.116	0.122	0.126	0.128	0.132
Goatfish	0.379	0.377	0.682	0.145	0.285	0.310	0.320	0.115	0.199	0.204	0.202	0.196	0.424	0.540	0.431	0.420	0.428	0.448	0.454	0.466	0.480
Goby	0.427	0.421	0.436	0.044	0.065	0.118	0.115	0.182	0.078	0.078	0.080	0.090	0.261	0.321	0.319	0.342	0.329	0.347	0.357	0.362	0.374
Spade fish	0.007	0.010	0.012	0.002	0.045	0.089	0.101	0.286	0.273	0.361	0.418	0.441	0.119	0.147	0.146	0.157	0.150	0.159	0.163	0.166	0.171
Croaker	0.146	0.120	0.043	0.042	0.070	0.113	0.110	0.015	0.015	0.019	0.021	0.023	0.116	0.142	0.141	0.152	0.146	0.154	0.158	0.161	0.166
Porgy	0.023	0.025	0.223	0.021	0.039	0.632	0.667	0.081	0.067	0.064	0.064	0.062	0.052	0.052	0.030	0.037	0.030	0.034	0.035	0.035	0.036
Therapon/Grunt	0.187	0.187	0.738	0.199	0.167	0.119	0.120	0.108	0.091	0.098	0.101	0.100	0.222	0.272	0.270	0.290	0.279	0.294	0.303	0.307	0.317
Red bulls eye	0.002	0.003	0.000	0.079	0.046	0.007	0.007	0.192	0.150	0.156	0.164	0.158	0.044	0.054	0.054	0.058	0.055	0.058	0.060	0.061	0.063
Hardtail	0.098	0.089	0.050	0.126	0.814	0.544	0.576	2.081	3.160	2.912	2.891	2.804	0.977	1.199	1.191	1.280	1.229	1.297	1.335	1.353	1.397
Big-eyed Scad	0.441	0.422	0.171	0.207	0.236	0.229	0.247	0.103	0.086	0.097	0.094	0.093	0.980	0.911	0.905	0.699	0.551	0.759	0.704	0.705	0.761
Round scad	0.550	0.516	0.187	3.505	1.369	1.798	1.881	0.284	0.248	0.256	0.211	0.207	3.148	1.569	1.534	1.363	1.598	1.576	1.589	1.671	1.695
Rainbow runner	0.037	0.037	0.151	0.030	0.053	0.025	0.027	0.509	0.487	0.644	0.745	0.785	0.219	0.269	0.267	0.287	0.276	0.291	0.299	0.304	0.313
Leather jacket	0.313	0.320	0.411	0.285	0.203	0.425	0.436	0.655	0.731	0.825	0.879	0.885	0.499	0.613	0.609	0.654	0.628	0.663	0.683	0.692	0.714
Crevalle	0.283	0.265	0.162	0.418	0.184	0.159	0.136	0.052	0.055	0.054	0.055	0.061	0.050	0.085	0.081	0.211	0.318	0.212	0.260	0.278	0.262
Mullet	0.429	0.419	0.308	0.486	0.401	0.366	0.324	0.132	0.127	0.120	0.124	0.139	0.485	0.321	0.408	0.490	0.496	0.488	0.517	0.526	0.537

Industrial	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Threadfin	0.016	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.022	0.023	0.024	0.024	0.025	0.026
Garfish	0.107	0.110	0.112	0.115	0.118	0.121	0.125	0.128	0.131	0.135	0.138	0.142	0.146	0.149	0.153	0.157	0.161	0.166	0.170	0.174
Halfbeak	0.019	0.020	0.020	0.021	0.021	0.022	0.023	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.032
Barracuda	0.024	0.025	0.026	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.032	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040
Flying fish	0.221	0.227	0.233	0.239	0.245	0.252	0.258	0.265	0.272	0.279	0.286	0.294	0.302	0.309	0.318	0.326	0.334	0.343	0.352	0.361
Cavalla	0.159	0.163	0.167	0.172	0.176	0.181	0.185	0.190	0.195	0.200	0.206	0.211	0.217	0.222	0.228	0.234	0.240	0.246	0.253	0.259
Round Herring	0.067	0.069	0.071	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.092	0.094	0.097	0.099	0.102	0.104	0.107	0.110
Fimbriated Sardine	0.174	0.178	0.183	0.188	0.192	0.198	0.203	0.208	0.213	0.219	0.225	0.231	0.237	0.243	0.249	0.256	0.262	0.269	0.276	0.283
Indian Sardine	0.013	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022
Deep-bodied Sardine	0.020	0.021	0.021	0.022	0.022	0.023	0.024	0.024	0.025	0.025	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.031	0.032	0.033
Anchovy	0.288	0.296	0.304	0.312	0.320	0.328	0.337	0.346	0.355	0.364	0.374	0.383	0.393	0.404	0.414	0.425	0.436	0.447	0.459	0.471
Sardine	0.314	0.322	0.331	0.339	0.348	0.357	0.367	0.376	0.386	0.396	0.407	0.417	0.428	0.439	0.451	0.462	0.475	0.487	0.500	0.513
Spanish Mackerel	0.097	0.100	0.102	0.105	0.108	0.111	0.113	0.116	0.119	0.123	0.126	0.129	0.132	0.136	0.139	0.143	0.147	0.151	0.155	0.159
Frigate Tuna	0.185	0.189	0.193	0.198	0.203	0.207	0.212	0.217	0.222	0.228	0.233	0.238	0.244	0.250	0.255	0.261	0.268	0.274	0.280	0.287
Skipjack	0.699	0.716	0.733	0.750	0.768	0.786	0.804	0.823	0.842	0.862	0.882	0.903	0.924	0.946	0.968	0.990	1.013	1.037	1.061	1.086
Eastern Little Tuna	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.010	0.010
Big-eye Tuna	0.152	0.156	0.160	0.163	0.167	0.171	0.175	0.179	0.183	0.188	0.192	0.197	0.201	0.206	0.211	0.216	0.221	0.226	0.231	0.237
Yellowfin Tuna	1.583	1.620	1.659	1.698	1.737	1.778	1.820	1.863	1.906	1.951	1.997	2.044	2.091	2.140	2.190	2.242	2.294	2.348	2.402	2.458
Swordfish, sailfish, marlin	0.054	0.056	0.057	0.059	0.060	0.062	0.064	0.065	0.067	0.069	0.070	0.072	0.074	0.076	0.078	0.080	0.082	0.084	0.087	0.089
Indo-Pacific Mackerel	0.058	0.059	0.061	0.062	0.064	0.065	0.067	0.069	0.071	0.073	0.074	0.076	0.078	0.080	0.083	0.085	0.087	0.089	0.092	0.094
Indian Mackerel	0.062	0.063	0.065	0.067	0.068	0.070	0.072	0.074	0.076	0.078	0.080	0.082	0.084	0.086	0.088	0.091	0.093	0.096	0.098	0.101
Hairtail	0.090	0.092	0.095	0.097	0.100	0.103	0.105	0.108	0.111	0.114	0.117	0.120	0.123	0.126	0.129	0.133	0.136	0.140	0.143	0.147
Sharks and rays	0.075	0.077	0.079	0.081	0.083	0.085	0.087	0.090	0.092	0.094	0.097	0.099	0.102	0.105	0.107	0.110	0.113	0.116	0.119	0.122
Trigger fish	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009
Misc fish	0.047	0.048	0.049	0.050	0.052	0.053	0.054	0.056	0.057	0.059	0.060	0.062	0.064	0.065	0.067	0.069	0.070	0.072	0.074	0.076
Blue crab	0.161	0.165	0.170	0.174	0.179	0.184	0.188	0.193	0.198	0.204	0.209	0.214	0.220	0.226	0.232	0.238	0.244	0.250	0.257	0.263
White shrimps	0.234	0.240	0.246	0.252	0.259	0.266	0.273	0.280	0.287	0.295	0.302	0.310	0.318	0.327	0.335	0.344	0.353	0.362	0.372	0.381
Endeavor prawn	0.022	0.022	0.023	0.023	0.024	0.025	0.025	0.026	0.027	0.027	0.028	0.029	0.030	0.030	0.031	0.032	0.033	0.034	0.034	0.035
Acetes	1.218	1.250	1.282	1.316	1.350	1.386	1.422	1.459	1.498	1.537	1.577	1.618	1.660	1.704	1.748	1.794	1.841	1.889	1.938	1.988
Squid	0.190	0.195	0.200	0.205	0.211	0.216	0.222	0.228	0.234	0.240	0.246	0.252	0.259	0.266	0.273	0.280	0.287	0.294	0.302	0.310
Cuttlefish	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.011
Octopus	0.034	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.045	0.046	0.047	0.048	0.049	0.051	0.052	0.053	0.055
Misc shells	0.067	0.069	0.071	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.092	0.094	0.097	0.099	0.102	0.104	0.107	0.110
Misc crustaceans	0.074	0.076	0.078	0.080	0.082	0.084	0.086	0.088	0.091	0.093	0.095	0.098	0.101	0.103	0.106	0.109	0.111	0.114	0.117	0.120
Misc. marine orgs.	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.010	0.010
Artisanal Zone B																				
Milkfish	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006
Gizzard shad	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018
Flatfish	0.012	0.012	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.016	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020
Sea catfish	0.054	0.056	0.058	0.059	0.061	0.062	0.064	0.066	0.068	0.070	0.072	0.074	0.076	0.078	0.080	0.082	0.084	0.087	0.089	0.092
Lizard fish	0.044	0.045	0.046	0.047	0.049	0.050	0.051	0.053	0.054	0.056	0.057	0.059	0.060	0.062	0.064	0.066	0.067	0.069	0.071	0.073
Moray eel	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.023	0.023	0.024
Grouper	0.545	0.560	0.575	0.591	0.608	0.625	0.642	0.660	0.678	0.697	0.716	0.736	0.756	0.777	0.798	0.820	0.843	0.866	0.890	0.915
Sea bass	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007
Fusilier	0.310	0.319	0.328	0.337	0.346	0.356	0.366	0.376	0.386	0.397	0.408	0.419	0.431	0.443	0.455	0.468	0.480	0.494	0.507	0.521

Industrial	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Threadfin	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.031	0.033	0.033	0.033	0.037	0.034	0.032	0.029	0.025	0.020	0.016	0.010	0.035
Garfish	0.179	0.183	0.188	0.193	0.198	0.204	0.209	0.211	0.223	0.226	0.217	0.263	0.234	0.187	0.138	0.222	0.310	0.403	0.499	0.369
Halfbeak	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.038	0.041	0.039	0.041	0.050	0.034	0.045	0.056	0.050	0.043	0.037	0.029	0.065
Barracuda	0.041	0.042	0.043	0.044	0.045	0.047	0.047	0.047	0.055	0.048	0.045	0.083	0.022	0.034	0.047	0.052	0.056	0.061	0.066	0.063
Flying fish	0.371	0.381	0.389	0.401	0.412	0.418	0.436	0.448	0.435	0.493	0.489	0.387	0.686	0.474	0.252	0.431	0.619	0.818	1.025	0.873
Cavalla	0.266	0.273	0.280	0.287	0.294	0.304	0.310	0.315	0.335	0.330	0.328	0.400	0.315	0.320	0.325	0.368	0.412	0.459	0.508	0.398
Round Herring	0.113	0.115	0.119	0.122	0.124	0.130	0.130	0.132	0.148	0.131	0.137	0.201	0.074	0.156	0.242	0.195	0.145	0.093	0.038	0.110
FimbriatedSardine	0.291	0.298	0.306	0.314	0.322	0.331	0.339	0.348	0.357	0.366	0.376	0.385	0.395	0.408	0.415	0.425	0.450	0.436	0.454	0.533
Indian Sardine	0.023	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.031	0.032	0.034	0.034	0.033	0.040	0.033
Deep-bodied Sardine	0.034	0.035	0.036	0.037	0.038	0.038	0.039	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.049	0.049	0.052	0.052	0.051	0.061
Anchovy	0.483	0.496	0.509	0.521	0.537	0.549	0.561	0.587	0.586	0.597	0.671	0.581	0.632	0.914	1.210	1.262	1.314	1.371	1.428	1.539
Sardine	0.526	0.539	0.554	0.568	0.581	0.601	0.613	0.620	0.666	0.650	0.641	0.816	0.592	0.611	0.631	0.594	0.553	0.512	0.467	0.455
Spanish Mackerel	0.163	0.167	0.171	0.176	0.180	0.185	0.189	0.195	0.201	0.201	0.215	0.219	0.199	0.262	0.329	0.286	0.241	0.194	0.144	0.235
Frigate Tuna	0.293	0.300	0.307	0.314	0.322	0.329	0.337	0.344	0.354	0.360	0.366	0.387	0.379	0.383	0.387	0.404	0.421	0.439	2.404	2.288
Skipjack	1.111	1.137	1.164	1.191	1.219	1.247	1.276	1.306	1.335	1.368	1.401	1.425	1.472	1.505	1.540	1.568	1.596	1.625	1.439	0.942
Eastern Little Tuna	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.012	0.015	0.019	0.075	0.174	0.278	0.226	1.550
Big-eye Tuna	0.242	0.248	0.254	0.259	0.266	0.272	0.278	0.285	0.291	0.298	0.305	0.312	0.319	0.327	0.334	0.350	0.367	0.384	0.197	0.147
Yellowfin Tuna	2.516	2.575	2.635	2.696	2.759	2.823	2.889	2.956	3.024	3.095	3.168	3.238	3.318	3.397	3.477	3.645	3.818	3.997	2.045	1.530
Swordfish, sailfish, marlin	0.091	0.093	0.096	0.099	0.100	0.106	0.106	0.103	0.126	0.107	0.090	0.203	0.042	0.036	0.030	0.033	0.036	0.039	0.042	0.047
Indo-Pacific Mackerel	0.096	0.099	0.101	0.104	0.107	0.110	0.112	0.116	0.119	0.118	0.130	0.128	0.115	0.168	0.224	0.224	0.223	0.223	0.222	0.230
Indian Mackerel	0.103	0.106	0.109	0.111	0.115	0.118	0.119	0.125	0.128	0.121	0.146	0.139	0.096	0.228	0.367	0.361	0.353	0.345	0.336	0.233
Hairtail	0.151	0.155	0.159	0.163	0.168	0.171	0.176	0.182	0.183	0.192	0.199	0.188	0.218	0.223	0.227	0.196	0.163	0.129	0.092	0.322
Sharks and rays	0.125	0.128	0.132	0.135	0.138	0.144	0.145	0.146	0.165	0.147	0.146	0.231	0.085	0.144	0.205	0.171	0.135	0.098	0.058	0.080
Trigger fish	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.012	0.015	0.013	0.010	0.010	0.010	0.010	0.010	0.008
Misc fish	0.078	0.080	0.082	0.084	0.087	0.088	0.091	0.096	0.091	0.100	0.115	0.071	0.130	0.164	0.201	0.178	0.154	0.129	0.102	0.179
Blue crab	0.270	0.278	0.284	0.291	0.301	0.305	0.314	0.331	0.318	0.344	0.386	0.273	0.427	0.525	0.628	0.608	0.586	0.564	0.539	0.479
White shrimps	0.391	0.402	0.412	0.422	0.434	0.445	0.456	0.470	0.479	0.490	0.517	0.505	0.525	0.603	0.685	0.699	0.713	0.730	0.745	0.756
Endeavor prawn	0.036	0.037	0.038	0.039	0.040	0.042	0.042	0.043	0.048	0.041	0.046	0.063	0.021	0.063	0.107	0.157	0.209	0.265	0.322	0.281
Acetes	2.040	2.093	2.147	2.205	2.261	2.314	2.392	2.434	2.482	2.640	2.564	2.630	3.157	2.300	1.398	1.326	1.248	1.169	1.081	1.004
Squid	0.318	0.327	0.334	0.344	0.353	0.359	0.374	0.384	0.374	0.426	0.412	0.341	0.595	0.367	0.126	0.175	0.226	0.280	0.336	0.443
Cuttlefish	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.015	0.012	0.013	0.022	0.003	0.015	0.052	0.092	0.071	0.048	0.025	0.000	0.375
Octopus	0.056	0.058	0.059	0.061	0.063	0.064	0.066	0.068	0.067	0.073	0.076	0.063	0.091	0.085	0.079	0.072	0.063	0.055	0.045	0.063
Misc shells	0.113	0.116	0.119	0.121	0.125	0.130	0.128	0.136	0.148	0.119	0.162	0.190	0.019	0.307	0.611	0.479	0.340	0.194	0.039	0.244
Misc crustaceans	0.123	0.127	0.130	0.133	0.138	0.140	0.143	0.152	0.146	0.154	0.181	0.124	0.182	0.268	0.358	0.363	0.367	0.372	0.377	0.357
Misc. marine orgs.	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.035
Artisanal Zone B																				
Milkfish	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.009	0.007	0.007	0.014	0.001	0.006	0.012	0.021	0.031	0.042	0.054	0.039
Gizzard shad	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.022	0.024	0.023	0.024	0.029	0.019	0.028	0.037	0.043	0.050	0.057	0.065	0.096
Flatfish	0.021	0.021	0.022	0.023	0.023	0.024	0.024	0.025	0.028	0.025	0.024	0.041	0.015	0.023	0.032	0.054	0.080	0.107	0.137	0.129
Sea catfish	0.094	0.096	0.100	0.102	0.104	0.110	0.109	0.111	0.127	0.109	0.114	0.184	0.051	0.132	0.222	0.227	0.234	0.239	0.244	0.230
Lizard fish	0.075	0.077	0.079	0.081	0.083	0.087	0.088	0.089	0.099	0.091	0.091	0.134	0.065	0.092	0.121	0.136	0.152	0.169	0.187	0.221
Moray eel	0.024	0.025	0.026	0.026	0.027	0.028	0.029	0.030	0.030	0.031	0.034	0.030	0.036	0.041	0.047	0.066	0.089	0.113	0.139	0.187
Grouper	0.940	0.966	0.993	1.020	1.048	1.078	1.106	1.137	1.173	1.193	1.235	1.289	1.258	1.369	1.488	1.477	1.471	1.444	1.413	1.737
Sea bass	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.010	0.008	0.010	0.012	0.003	0.016	0.020	0.024	0.025	0.026	0.027	0.028	0.041
Fusilier	0.536	0.551	0.565	0.581	0.599	0.609	0.634	0.657	0.638	0.714	0.730	0.566	0.955	0.779	0.576	0.545	0.513	0.470	0.422	0.496

Industrial	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Threadfin	0.035	0.043	0.150	0.026	0.046	0.033	0.030	0.004	0.004	0.005	0.005	0.005	0.040	0.049	0.048	0.052	0.050	0.052	0.054	0.055	0.056
Garfish	0.368	0.393	0.218	0.454	0.690	0.516	0.534	0.064	0.083	0.081	0.081	0.079	0.360	0.442	0.440	0.472	0.453	0.479	0.493	0.499	0.516
Halfbeak	0.057	0.059	0.048	0.012	0.033	0.150	0.159	0.036	0.044	0.045	0.045	0.044	0.066	0.081	0.080	0.086	0.083	0.088	0.090	0.091	0.094
Barracuda	0.058	0.063	0.069	0.140	0.193	0.062	0.059	0.030	0.029	0.030	0.030	0.030	0.074	0.092	0.091	0.097	0.094	0.099	0.102	0.103	0.107
Flying fish	0.935	0.907	0.276	0.119	0.328	0.170	0.182	0.443	0.555	0.692	0.708	0.700	0.442	0.408	0.442	0.340	0.400	0.415	0.404	0.427	0.437
Cavalla	0.411	0.414	1.120	0.365	0.441	0.551	0.583	0.054	0.051	0.053	0.054	0.054	0.255	0.278	0.285	0.446	0.384	0.390	0.429	0.422	0.435
Round Herring	0.127	0.107	0.006	0.028	0.132	0.170	0.170	0.007	0.007	0.007	0.008	0.008	0.003	0.006	0.006	0.089	0.069	0.057	0.076	0.071	0.071
Fimbriated Sardine	0.388	0.515	0.334	0.083	0.191	0.260	0.264	0.276	0.228	0.247	0.246	0.241	0.379	0.301	0.185	0.222	0.266	0.235	0.254	0.265	0.264
Indian Sardine	0.031	0.064	0.008	0.025	0.175	0.007	0.007	0.043	0.052	0.053	0.050	0.049	0.762	0.619	0.558	0.532	0.534	0.570	0.574	0.588	0.607
Deep-bodied Sardine	0.053	0.046	0.093	0.025	0.021	0.265	0.280	0.019	0.019	0.025	0.028	0.030	0.040	0.050	0.049	0.053	0.051	0.054	0.055	0.056	0.058
Anchovy	1.551	1.988	1.473	0.875	1.800	0.630	0.672	2.373	2.061	1.990	1.853	1.802	2.760	2.793	2.904	1.899	1.638	2.270	2.034	2.080	2.241
Sardine	0.443	0.429	0.402	0.385	0.385	0.368	0.349	0.319	0.306	0.281	0.258	0.232	0.206	0.252	0.251	0.269	0.259	0.273	0.281	0.285	0.294
Spanish Mackerel	0.254	0.208	0.485	1.162	0.337	0.172	0.171	0.792	0.770	0.867	0.937	0.970	0.471	0.623	0.569	0.862	1.023	0.857	0.962	0.997	0.986
Frigate Tuna	1.345	1.653	2.133	0.201	0.232	0.241	0.245	0.251	1.413	1.305	1.256	1.117	1.060	1.202	1.376	1.200	1.250	1.317	1.291	1.314	1.369
Skipjack	1.486	0.948	0.845	0.724	0.427	0.415	0.418	0.453	1.936	2.218	2.303	2.880	3.239	2.924	2.523	3.251	3.252	3.203	3.455	3.560	3.562
Eastern Little Tuna	0.553	1.396	1.255	0.163	0.165	0.150	0.144	0.138	0.267	0.125	0.043	0.119	0.116	0.096	0.047	0.114	0.113	0.105	0.126	0.125	0.124
Big-eye Tuna	0.283	0.241	0.234	0.525	0.563	0.579	0.594	0.607	0.379	0.392	0.383	0.410	0.287	0.378	0.419	0.363	0.390	0.414	0.411	0.397	0.427
Yellowfin Tuna	2.938	2.520	2.448	5.462	5.853	6.021	6.175	6.304	3.936	4.073	4.316	3.966	3.985	4.289	4.728	4.375	4.512	4.697	4.676	4.792	4.942
Swordfish, sailfish, marlin	0.044	0.057	0.007	0.195	0.064	0.094	0.099	0.254	0.188	0.190	0.191	0.193	0.125	0.153	0.152	0.164	0.157	0.166	0.171	0.173	0.179
Indo-Pacific Mackerel	0.213	0.199	0.207	0.385	0.453	0.485	0.499	0.043	0.036	0.035	0.035	0.035	0.340	0.412	0.370	1.519	1.610	1.216	1.527	1.528	1.495
Indian Mackerel	0.253	0.227	0.158	0.174	0.338	0.377	0.360	0.154	0.182	0.189	0.175	0.173	0.295	0.352	0.351	0.417	0.500	0.444	0.477	0.499	0.497
Hairtail	0.360	0.388	0.716	0.212	0.307	0.166	0.176	0.052	0.050	0.064	0.073	0.080	0.337	0.455	1.627	0.624	0.521	0.982	0.743	0.786	0.882
Sharks and rays	0.066	0.082	0.177	0.313	0.309	0.264	0.301	0.013	0.013	0.016	0.017	0.018	0.153	0.188	0.186	0.200	0.192	0.203	0.209	0.212	0.219
Trigger fish	0.007	0.028	0.011	0.032	0.125	0.060	0.052	0.158	0.256	0.232	0.231	0.224	0.086	0.105	0.105	0.113	0.108	0.114	0.117	0.119	0.123
Misc fish	0.317	0.208	0.750	0.233	0.298	0.319	0.320	0.233	0.145	0.163	0.170	0.173	0.274	0.337	0.335	0.360	0.345	0.365	0.375	0.380	0.393
Blue crab	0.508	0.579	0.774	0.295	0.249	0.538	0.534	0.423	0.467	0.486	0.513	0.579	0.707	0.730	0.746	0.553	0.532	0.644	0.606	0.624	0.657
White shrimps	0.756	0.821	1.077	0.352	0.376	0.475	0.486	0.759	0.832	0.855	0.882	0.998	0.834	1.024	1.017	1.092	1.049	1.108	1.140	1.155	1.193
Endeavor prawn	0.295	0.228	0.635	0.243	0.281	0.390	0.330	0.430	0.514	0.585	0.606	0.693	0.394	0.483	0.481	0.516	0.496	0.524	0.539	0.546	0.564
Acetes	1.052	1.147	0.853	1.832	1.303	2.770	3.162	0.973	1.162	1.364	1.441	1.624	1.123	1.175	0.931	0.584	0.756	0.798	0.748	0.807	0.825
Squid	0.457	0.501	0.104	0.862	0.672	0.634	0.576	0.399	0.272	0.282	0.290	0.313	0.569	0.743	0.758	1.276	1.570	1.257	1.439	1.497	1.469
Cuttlefish	0.332	0.252	0.031	0.001	0.004	0.003	0.003	0.007	0.005	0.005	0.005	0.005	0.100	0.123	0.122	0.131	0.126	0.133	0.137	0.139	0.143
Octopus	0.056	0.061	0.006	0.033	0.016	0.030	0.032	0.041	0.062	0.057	0.057	0.052	0.062	0.075	0.075	0.080	0.077	0.082	0.084	0.085	0.088
Misc shells	0.269	0.315	0.512	0.725	0.994	0.173	0.142	0.038	0.018	0.019	0.015	0.017	0.218	0.268	0.266	0.286	0.274	0.289	0.298	0.302	0.312
Misc crustaceans	0.397	0.385	0.302	0.295	0.250	0.342	0.354	0.126	0.131	0.130	0.126	0.144	0.316	0.388	0.386	0.414	0.398	0.420	0.432	0.438	0.452
Misc. marine orgs.	0.032	0.067	0.058	0.051	0.046	0.009	0.009	0.018	0.010	0.008	0.006	0.007	0.022	0.027	0.027	0.029	0.027	0.029	0.030	0.030	0.031
Artisanal Zone B																					
Milkfish	0.038	0.034	0.029	0.126	0.063	0.329	0.333	0.027	0.029	0.054	0.056	0.055	0.066	0.093	0.079	0.063	0.052	0.068	0.065	0.065	0.070
Gizzard shad	0.083	0.069	0.007	0.019	0.020	0.830	0.823	0.129	0.160	0.118	0.123	0.139	0.138	0.194	0.164	0.132	0.108	0.143	0.135	0.136	0.146
Flatfish	0.129	0.114	0.096	0.066	0.062	0.079	0.083	0.016	0.019	0.024	0.025	0.026	0.067	0.094	0.080	0.064	0.053	0.069	0.065	0.066	0.071
Sea catfish	0.224	0.218	0.207	0.427	0.354	0.586	0.587	1.169	0.775	0.704	0.734	0.765	0.386	0.542	0.459	0.369	0.303	0.399	0.377	0.379	0.407
Lizard fish	0.217	0.219	0.103	0.079	0.110	0.068	0.068	0.131	0.251	0.229	0.239	0.238	0.153	0.214	0.182	0.146	0.120	0.158	0.149	0.150	0.161
Moray eel	0.203	0.178	0.077	0.059	0.053	0.053	0.056	0.086	0.060	0.053	0.056	0.061	0.086	0.121	0.103	0.082	0.068	0.089	0.084	0.085	0.091
Grouper	1.772	1.948	1.178	1.621	1.568	1.395	1.400	2.003	1.715	1.668	1.741	1.803	1.573	1.262	1.645	1.641	1.196	1.581	1.555	1.521	1.639
Sea bass	0.040	0.045	0.025	0.058	0.073	0.091	0.092	0.051	0.084	0.103	0.107	0.121	0.051	0.071	0.060	0.049	0.040	0.053	0.050	0.050	0.053
Fusilier	0.505	0.577	0.380	1.297	1.392	1.061	1.089	0.413	0.951	1.032	1.076	1.061	0.926	0.736	0.815	1.201	0.893	1.023	1.098	1.059	1.118

Artisanal Zone B	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Snapper	0.373	0.383	0.394	0.405	0.416	0.428	0.439	0.452	0.464	0.477	0.490	0.504	0.518	0.532	0.547	0.562	0.577	0.593	0.609	0.626
Threadfin bream	0.807	0.830	0.853	0.876	0.901	0.926	0.951	0.977	1.005	1.032	1.061	1.090	1.120	1.151	1.183	1.216	1.249	1.284	1.319	1.356
Siganid	0.363	0.373	0.383	0.394	0.405	0.416	0.427	0.439	0.451	0.464	0.477	0.490	0.503	0.517	0.532	0.546	0.561	0.577	0.593	0.609
Whiting	0.131	0.134	0.138	0.142	0.146	0.150	0.154	0.158	0.163	0.167	0.172	0.177	0.181	0.187	0.192	0.197	0.202	0.208	0.214	0.220
Perchlet/Glassfish	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.015
Surgeon fish	0.053	0.054	0.056	0.057	0.059	0.060	0.062	0.064	0.065	0.067	0.069	0.071	0.073	0.075	0.077	0.079	0.081	0.084	0.086	0.088
Parrot fish/Wrasse	0.136	0.140	0.144	0.148	0.152	0.156	0.160	0.165	0.169	0.174	0.179	0.184	0.189	0.194	0.199	0.205	0.210	0.216	0.222	0.228
Slipmouth	0.596	0.612	0.629	0.647	0.665	0.683	0.702	0.721	0.741	0.762	0.783	0.805	0.827	0.850	0.873	0.897	0.922	0.948	0.974	1.001
Mojarra	0.171	0.175	0.180	0.185	0.190	0.196	0.201	0.207	0.212	0.218	0.224	0.231	0.237	0.243	0.250	0.257	0.264	0.272	0.279	0.287
Goatfish	0.108	0.111	0.114	0.117	0.120	0.123	0.127	0.130	0.134	0.138	0.141	0.145	0.149	0.153	0.158	0.162	0.167	0.171	0.176	0.181
Goby	0.024	0.025	0.026	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041
Moonfish	0.019	0.019	0.020	0.021	0.021	0.022	0.022	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.032
Spade fish	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.013
Flathead	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Croaker	0.154	0.158	0.163	0.167	0.172	0.177	0.182	0.187	0.192	0.197	0.202	0.208	0.214	0.220	0.226	0.232	0.238	0.245	0.252	0.259
Porgy	0.259	0.266	0.274	0.281	0.289	0.297	0.305	0.314	0.323	0.331	0.341	0.350	0.360	0.370	0.380	0.390	0.401	0.412	0.424	0.435
Therapon/Grunt	0.177	0.182	0.187	0.192	0.198	0.203	0.209	0.214	0.220	0.226	0.233	0.239	0.246	0.253	0.259	0.267	0.274	0.282	0.289	0.297
Red bulls eye	0.040	0.041	0.042	0.043	0.044	0.045	0.047	0.048	0.049	0.051	0.052	0.053	0.055	0.056	0.058	0.060	0.061	0.063	0.065	0.066
Lactarid	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Hardtail	0.104	0.107	0.110	0.113	0.116	0.119	0.122	0.126	0.129	0.133	0.136	0.140	0.144	0.148	0.152	0.156	0.161	0.165	0.170	0.174
Big-eyed Scad	0.240	0.247	0.254	0.261	0.268	0.276	0.283	0.291	0.299	0.307	0.316	0.325	0.334	0.343	0.352	0.362	0.372	0.382	0.393	0.404
Round scad	0.866	0.890	0.915	0.940	0.966	0.993	1.020	1.049	1.078	1.108	1.138	1.170	1.202	1.235	1.269	1.305	1.340	1.377	1.416	1.454
Rainbow runner	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.023	0.023	0.024	0.024	0.025	0.026	0.027	0.027	0.028	0.029	0.030	0.030
Leather jacket	0.082	0.084	0.087	0.089	0.091	0.094	0.097	0.099	0.102	0.105	0.108	0.111	0.114	0.117	0.120	0.123	0.127	0.130	0.134	0.138
Crevalle	0.273	0.281	0.289	0.297	0.305	0.313	0.322	0.331	0.340	0.349	0.359	0.369	0.379	0.390	0.400	0.411	0.423	0.434	0.446	0.459
Mullet	0.176	0.180	0.185	0.191	0.196	0.201	0.207	0.213	0.218	0.224	0.231	0.237	0.244	0.250	0.257	0.264	0.272	0.279	0.287	0.295
Threadfin	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.015
Dolphin fish	0.013	0.013	0.014	0.014	0.015	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022
Silverside	0.054	0.055	0.057	0.058	0.060	0.062	0.063	0.065	0.067	0.069	0.071	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.088	0.090
Garfish	0.170	0.174	0.179	0.184	0.189	0.195	0.200	0.206	0.211	0.217	0.223	0.229	0.236	0.242	0.249	0.256	0.263	0.270	0.277	0.285
Halfbeak	0.056	0.057	0.059	0.060	0.062	0.064	0.065	0.067	0.069	0.071	0.073	0.075	0.077	0.079	0.081	0.084	0.086	0.088	0.091	0.093
Barracuda	0.139	0.143	0.147	0.151	0.155	0.160	0.164	0.169	0.173	0.178	0.183	0.188	0.193	0.199	0.204	0.210	0.216	0.222	0.228	0.234
Sergeant fish	0.028	0.029	0.030	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046
Leaf fish	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.088	0.090	0.092	0.095	0.097	0.100	0.103	0.105	0.108	0.111	0.114	0.117	0.120
Pomfret	0.143	0.147	0.151	0.155	0.159	0.163	0.168	0.172	0.177	0.182	0.186	0.191	0.197	0.202	0.207	0.213	0.218	0.224	0.230	0.236
Flying fish	1.303	1.338	1.374	1.411	1.448	1.487	1.527	1.568	1.610	1.653	1.697	1.743	1.789	1.837	1.886	1.937	1.988	2.041	2.096	2.151
Big-eye	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Cavalla	0.442	0.454	0.467	0.480	0.493	0.507	0.521	0.535	0.550	0.565	0.581	0.597	0.614	0.630	0.648	0.666	0.684	0.703	0.723	0.742
Ten Pounder	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Wolf herring	0.044	0.045	0.046	0.048	0.049	0.050	0.052	0.053	0.055	0.056	0.058	0.059	0.061	0.063	0.064	0.066	0.068	0.070	0.072	0.074
Round Herring	0.246	0.253	0.260	0.267	0.275	0.283	0.290	0.298	0.307	0.315	0.324	0.333	0.342	0.351	0.361	0.371	0.381	0.392	0.403	0.414
Fimbriated Sardine	0.475	0.488	0.502	0.516	0.530	0.545	0.560	0.575	0.591	0.608	0.624	0.642	0.659	0.678	0.696	0.716	0.735	0.756	0.776	0.798
Indian Sardine	0.367	0.377	0.387	0.398	0.409	0.420	0.432	0.444	0.456	0.469	0.482	0.495	0.509	0.523	0.537	0.552	0.567	0.583	0.599	0.616
Deep-bodied Sardine	0.044	0.045	0.046	0.048	0.049	0.050	0.052	0.053	0.054	0.056	0.058	0.059	0.061	0.062	0.064	0.066	0.068	0.070	0.072	0.074
Anchovy	1.067	1.096	1.127	1.158	1.190	1.223	1.257	1.292	1.328	1.364	1.402	1.441	1.481	1.522	1.564	1.607	1.651	1.697	1.743	1.792
Big-eyed Herring	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.016	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020
Sardine	1.095	1.125	1.156	1.188	1.221	1.255	1.290	1.326	1.362	1.400	1.439	1.479	1.519	1.561	1.605	1.649	1.694	1.741	1.789	1.839

Artisanal Zone B	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Snapper	0.644	0.661	0.680	0.698	0.716	0.740	0.756	0.773	0.816	0.806	0.828	0.957	0.775	0.898	1.034	1.077	1.129	1.172	1.219	1.423
Threadfin bream	1.394	1.430	1.473	1.513	1.545	1.611	1.638	1.644	1.824	1.723	1.656	2.437	1.404	1.430	1.452	1.461	1.478	1.478	1.475	2.192
Siganid	0.626	0.643	0.662	0.679	0.696	0.721	0.736	0.748	0.802	0.781	0.787	0.981	0.715	0.804	0.901	0.964	1.040	1.110	1.186	1.104
Whiting	0.226	0.232	0.239	0.245	0.250	0.262	0.265	0.263	0.303	0.274	0.256	0.440	0.182	0.195	0.209	0.240	0.277	0.315	0.355	0.334
Perchlet/Glassfish	0.015	0.015	0.016	0.016	0.017	0.017	0.017	0.018	0.019	0.016	0.023	0.023	0.007	0.043	0.084	0.073	0.062	0.048	0.033	0.054
Surgeon fish	0.091	0.093	0.096	0.098	0.101	0.106	0.106	0.107	0.122	0.106	0.112	0.171	0.054	0.135	0.225	0.251	0.281	0.310	0.343	0.353
Parrot fish/Wrasse	0.235	0.241	0.248	0.254	0.261	0.271	0.274	0.280	0.306	0.280	0.301	0.393	0.200	0.370	0.561	0.579	0.602	0.620	0.639	0.597
Slipmouth	1.028	1.057	1.086	1.116	1.146	1.178	1.211	1.244	1.276	1.318	1.347	1.377	1.450	1.438	1.418	1.600	1.811	2.021	2.251	2.324
Mojarra	0.295	0.302	0.312	0.320	0.326	0.342	0.346	0.344	0.393	0.359	0.337	0.561	0.251	0.263	0.275	0.307	0.345	0.381	0.421	0.452
Goatfish	0.186	0.191	0.196	0.202	0.206	0.215	0.218	0.219	0.245	0.226	0.222	0.336	0.163	0.210	0.263	0.362	0.473	0.591	0.720	0.673
Goby	0.042	0.043	0.044	0.045	0.047	0.048	0.049	0.051	0.050	0.055	0.057	0.047	0.068	0.066	0.064	0.052	0.038	0.023	0.005	0.040
Moonfish	0.033	0.034	0.034	0.035	0.037	0.037	0.038	0.041	0.038	0.043	0.048	0.026	0.062	0.064	0.067	0.069	0.071	0.073	0.057	0.081
Spade fish	0.013	0.014	0.014	0.014	0.015	0.015	0.015	0.017	0.016	0.016	0.021	0.012	0.018	0.035	0.055	0.047	0.037	0.026	0.014	0.025
Flathead	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.003	0.007	0.007	0.007	0.011	0.015	0.020	0.025	0.021
Croaker	0.266	0.273	0.281	0.289	0.295	0.306	0.314	0.316	0.340	0.338	0.321	0.424	0.329	0.266	0.195	0.266	0.346	0.431	0.525	0.135
Porgy	0.447	0.460	0.472	0.485	0.499	0.513	0.526	0.540	0.559	0.567	0.585	0.621	0.592	0.643	0.698	0.693	0.690	0.677	0.663	0.931
Therapon/Grunt	0.306	0.314	0.323	0.331	0.341	0.349	0.360	0.373	0.373	0.393	0.418	0.368	0.456	0.498	0.544	0.509	0.473	0.426	0.374	0.429
Red bulls eye	0.068	0.070	0.072	0.074	0.076	0.078	0.080	0.082	0.086	0.086	0.088	0.100	0.084	0.095	0.108	0.122	0.139	0.155	0.173	0.358
Lactarid	0.007	0.007	0.007	0.007	0.008	0.007	0.008	0.009	0.007	0.010	0.011	0.001	0.018	0.015	0.012	0.039	0.070	0.103	0.139	0.115
Hardtail	0.179	0.184	0.189	0.194	0.199	0.207	0.210	0.213	0.233	0.220	0.223	0.298	0.180	0.233	0.292	0.336	0.386	0.437	0.493	0.587
Big-eyed Scad	0.415	0.427	0.438	0.449	0.464	0.476	0.484	0.509	0.514	0.512	0.588	0.525	0.506	0.839	1.213	1.252	1.303	1.341	1.382	1.431
Round scad	1.494	1.538	1.575	1.622	1.678	1.689	1.772	1.857	1.718	2.038	2.134	1.215	3.048	2.445	1.754	1.964	2.208	2.450	2.714	2.800
Rainbow runner	0.031	0.032	0.033	0.034	0.035	0.035	0.037	0.039	0.035	0.043	0.047	0.017	0.072	0.059	0.044	0.088	0.138	0.191	0.250	0.251
Leather jacket	0.141	0.146	0.149	0.153	0.158	0.162	0.166	0.175	0.171	0.179	0.205	0.156	0.204	0.289	0.383	0.391	0.401	0.407	0.413	0.474
Crevalle	0.471	0.484	0.498	0.512	0.525	0.541	0.555	0.567	0.593	0.598	0.604	0.680	0.614	0.622	0.628	0.724	0.834	0.945	1.067	1.008
Mullet	0.303	0.311	0.320	0.329	0.338	0.346	0.358	0.367	0.371	0.396	0.398	0.379	0.474	0.403	0.321	0.392	0.473	0.556	0.648	0.658
Threadfin	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.019	0.021	0.020	0.021	0.022	0.024	0.025	0.025	0.030	0.027
Dolphin fish	0.022	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.031	0.030	0.032	0.033	0.036	0.037	0.037	0.045	0.042
Silverside	0.093	0.095	0.098	0.101	0.103	0.106	0.109	0.112	0.116	0.118	0.121	0.130	0.123	0.130	0.137	0.148	0.152	0.157	0.185	0.163
Garfish	0.293	0.301	0.310	0.318	0.326	0.337	0.344	0.351	0.375	0.364	0.372	0.456	0.328	0.400	0.479	0.498	0.521	0.540	0.560	0.566
Halfbeak	0.096	0.099	0.101	0.104	0.107	0.109	0.112	0.118	0.116	0.121	0.138	0.108	0.137	0.193	0.256	0.270	0.287	0.301	0.317	0.425
Barracuda	0.241	0.247	0.254	0.261	0.267	0.277	0.283	0.287	0.307	0.302	0.301	0.372	0.288	0.295	0.301	0.381	0.472	0.566	0.670	0.669
Sergeant fish	0.048	0.049	0.050	0.052	0.053	0.055	0.056	0.056	0.061	0.058	0.058	0.078	0.049	0.059	0.070	0.057	0.043	0.026	0.008	0.013
Leaf fish	0.123	0.126	0.131	0.134	0.135	0.144	0.144	0.139	0.173	0.143	0.124	0.287	0.049	0.063	0.080	0.064	0.047	0.027	0.006	0.016
Pomfret	0.243	0.249	0.256	0.262	0.271	0.276	0.284	0.297	0.292	0.308	0.339	0.272	0.362	0.437	0.519	0.417	0.305	0.177	0.036	0.036
Flying fish	2.209	2.271	2.324	2.391	2.469	2.489	2.603	2.720	2.542	2.970	3.096	1.902	4.318	3.500	2.562	2.082	1.558	0.955	0.289	0.348
Big-eye	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.013
Cavalla	0.763	0.784	0.806	0.828	0.851	0.874	0.897	0.926	0.944	0.971	1.020	0.998	1.056	1.179	1.313	1.408	1.521	1.627	1.741	1.780
Ten Pounder	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.005	0.006	0.009	0.002	0.009	0.018	0.016	0.014	0.012	0.009	0.011
Wolf herring	0.076	0.078	0.080	0.082	0.084	0.089	0.089	0.087	0.105	0.090	0.080	0.167	0.044	0.044	0.043	0.061	0.082	0.104	0.128	0.133
Round Herring	0.425	0.438	0.448	0.461	0.477	0.482	0.504	0.526	0.495	0.576	0.595	0.385	0.829	0.659	0.464	0.529	0.604	0.680	0.762	0.745
Fimbriated Sardine	0.820	0.842	0.866	0.890	0.914	0.941	0.965	0.989	1.026	1.042	1.063	1.150	1.093	1.127	1.224	1.348	1.215	1.528	1.788	0.664
Indian Sardine	0.633	0.650	0.668	0.686	0.705	0.726	0.744	0.763	0.792	0.803	0.822	0.888	0.835	0.885	0.940	0.999	1.040	1.103	1.201	1.144
Deep-bodied Sardine	0.076	0.078	0.080	0.082	0.084	0.087	0.089	0.091	0.095	0.096	0.098	0.106	0.099	0.106	0.113	0.117	0.128	0.131	0.131	0.165
Anchovy	1.842	1.890	1.946	1.999	2.043	2.126	2.163	2.184	2.391	2.279	2.244	3.094	1.928	2.116	2.321	2.854	3.463	4.095	4.787	4.708
Big-eyed Herring	0.020	0.021	0.022	0.022	0.023	0.023	0.024	0.025	0.026	0.026	0.027	0.029	0.027	0.029	0.031	0.032	0.034	0.036	0.037	0.038
Sardine	1.890	1.941	1.995	2.051	2.105	2.163	2.231	2.276	2.344	2.450	2.417	2.560	2.784	2.298	1.740	1.868	2.021	2.163	2.318	1.809

Artisanal Zone B	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Snapper	1.390	1.482	0.357	1.165	1.159	0.910	0.919	0.353	0.760	0.724	0.755	0.777	1.402	0.674	0.819	1.056	0.912	0.980	1.038	1.029	1.072
Threadfin bream	2.241	2.496	2.135	2.513	1.705	1.697	1.750	2.502	3.135	3.504	3.487	3.437	6.111	2.831	2.757	2.754	2.260	2.739	2.728	2.715	2.879
Siganid	1.124	1.117	1.373	2.886	1.687	1.779	1.784	2.233	2.572	2.039	2.130	2.250	3.045	2.707	2.876	3.087	2.242	2.893	2.895	2.819	3.029
Whiting	0.308	0.326	0.524	0.829	0.427	0.389	0.370	0.130	0.181	0.189	0.192	0.200	0.336	0.471	0.400	0.321	0.263	0.347	0.328	0.330	0.354
Perchlet/Glassfish	0.048	0.035	0.032	0.074	0.067	0.039	0.039	0.256	0.209	0.158	0.166	0.186	0.076	0.106	0.090	0.072	0.059	0.078	0.074	0.074	0.080
Surgeon fish	0.339	0.325	0.100	0.131	0.243	0.321	0.343	0.083	0.187	0.221	0.231	0.252	0.228	0.321	0.272	0.218	0.179	0.236	0.223	0.224	0.241
Parrot fish/Wrasse	0.594	0.589	0.293	0.784	0.946	0.847	0.851	0.756	0.864	0.924	0.965	1.017	0.699	0.561	0.692	0.869	0.753	0.814	0.857	0.852	0.887
Slipmouth	2.363	2.414	1.886	2.203	2.282	1.815	1.835	3.274	2.942	3.296	3.239	3.281	4.383	4.877	4.573	4.045	2.983	4.097	3.914	3.860	4.179
Mojarra	0.430	0.403	0.295	0.262	0.284	0.196	0.204	0.250	0.199	0.210	0.219	0.223	0.323	0.453	0.384	0.309	0.253	0.334	0.315	0.317	0.340
Goatfish	0.666	0.679	0.596	0.499	0.461	0.358	0.364	1.120	1.084	1.046	1.060	1.039	0.921	0.980	0.851	1.015	0.777	0.931	0.959	0.937	0.995
Goby	0.034	0.019	0.294	0.323	0.578	0.320	0.324	0.650	0.837	1.120	1.169	1.180	0.325	0.457	0.387	0.311	0.255	0.337	0.317	0.319	0.343
Moonfish	0.075	0.075	0.048	0.100	0.251	0.136	0.135	0.033	0.056	0.093	0.097	0.095	0.082	0.115	0.097	0.078	0.064	0.085	0.080	0.080	0.086
Spade fish	0.026	0.028	0.034	0.100	0.108	0.075	0.072	0.046	0.038	0.045	0.047	0.049	0.043	0.061	0.052	0.041	0.034	0.045	0.042	0.043	0.046
Flathead	0.020	0.019	0.008	0.014	0.017	0.030	0.033	0.013	0.036	0.027	0.028	0.030	0.018	0.025	0.021	0.017	0.014	0.018	0.017	0.017	0.019
Croaker	0.458	0.453	0.361	0.588	0.504	0.521	0.519	0.572	0.538	0.591	0.614	0.687	0.444	0.623	0.528	0.425	0.348	0.460	0.433	0.436	0.468
Porgy	0.824	0.781	0.427	0.915	0.840	0.801	0.812	1.357	1.488	1.510	1.576	1.639	0.804	0.433	0.488	0.532	0.323	0.474	0.468	0.444	0.488
Therapon/Grunt	0.304	0.387	0.408	0.377	0.424	0.342	0.346	0.315	0.395	0.433	0.453	0.499	0.411	0.578	0.490	0.394	0.323	0.426	0.402	0.404	0.434
Red bulls eye	0.203	0.218	0.223	0.075	0.274	0.103	0.103	0.166	0.099	0.084	0.088	0.092	0.155	0.217	0.184	0.148	0.121	0.160	0.151	0.152	0.163
Lactarid	0.125	0.136	0.011	0.006	0.002	0.001	0.001	0.016	0.018	0.022	0.024	0.023	0.042	0.060	0.051	0.041	0.033	0.044	0.041	0.042	0.045
Hardtail	0.567	0.592	0.362	0.408	0.488	0.333	0.347	0.199	0.556	0.812	0.847	0.848	0.454	0.638	0.541	0.435	0.357	0.471	0.444	0.446	0.479
Big-eyed Scad	1.452	1.550	0.896	1.199	1.249	0.852	0.891	1.890	3.000	2.668	2.756	2.719	2.620	3.050	3.007	3.452	2.798	3.259	3.348	3.304	3.487
Round scad	2.710	2.936	1.139	2.051	1.863	2.468	2.618	2.916	2.628	2.002	2.104	2.127	3.320	5.043	6.169	6.844	24.86	13.15	15.72	18.99	16.79
Rainbow runner	0.254	0.229	0.041	0.102	0.082	0.096	0.101	0.055	0.122	0.129	0.135	0.131	0.123	0.172	0.146	0.117	0.096	0.127	0.120	0.120	0.129
Leather jacket	0.462	0.450	0.181	0.342	0.239	0.149	0.158	0.214	0.144	0.562	0.587	0.594	0.330	0.463	0.393	0.316	0.259	0.342	0.322	0.324	0.348
Crevalle	0.932	0.939	2.259	1.238	1.418	0.802	0.817	0.452	0.857	0.953	0.994	1.045	4.485	5.103	3.670	3.891	2.993	3.720	3.733	3.668	3.913
Mullet	0.664	0.649	1.441	1.218	1.437	1.154	1.187	1.001	0.983	1.416	1.473	1.533	0.668	0.431	0.426	0.810	0.449	0.593	0.654	0.595	0.648
Threadfin	0.024	0.032	0.063	0.083	0.108	0.023	0.023	0.328	0.381	0.160	0.167	0.176	0.107	0.151	0.128	0.103	0.084	0.111	0.105	0.105	0.113
Dolphin fish	0.034	0.025	0.010	0.016	0.017	0.024	0.027	0.024	0.010	0.011	0.011	0.013	0.020	0.028	0.024	0.019	0.016	0.021	0.020	0.020	0.021
Silverside	0.164	0.149	0.050	0.054	0.046	0.011	0.012	0.008	0.007	0.005	0.006	0.005	0.123	0.173	0.147	0.118	0.097	0.128	0.120	0.121	0.130
Garfish	0.561	0.574	0.888	0.575	1.012	1.335	1.348	0.772	1.365	1.564	1.630	1.596	0.820	1.152	0.977	0.785	0.644	0.849	0.801	0.806	0.865
Halfbeak	0.408	0.400	0.212	0.153	0.238	0.213	0.218	0.064	0.052	0.161	0.167	0.174	0.228	0.321	0.272	0.219	0.179	0.237	0.223	0.224	0.241
Barracuda	0.701	0.684	0.654	0.566	0.570	0.432	0.438	0.494	0.657	0.992	1.035	1.119	0.589	0.827	0.701	0.563	0.462	0.610	0.575	0.578	0.621
Sergeant fish	0.012	0.010	0.015	0.023	0.031	0.029	0.029	0.038	0.037	0.041	0.042	0.041	0.019	0.027	0.023	0.019	0.015	0.020	0.019	0.019	0.020
Leaf fish	0.014	0.011	0.025	0.028	0.014	0.018	0.018	0.000	0.002	0.002	0.002	0.002	0.013	0.018	0.015	0.012	0.010	0.013	0.012	0.012	0.013
Pomfret	0.032	0.047	0.605	0.032	0.058	0.075	0.077	0.006	0.002	0.002	0.002	0.002	0.075	0.105	0.089	0.071	0.058	0.077	0.073	0.073	0.078
Flying fish	0.345	0.385	1.623	0.193	0.405	0.578	0.582	0.965	2.053	1.684	1.754	1.709	1.099	1.199	1.145	1.099	0.864	1.094	1.074	1.063	1.136
Big-eye	0.010	0.008	0.031	0.012	0.147	0.015	0.016	0.020	0.026	0.073	0.076	0.080	0.025	0.036	0.030	0.024	0.020	0.026	0.025	0.025	0.027
Cavalla	1.797	1.825	1.754	2.858	2.830	2.099	2.117	2.492	1.304	2.276	2.376	2.467	1.741	1.511	1.669	1.923	1.590	1.824	1.879	1.859	1.957
Ten Pounder	0.010	0.009	0.007	0.025	0.043	0.048	0.045	0.045	0.104	0.117	0.123	0.133	0.035	0.049	0.042	0.034	0.028	0.036	0.034	0.035	0.037
Wolf herring	0.120	0.109	0.024	0.048	0.016	0.021	0.024	0.034	0.050	0.064	0.066	0.075	0.074	0.104	0.088	0.071	0.058	0.076	0.072	0.072	0.078
Round Herring	0.758	0.765	0.174	0.176	0.214	0.090	0.091	0.020	0.010	0.011	0.012	0.013	0.016	0.167	0.303	0.456	0.357	0.392	0.425	0.413	0.433
Fimbriated Sardine	2.521	2.537	0.840	3.887	4.692	7.754	8.090	5.072	4.719	3.771	4.062	4.283	1.486	1.834	2.481	3.545	3.006	3.173	3.425	3.376	3.508
Indian Sardine	1.251	1.442	0.850	1.811	2.116	1.776	1.774	1.504	1.802	3.962	4.223	4.370	3.236	3.949	4.787	5.038	3.878	4.830	4.839	4.757	5.077
Deep-bodied Sardine	0.132	0.120	0.271	0.038	0.081	0.010	0.011	0.028	0.024	0.033	0.035	0.039	0.032	0.045	0.038	0.031	0.025	0.033	0.031	0.032	0.034
Anchovy	4.712	4.990	2.671	3.624	3.507	4.463	4.555	4.028	3.958	3.284	3.220	3.377	4.340	3.942	3.818	4.001	2.970	3.804	3.794	3.711	3.980
Big-eyed Herring	0.043	0.039	0.038	0.064	0.025	0.066	0.071	0.002	0.009	0.008	0.009	0.010	0.015	0.022	0.018	0.015	0.012	0.016	0.015	0.015	0.016
Sardine	1.708	1.676	1.684	1.630	1.571	1.508	1.439	1.365	1.285	1.200	1.108	1.010	0.918	1.289	1.093	0.878	0.720	0.950	0.896	0.901	0.967

Artisanal Zone B	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Spanish Mackerel	0.473	0.486	0.500	0.514	0.528	0.543	0.558	0.573	0.589	0.605	0.622	0.639	0.657	0.675	0.694	0.713	0.732	0.753	0.774	0.795
Frigate Tuna	5.486	5.633	5.784	5.939	6.098	6.261	6.429	6.601	6.778	6.960	7.146	7.337	7.533	7.734	7.941	8.154	8.371	8.595	8.825	9.059
Skipjack	2.082	2.138	2.195	2.254	2.315	2.377	2.440	2.506	2.573	2.642	2.712	2.785	2.859	2.936	3.014	3.095	3.177	3.262	3.349	3.439
Eastern Little Tuna	1.610	1.653	1.698	1.743	1.790	1.838	1.887	1.938	1.990	2.043	2.098	2.154	2.211	2.270	2.331	2.393	2.457	2.523	2.590	2.660
Sailfish	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.046	0.047	0.048	0.049	0.051	0.052	0.054
Swordfish	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.047	0.048	0.049	0.051	0.052	0.054	0.055	0.057	0.058	0.060	0.061	0.063	0.065
Marlin	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Big-eye Tuna	0.351	0.361	0.370	0.380	0.390	0.401	0.412	0.423	0.434	0.446	0.457	0.470	0.482	0.495	0.508	0.522	0.536	0.550	0.565	0.580
Yellowfin Tuna	1.873	1.923	1.975	2.028	2.082	2.138	2.195	2.254	2.314	2.376	2.440	2.505	2.572	2.641	2.712	2.784	2.858	2.935	3.013	3.094
Indo-Pacific Mackerel	0.246	0.253	0.260	0.267	0.274	0.282	0.290	0.298	0.306	0.314	0.323	0.332	0.341	0.351	0.360	0.370	0.381	0.391	0.402	0.413
Indian Mackerel	0.383	0.394	0.405	0.416	0.428	0.439	0.452	0.464	0.477	0.490	0.504	0.518	0.532	0.547	0.562	0.577	0.593	0.610	0.626	0.644
Japanese Mackerel	0.068	0.069	0.071	0.073	0.075	0.077	0.080	0.082	0.084	0.086	0.089	0.091	0.094	0.096	0.099	0.102	0.105	0.107	0.110	0.113
Hairtail	0.256	0.263	0.270	0.277	0.285	0.293	0.301	0.309	0.318	0.327	0.336	0.345	0.355	0.364	0.375	0.385	0.396	0.406	0.418	0.429
Shark	0.061	0.062	0.064	0.066	0.068	0.070	0.072	0.074	0.076	0.078	0.080	0.082	0.084	0.087	0.089	0.091	0.094	0.097	0.099	0.102
Skates and Rays	0.132	0.136	0.140	0.144	0.148	0.152	0.156	0.160	0.165	0.169	0.174	0.179	0.184	0.189	0.194	0.199	0.205	0.210	0.216	0.222
Trigger fish	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Misc fish	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.016	0.016	0.016	0.017	0.017
Blue crab	0.446	0.459	0.472	0.485	0.498	0.512	0.526	0.541	0.556	0.571	0.587	0.603	0.620	0.637	0.654	0.672	0.691	0.710	0.730	0.750
Mangrove or Mud crab	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.015	0.015	0.015	0.016
Spiny lobster	0.028	0.029	0.030	0.031	0.032	0.033	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.041	0.042	0.043	0.044	0.045	0.046	0.048
Shovel nosed or Slipper Lobster	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004
White shrimps	0.313	0.322	0.331	0.340	0.349	0.359	0.369	0.379	0.390	0.401	0.412	0.423	0.435	0.447	0.459	0.472	0.485	0.498	0.512	0.526
Tiger prawn	0.014	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.022	0.023	0.024	0.024
Endeavor prawn	0.062	0.064	0.066	0.067	0.069	0.071	0.073	0.075	0.077	0.079	0.082	0.084	0.086	0.089	0.091	0.094	0.096	0.099	0.101	0.104
Acetes	0.791	0.813	0.835	0.858	0.882	0.906	0.932	0.957	0.984	1.011	1.039	1.068	1.097	1.128	1.159	1.191	1.224	1.258	1.292	1.328
Shrimp	0.035	0.036	0.037	0.038	0.039	0.040	0.042	0.043	0.044	0.045	0.046	0.048	0.049	0.050	0.052	0.053	0.055	0.056	0.058	0.059
Sea Mantis	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009
Oyster	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008
Capiz shells	0.144	0.148	0.152	0.157	0.161	0.166	0.170	0.175	0.180	0.185	0.190	0.195	0.200	0.206	0.212	0.217	0.224	0.229	0.236	0.243
Green mussel	0.089	0.091	0.094	0.096	0.099	0.102	0.105	0.107	0.110	0.113	0.117	0.120	0.123	0.127	0.130	0.134	0.137	0.141	0.145	0.149
Scallop	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.047	0.048	0.049	0.051	0.052	0.053
Giant clam	0.085	0.087	0.089	0.092	0.094	0.097	0.100	0.102	0.105	0.108	0.111	0.114	0.117	0.121	0.124	0.127	0.131	0.135	0.138	0.142
Cockles	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.022	0.023	0.024	0.024	0.025	0.026	0.026	0.027	0.028	0.029	0.030	0.030
Squid	0.183	0.188	0.193	0.199	0.204	0.210	0.216	0.222	0.228	0.234	0.240	0.247	0.254	0.261	0.268	0.276	0.283	0.291	0.299	0.307
Cuttlefish	0.031	0.032	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.043	0.044	0.045	0.046	0.047	0.049	0.050	0.052
Octopus	0.028	0.029	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.047
Misc shells	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.021	0.022	0.023	0.023	0.024	0.025	0.025	0.026	0.027
Sea cucumber	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.009
Jellyfish	0.098	0.100	0.103	0.106	0.109	0.112	0.115	0.118	0.122	0.125	0.128	0.132	0.136	0.139	0.143	0.147	0.151	0.156	0.160	0.164
Misc. marine orgs.	0.129	0.133	0.137	0.141	0.144	0.148	0.153	0.157	0.161	0.166	0.170	0.175	0.180	0.185	0.190	0.195	0.200	0.206	0.211	0.218
Artisanal Zone C																				
Milkfish	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Gizzard shad	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.013	0.013	0.013
Flatfish	0.114	0.115	0.117	0.119	0.120	0.122	0.124	0.125	0.127	0.129	0.130	0.132	0.134	0.136	0.138	0.139	0.141	0.143	0.145	0.147

Artisanal Zone B	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Spanish Mackerel	0.817	0.840	0.861	0.887	0.913	0.929	0.967	0.998	0.978	1.087	1.097	0.901	1.432	1.125	0.773	0.827	0.890	0.949	1.013	1.352
Frigate Tuna	9.301	9.553	9.801	10.06	10.35	10.58	10.90	11.26	11.31	11.90	12.40	11.46	13.80	14.02	14.23	16.10	18.19	20.51	23.10	21.70
Skipjack	3.531	3.623	3.723	3.821	3.916	4.039	4.131	4.214	4.432	4.417	4.472	5.135	4.352	4.624	4.924	4.463	3.926	3.302	2.579	2.899
Eastern Little Tuna	2.730	2.804	2.878	2.952	3.037	3.114	3.185	3.308	3.356	3.407	3.703	3.505	3.563	4.702	6.012	5.338	4.557	3.654	2.609	1.868
Sailfish	0.055	0.057	0.058	0.060	0.062	0.063	0.065	0.067	0.066	0.073	0.074	0.061	0.096	0.075	0.051	0.061	0.073	0.085	0.097	0.123
Swordfish	0.067	0.069	0.070	0.072	0.074	0.076	0.079	0.081	0.080	0.088	0.090	0.074	0.113	0.097	0.078	0.162	0.257	0.359	0.471	0.377
Marlin	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.005	0.008	0.005	0.002	0.012	0.024	0.037	0.051	0.043
Big-eye Tuna	0.596	0.611	0.628	0.645	0.660	0.682	0.699	0.705	0.752	0.753	0.723	0.903	0.756	0.610	0.437	0.438	0.437	0.435	0.431	0.849
Yellowfin Tuna	3.177	3.259	3.349	3.440	3.518	3.635	3.728	3.761	4.010	4.019	3.855	4.815	4.035	3.254	2.331	2.334	2.330	2.319	2.299	4.526
Indo-Pacific Mackerel	0.424	0.436	0.448	0.460	0.473	0.486	0.500	0.513	0.528	0.542	0.556	0.574	0.586	0.602	0.617	0.589	0.562	0.523	0.480	0.556
Indian Mackerel	0.662	0.679	0.699	0.717	0.736	0.762	0.775	0.796	0.844	0.814	0.865	1.002	0.718	1.033	1.384	1.552	1.746	1.940	2.151	1.983
Japanese Mackerel	0.117	0.120	0.123	0.127	0.132	0.130	0.140	0.147	0.125	0.170	0.173	0.044	0.314	0.182	0.032	0.027	0.023	0.017	0.011	0.039
Hairtail	0.440	0.454	0.465	0.476	0.499	0.499	0.510	0.573	0.496	0.546	0.777	0.222	0.707	1.539	2.472	2.098	1.690	1.214	0.686	0.621
Shark	0.105	0.108	0.111	0.114	0.116	0.121	0.122	0.125	0.137	0.125	0.134	0.178	0.089	0.160	0.240	0.231	0.221	0.208	0.193	0.293
Skates and Rays	0.228	0.234	0.241	0.248	0.254	0.263	0.269	0.271	0.292	0.290	0.278	0.360	0.284	0.238	0.185	0.276	0.378	0.487	0.607	0.614
Trigger fish	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.006	0.008	0.009	0.001	0.015	0.011	0.006	0.009	0.013	0.017	0.021	0.022
Misc fish	0.018	0.018	0.019	0.019	0.020	0.020	0.021	0.022	0.022	0.023	0.023	0.023	0.028	0.022	0.015	0.025	0.036	0.048	0.062	0.092
Blue crab	0.771	0.791	0.815	0.836	0.855	0.890	0.905	0.914	1.001	0.953	0.939	1.296	0.803	0.890	0.984	0.971	0.961	0.937	0.909	0.848
Mangrove or Mud crab	0.016	0.017	0.017	0.018	0.018	0.018	0.019	0.021	0.018	0.021	0.028	0.009	0.028	0.051	0.077	0.071	0.065	0.057	0.049	0.064
Spiny lobster	0.049	0.050	0.052	0.053	0.055	0.056	0.058	0.060	0.060	0.062	0.066	0.062	0.069	0.078	0.088	0.078	0.067	0.053	0.039	0.039
Shovel nosed or Slipper Lobster	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.005	0.008	0.005	0.002	0.002	0.001	0.001	0.001	0.001
White shrimps	0.541	0.555	0.571	0.587	0.601	0.620	0.639	0.646	0.678	0.702	0.668	0.781	0.776	0.554	0.300	0.310	0.323	0.333	0.344	0.485
Tiger prawn	0.025	0.026	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.032	0.033	0.031	0.037	0.037	0.036	0.051	0.067	0.085	0.104	0.133
Endeavor prawn	0.107	0.110	0.113	0.116	0.118	0.125	0.126	0.123	0.147	0.130	0.112	0.231	0.074	0.053	0.029	0.065	0.106	0.150	0.199	0.182
Acetes	1.365	1.402	1.440	1.482	1.520	1.561	1.616	1.638	1.691	1.792	1.705	1.859	2.113	1.411	0.611	0.989	1.415	1.871	2.372	2.227
Shrimp	0.061	0.063	0.064	0.066	0.068	0.070	0.072	0.073	0.076	0.077	0.079	0.086	0.080	0.085	0.091	0.096	0.100	0.107	0.116	0.108
Sea Mantis	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.011	0.012	0.015	0.009	0.012	0.026	0.041	0.036	0.032	0.027	0.021	0.020
Oyster	0.008	0.008	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.010	0.013	0.010	0.009	0.008	0.006	0.004	0.002	0.000	0.920
Capiz shells	0.248	0.257	0.264	0.265	0.286	0.285	0.270	0.352	0.280	0.220	0.620	0.029	0.030	1.945	4.101	3.241	2.296	1.213	0.016	0.024
Green mussel	0.153	0.157	0.162	0.166	0.168	0.180	0.179	0.172	0.221	0.174	0.150	0.388	0.027	0.068	0.113	0.259	0.424	0.601	0.796	0.667
Scallop	0.055	0.056	0.058	0.060	0.061	0.063	0.065	0.064	0.072	0.070	0.062	0.098	0.062	0.035	0.003	0.022	0.043	0.066	0.091	0.117
Giant clam	0.146	0.149	0.155	0.159	0.160	0.172	0.171	0.163	0.211	0.169	0.135	0.378	0.034	0.023	0.010	0.009	0.008	0.007	0.006	0.004
Cockles	0.031	0.032	0.033	0.034	0.035	0.035	0.037	0.038	0.037	0.041	0.042	0.035	0.054	0.044	0.032	0.029	0.026	0.023	0.019	0.051
Squid	0.316	0.324	0.334	0.343	0.350	0.365	0.371	0.375	0.411	0.390	0.385	0.533	0.324	0.368	0.415	0.526	0.653	0.785	0.931	0.830
Cuttlefish	0.053	0.054	0.056	0.057	0.059	0.061	0.062	0.063	0.069	0.063	0.068	0.088	0.045	0.084	0.127	0.135	0.145	0.154	0.164	0.146
Octopus	0.048	0.049	0.051	0.052	0.053	0.055	0.057	0.058	0.060	0.061	0.062	0.067	0.065	0.064	0.062	0.078	0.096	0.114	0.134	0.143
Misc shells	0.027	0.028	0.029	0.030	0.031	0.031	0.032	0.035	0.030	0.037	0.044	0.011	0.062	0.067	0.073	0.066	0.058	0.048	0.038	0.101
Sea cucumber	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.011	0.010	0.011	0.014	0.008	0.015	0.021	0.029	0.042	0.057	0.073	0.090	0.088
Jellyfish	0.169	0.173	0.178	0.183	0.187	0.195	0.200	0.197	0.221	0.214	0.189	0.303	0.191	0.105	0.007	0.006	0.006	0.005	0.005	0.004
Misc. marine orgs.	0.224	0.229	0.237	0.243	0.245	0.263	0.262	0.250	0.323	0.257	0.212	0.571	0.051	0.060	0.070	0.065	0.060	0.053	0.046	0.071
Artisanal Zone C																				
Milkfish	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.002	0.002	0.011	0.019	0.015	0.011	0.007	0.003	0.034
Gizzard shad	0.013	0.013	0.013	0.014	0.014	0.014	0.014	0.015	0.014	0.016	0.015	0.011	0.022	0.014	0.005	0.008	0.011	0.014	0.018	0.020
Flatfish	0.149	0.151	0.152	0.155	0.159	0.156	0.163	0.171	0.145	0.187	0.195	0.063	0.321	0.218	0.113	0.111	0.110	0.107	0.106	0.141

Artisanal Zone B	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Spanish Mackerel	1.307	1.352	0.534	0.912	0.849	0.876	0.900	1.676	1.484	1.144	1.192	1.195	0.446	0.416	0.440	0.674	1.059	0.759	0.876	0.950	0.908
Frigate Tuna	17.78	17.73	18.11	9.640	6.079	8.251	8.379	8.516	12.77	14.45	13.48	14.14	14.82	23.77	24.40	25.05	23.89	26.39	27.09	27.80	28.54
Skipjack	4.234	5.534	5.895	12.07	14.83	13.98	14.41	14.88	11.95	8.673	8.271	7.994	8.142	15.67	16.08	16.51	9.07	17.39	17.85	18.32	18.81
Eastern Little Tuna	0.915	0.249	0.280	0.427	0.376	0.415	0.432	0.427	0.899	3.349	4.508	4.836	5.434	5.026	5.159	5.296	7.013	5.579	5.727	5.878	6.033
Sailfish	0.101	0.103	0.023	0.028	0.013	0.021	0.024	0.235	0.239	0.232	0.243	0.252	0.103	0.144	0.122	0.098	0.081	0.106	0.100	0.101	0.108
Swordfish	0.371	0.323	0.143	0.254	0.289	0.342	0.347	0.446	0.381	0.377	0.393	0.404	0.281	0.394	0.334	0.269	0.220	0.291	0.274	0.276	0.296
Marlin	0.047	0.056	0.005	0.016	0.013	0.004	0.005	0.046	0.004	0.005	0.005	0.005	0.019	0.027	0.023	0.018	0.015	0.020	0.019	0.019	0.020
Big-eye Tuna	1.541	1.586	1.604	2.088	2.371	2.306	2.373	2.437	2.318	2.352	2.047	2.237	2.960	0.263	0.270	0.278	1.530	0.292	0.300	0.308	0.316
Yellowfin Tuna	8.224	8.459	8.557	11.14	12.65	12.30	12.66	13.00	12.37	12.54	14.16	14.38	13.38	1.191	1.222	1.254	8.158	1.322	1.356	1.392	1.429
Indo-Pacific Mackerel	0.556	0.651	0.722	1.267	0.695	1.839	1.868	1.278	1.293	1.151	1.177	1.180	1.250	1.509	1.927	2.023	1.576	1.948	1.952	1.923	2.049
Indian Mackerel	1.927	2.103	2.679	3.172	3.482	3.000	3.192	5.362	4.120	3.972	4.015	4.184	7.343	6.117	7.738	8.031	5.401	7.471	7.361	7.101	7.721
Japanese Mackerel	0.047	0.112	0.120	0.156	0.266	0.219	0.217	0.089	0.015	0.008	0.009	0.009	0.106	0.148	0.126	0.101	0.083	0.109	0.103	0.104	0.111
Hairtail	0.564	0.565	0.836	1.132	2.071	1.245	1.346	0.396	0.535	0.538	0.557	0.595	0.613	0.417	0.509	0.569	0.442	0.535	0.545	0.534	0.568
Shark	0.280	0.306	0.157	0.538	0.449	0.306	0.312	0.179	0.246	0.264	0.276	0.283	0.259	0.364	0.309	0.248	0.203	0.268	0.253	0.255	0.273
Skates and Rays	0.630	0.577	0.163	0.333	0.291	0.421	0.447	0.257	0.270	0.278	0.290	0.305	0.378	0.530	0.450	0.361	0.296	0.391	0.369	0.371	0.398
Trigger fish	0.023	0.023	0.008	0.041	0.027	0.008	0.008	0.025	0.018	0.022	0.023	0.023	0.017	0.024	0.021	0.017	0.014	0.018	0.017	0.017	0.018
Misc fish	0.085	0.150	0.213	0.521	0.733	0.698	0.768	0.282	0.624	0.481	0.501	0.546	0.282	0.396	0.336	0.270	0.221	0.292	0.275	0.277	0.297
Blue crab	0.791	0.792	8.703	1.698	1.506	1.861	1.922	1.522	1.952	1.836	1.708	1.766	2.117	1.921	2.134	2.127	1.241	1.944	1.871	1.773	1.968
Mangrove or Mud crab	0.054	0.042	0.061	0.027	0.066	0.095	0.103	0.054	0.051	0.089	0.095	0.102	0.059	0.083	0.070	0.056	0.046	0.061	0.057	0.058	0.062
Spiny lobster	0.038	0.040	0.066	0.172	0.110	0.108	0.107	0.012	0.008	0.010	0.010	0.012	0.062	0.087	0.073	0.059	0.048	0.064	0.060	0.061	0.065
Shovel nosed or Slipper Lobster	0.001	0.003	0.009	0.064	0.051	0.060	0.062	0.002	0.023	0.032	0.033	0.037	0.019	0.026	0.022	0.018	0.015	0.020	0.018	0.019	0.020
White shrimps	0.441	0.522	4.671	0.590	0.445	0.470	0.467	1.097	0.745	0.738	0.767	0.776	0.874	1.227	1.040	0.836	0.686	0.905	0.853	0.858	0.921
Tiger prawn	0.131	0.116	0.033	0.105	0.063	0.055	0.057	0.053	0.047	0.046	0.048	0.051	0.068	0.095	0.081	0.065	0.053	0.070	0.066	0.067	0.072
Endeavor prawn	0.182	0.149	0.236	0.287	0.200	0.264	0.260	0.390	0.416	0.404	0.418	0.432	0.228	0.321	0.272	0.219	0.179	0.237	0.223	0.224	0.241
Acetes	2.148	2.005	0.255	0.326	0.295	0.189	0.183	0.055	0.081	0.048	0.050	0.054	0.327	0.197	0.302	0.224	0.217	0.262	0.247	0.255	0.269
Shrimp	0.124	0.138	0.072	0.197	0.187	0.463	0.520	0.430	0.321	0.326	0.341	0.382	0.147	0.207	0.175	0.141	0.115	0.152	0.144	0.144	0.155
Sea Mantis	0.025	0.021	0.020	0.075	0.040	0.043	0.039	0.100	0.117	0.105	0.089	0.090	0.044	0.061	0.052	0.042	0.034	0.045	0.043	0.043	0.046
Oyster	1.149	0.965	0.002	0.001	0.002	0.007	0.007	0.004	0.002	0.002	0.002	0.002	0.200	0.280	0.238	0.191	0.157	0.207	0.195	0.196	0.210
Capiz shells	0.024	0.032	0.033	0.036	0.018	0.015	0.016	0.004	0.002	0.003	0.003	0.003	0.394	0.553	0.469	0.377	0.309	0.408	0.385	0.387	0.415
Green mussel	0.491	0.330	0.004	0.003	0.001	0.000	0.000	0.004	0.001	0.001	0.001	0.001	0.123	0.173	0.147	0.118	0.097	0.128	0.120	0.121	0.130
Scallop	0.094	0.072	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.047	0.040	0.032	0.026	0.035	0.033	0.033	0.035
Giant clam	0.002	0.000	0.003	0.005	0.008	0.011	0.014	0.017	0.021	0.024	0.028	0.032	0.036	0.051	0.043	0.035	0.029	0.038	0.035	0.036	0.038
Cockles	0.059	0.054	0.266	0.152	0.006	0.005	0.004	0.003	0.002	0.001	0.000	0.000	0.049	0.069	0.059	0.047	0.039	0.051	0.048	0.048	0.052
Squid	0.849	0.925	1.113	1.096	1.248	1.103	1.165	2.399	1.663	1.972	1.970	2.024	1.988	1.982	2.421	2.460	1.639	2.302	2.254	2.174	2.369
Cuttlefish	0.147	0.130	0.176	0.310	0.198	0.277	0.299	0.119	0.044	0.032	0.034	0.037	0.139	0.196	0.166	0.133	0.109	0.144	0.136	0.137	0.147
Octopus	0.149	0.146	0.190	0.698	0.968	1.424	1.442	1.559	0.886	0.996	1.042	1.171	0.528	0.742	0.629	0.506	0.415	0.547	0.516	0.519	0.557
Misc shells	0.090	0.095	0.075	0.143	0.491	0.088	0.092	0.063	0.028	0.025	0.028	0.031	0.088	0.124	0.105	0.085	0.069	0.091	0.086	0.087	0.093
Sea cucumber	0.095	0.101	0.093	0.096	0.123	0.167	0.169	0.098	0.050	0.058	0.051	0.050	0.076	0.107	0.090	0.073	0.060	0.079	0.074	0.075	0.080
Jellyfish	0.003	0.002	0.001	0.000	0.009	0.018	0.018	0.007	0.004	0.004	0.004	0.004	0.029	0.041	0.035	0.028	0.023	0.030	0.029	0.029	0.031
Misc. marine orgs.	0.074	0.070	0.057	0.117	0.232	0.108	0.161	0.007	0.003	0.003	0.004	0.005	0.124	0.174	0.148	0.119	0.097	0.128	0.121	0.122	0.131
Artisanal Zone C																					
Milkfish	0.027	0.031	0.025	0.050	0.037	0.324	0.318	0.003	0.003	0.004	0.003	0.003	0.069	0.067	0.070	0.063	0.069	0.069	0.069	0.071	0.071
Gizzard shad	0.014	0.037	0.002	0.010	0.007	0.008	0.008	0.042	0.042	0.040	0.044	0.042	0.029	0.028	0.029	0.026	0.028	0.029	0.028	0.029	0.029
Flatfish	0.126	0.107	0.112	0.079	0.085	0.044	0.043	0.011	0.012	0.013	0.012	0.013	0.119	0.115	0.121	0.108	0.118	0.119	0.118	0.121	0.122

Artisanal Zone C	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Sea catfish	0.043	0.044	0.044	0.045	0.045	0.046	0.047	0.047	0.048	0.049	0.049	0.050	0.050	0.051	0.052	0.053	0.053	0.054	0.055	0.055
Lizard fish	0.046	0.047	0.047	0.048	0.049	0.049	0.050	0.051	0.051	0.052	0.053	0.054	0.054	0.055	0.056	0.057	0.057	0.058	0.059	0.060
Moray eel	0.017	0.017	0.017	0.017	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.020	0.020	0.020	0.020	0.021	0.021	0.021	0.022
Grouper	0.209	0.211	0.214	0.217	0.220	0.223	0.226	0.229	0.232	0.236	0.239	0.242	0.245	0.248	0.252	0.255	0.259	0.262	0.266	0.269
Sea bass	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Fusilier	0.128	0.130	0.131	0.133	0.135	0.137	0.139	0.141	0.143	0.144	0.146	0.148	0.150	0.152	0.154	0.157	0.159	0.161	0.163	0.165
Snapper	0.208	0.211	0.214	0.217	0.220	0.223	0.226	0.229	0.232	0.235	0.238	0.241	0.244	0.248	0.251	0.254	0.258	0.261	0.265	0.268
Threadfin bream	0.615	0.624	0.632	0.641	0.649	0.658	0.667	0.676	0.685	0.694	0.704	0.713	0.723	0.733	0.742	0.753	0.763	0.773	0.783	0.794
Siganid	0.168	0.170	0.173	0.175	0.177	0.180	0.182	0.185	0.187	0.190	0.192	0.195	0.198	0.200	0.203	0.206	0.208	0.211	0.214	0.217
Sillago/Whiting	0.285	0.289	0.292	0.296	0.300	0.305	0.309	0.313	0.317	0.321	0.326	0.330	0.335	0.339	0.344	0.348	0.353	0.358	0.362	0.367
Perchlet/Glassfish	0.016	0.016	0.016	0.016	0.017	0.017	0.017	0.017	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.019	0.020	0.020	0.020	0.020
Surgeon fish	0.025	0.025	0.025	0.026	0.026	0.026	0.027	0.027	0.028	0.028	0.028	0.029	0.029	0.029	0.030	0.030	0.031	0.031	0.031	0.032
Parrot fish/Wrasse	0.082	0.083	0.084	0.085	0.086	0.088	0.089	0.090	0.091	0.092	0.094	0.095	0.096	0.097	0.099	0.100	0.101	0.103	0.104	0.106
Hairtail	0.882	0.894	0.906	0.918	0.931	0.944	0.956	0.969	0.982	0.996	1.009	1.023	1.036	1.050	1.065	1.079	1.093	1.108	1.123	1.138
Mojarra	0.107	0.108	0.109	0.111	0.112	0.114	0.115	0.117	0.119	0.120	0.122	0.123	0.125	0.127	0.129	0.130	0.132	0.134	0.136	0.137
Goatfish	0.228	0.231	0.234	0.238	0.241	0.244	0.247	0.251	0.254	0.258	0.261	0.265	0.268	0.272	0.275	0.279	0.283	0.287	0.291	0.294
Goby	0.038	0.039	0.039	0.040	0.040	0.041	0.041	0.042	0.042	0.043	0.044	0.044	0.045	0.045	0.046	0.047	0.047	0.048	0.049	0.049
Moonfish	0.074	0.075	0.076	0.077	0.078	0.079	0.080	0.081	0.082	0.083	0.084	0.085	0.086	0.088	0.089	0.090	0.091	0.092	0.094	0.095
Spade fish	0.041	0.041	0.042	0.042	0.043	0.044	0.044	0.045	0.045	0.046	0.047	0.047	0.048	0.048	0.049	0.050	0.050	0.051	0.052	0.052
Flathead	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.010
Rudder fish	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Croaker	0.151	0.153	0.155	0.157	0.160	0.162	0.164	0.166	0.168	0.171	0.173	0.175	0.178	0.180	0.182	0.185	0.187	0.190	0.193	0.195
Porgy	0.114	0.116	0.117	0.119	0.120	0.122	0.124	0.125	0.127	0.129	0.131	0.132	0.134	0.136	0.138	0.140	0.141	0.143	0.145	0.147
Therapon/Grunt	0.211	0.214	0.216	0.219	0.222	0.225	0.228	0.231	0.235	0.238	0.241	0.244	0.248	0.251	0.254	0.258	0.261	0.265	0.268	0.272
Red bulls eye	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Hardtail	0.046	0.046	0.047	0.047	0.048	0.049	0.049	0.050	0.051	0.051	0.052	0.053	0.054	0.054	0.055	0.056	0.057	0.057	0.058	0.059
Big-eyed Scad	0.278	0.282	0.286	0.289	0.293	0.297	0.301	0.305	0.310	0.314	0.318	0.322	0.327	0.331	0.335	0.340	0.345	0.349	0.354	0.359
Round scad	0.539	0.547	0.554	0.562	0.569	0.577	0.585	0.593	0.601	0.609	0.617	0.625	0.634	0.642	0.651	0.660	0.669	0.678	0.687	0.696
Rainbow runner	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011
Leather jacket	0.020	0.020	0.020	0.021	0.021	0.021	0.021	0.022	0.022	0.022	0.023	0.023	0.023	0.024	0.024	0.024	0.025	0.025	0.025	0.026
Crevalle	0.183	0.185	0.188	0.190	0.193	0.196	0.198	0.201	0.204	0.206	0.209	0.212	0.215	0.218	0.221	0.224	0.227	0.230	0.233	0.236
Mullet	0.239	0.242	0.245	0.249	0.252	0.255	0.259	0.262	0.266	0.270	0.273	0.277	0.281	0.284	0.288	0.292	0.296	0.300	0.304	0.308
Threadfin	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.009
Dolphin fish	0.023	0.023	0.024	0.024	0.024	0.025	0.025	0.025	0.026	0.026	0.026	0.027	0.027	0.027	0.028	0.028	0.028	0.029	0.029	0.030
Silverside	0.047	0.048	0.049	0.049	0.050	0.051	0.051	0.052	0.053	0.054	0.054	0.055	0.056	0.057	0.057	0.058	0.059	0.060	0.060	0.061
Garfish	0.106	0.107	0.109	0.110	0.112	0.113	0.115	0.116	0.118	0.120	0.121	0.123	0.125	0.126	0.128	0.130	0.131	0.133	0.135	0.137
Halfbeak	0.109	0.111	0.112	0.114	0.115	0.117	0.118	0.120	0.122	0.123	0.125	0.127	0.128	0.130	0.132	0.134	0.135	0.137	0.139	0.141
Barracuda	0.121	0.123	0.125	0.126	0.128	0.130	0.132	0.133	0.135	0.137	0.139	0.141	0.143	0.144	0.146	0.148	0.150	0.152	0.154	0.157
Sergeant fish	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.010
Pomfret	0.096	0.097	0.099	0.100	0.101	0.103	0.104	0.106	0.107	0.108	0.110	0.111	0.113	0.114	0.116	0.117	0.119	0.121	0.122	0.124
Flying fish	1.084	1.099	1.114	1.129	1.144	1.160	1.176	1.191	1.208	1.224	1.240	1.257	1.274	1.291	1.309	1.326	1.344	1.362	1.380	1.400
Smooth scad	0.060	0.060	0.061	0.062	0.063	0.064	0.065	0.065	0.066	0.067	0.068	0.069	0.070	0.071	0.072	0.073	0.074	0.075	0.076	0.077
Big-eye	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.012
Cavalla	0.107	0.108	0.110	0.111	0.113	0.114	0.116	0.117	0.119	0.120	0.122	0.124	0.125	0.127	0.129	0.131	0.132	0.134	0.136	0.138
Tarpon	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
Wolf herring	0.062	0.063	0.064	0.065	0.066	0.067	0.067	0.068	0.069	0.070	0.071	0.072	0.073	0.074	0.075	0.076	0.077	0.078	0.079	0.080
Round Herring	0.355	0.360	0.364	0.369	0.374	0.379	0.385	0.390	0.395	0.400	0.406	0.411	0.417	0.422	0.428	0.434	0.440	0.446	0.452	0.458

Artisanal Zone C	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Sea catfish	0.056	0.057	0.058	0.058	0.060	0.060	0.061	0.063	0.061	0.063	0.071	0.053	0.069	0.097	0.126	0.122	0.117	0.111	0.106	0.152
Lizard fish	0.060	0.061	0.062	0.063	0.064	0.064	0.066	0.068	0.063	0.071	0.076	0.047	0.096	0.092	0.088	0.113	0.140	0.167	0.194	0.244
Moray eel	0.022	0.022	0.022	0.023	0.023	0.023	0.024	0.024	0.024	0.025	0.025	0.025	0.026	0.026	0.025	0.038	0.052	0.066	0.081	0.091
Grouper	0.273	0.277	0.280	0.284	0.288	0.292	0.295	0.301	0.303	0.304	0.321	0.306	0.309	0.375	0.442	0.463	0.486	0.506	0.529	0.698
Sea bass	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.005	0.005	0.003	0.006	0.007	0.007	0.006	0.005	0.004	0.003	0.007
Fusilier	0.167	0.170	0.172	0.174	0.176	0.180	0.182	0.181	0.191	0.187	0.179	0.222	0.176	0.153	0.130	0.122	0.115	0.106	0.098	0.144
Snapper	0.272	0.276	0.279	0.283	0.287	0.291	0.295	0.298	0.304	0.306	0.308	0.323	0.310	0.316	0.322	0.349	0.376	0.403	0.432	0.492
Threadfin bream	0.804	0.816	0.826	0.836	0.853	0.855	0.868	0.906	0.860	0.907	1.027	0.712	1.055	1.407	1.768	1.815	1.867	1.912	1.963	2.079
Siganid	0.220	0.223	0.226	0.229	0.232	0.234	0.239	0.243	0.240	0.252	0.257	0.229	0.291	0.273	0.255	0.247	0.239	0.229	0.220	0.280
Sillago/Whiting	0.372	0.377	0.382	0.387	0.393	0.398	0.402	0.411	0.412	0.417	0.438	0.414	0.433	0.504	0.576	0.650	0.728	0.804	0.885	1.144
Perchlet/Glassfish	0.021	0.021	0.021	0.021	0.022	0.022	0.022	0.025	0.020	0.022	0.035	0.005	0.028	0.077	0.128	0.112	0.097	0.080	0.063	0.165
Surgeon fish	0.032	0.033	0.033	0.034	0.034	0.035	0.035	0.035	0.038	0.035	0.035	0.046	0.027	0.034	0.041	0.056	0.071	0.086	0.102	0.128
Parrot fish/Wrasse	0.107	0.109	0.110	0.111	0.113	0.114	0.116	0.120	0.114	0.125	0.130	0.095	0.159	0.148	0.137	0.137	0.138	0.138	0.138	0.210
Hairtail	1.153	1.169	1.185	1.199	1.218	1.234	1.244	1.276	1.281	1.274	1.377	1.295	1.252	1.701	2.161	2.190	2.225	2.249	2.281	2.230
Mojarra	0.139	0.141	0.143	0.145	0.148	0.147	0.151	0.158	0.143	0.166	0.178	0.094	0.240	0.217	0.193	0.249	0.307	0.366	0.426	0.444
Goatfish	0.298	0.303	0.306	0.309	0.318	0.317	0.317	0.346	0.315	0.315	0.436	0.218	0.314	0.820	1.339	1.185	1.030	0.864	0.698	0.753
Goby	0.050	0.051	0.051	0.052	0.053	0.053	0.054	0.057	0.052	0.056	0.069	0.035	0.067	0.112	0.159	0.134	0.109	0.082	0.055	0.113
Moonfish	0.096	0.098	0.099	0.100	0.102	0.102	0.104	0.109	0.101	0.111	0.123	0.078	0.139	0.163	0.187	0.157	0.128	0.096	0.065	0.078
Spade fish	0.053	0.054	0.055	0.055	0.057	0.056	0.058	0.060	0.055	0.064	0.067	0.038	0.092	0.076	0.059	0.057	0.055	0.052	0.049	0.058
Flathead	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.010	0.014	0.009	0.008	0.026	0.044	0.034	0.024	0.014	0.004	0.007
Rudder fish	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.003	0.002	0.003	0.003	0.001	0.004	0.006	0.006	0.005	0.005	0.005	0.009
Croaker	0.198	0.201	0.203	0.205	0.211	0.210	0.211	0.229	0.206	0.216	0.284	0.133	0.249	0.498	0.754	0.708	0.662	0.612	0.562	0.677
Porgy	0.149	0.151	0.153	0.155	0.157	0.160	0.162	0.162	0.169	0.169	0.161	0.191	0.168	0.136	0.102	0.123	0.145	0.167	0.190	0.304
Therapon/Grunt	0.275	0.280	0.282	0.287	0.292	0.291	0.300	0.310	0.287	0.327	0.341	0.216	0.453	0.384	0.313	0.378	0.445	0.512	0.582	0.679
Red bulls eye	0.006	0.006	0.006	0.006	0.007	0.006	0.007	0.007	0.006	0.007	0.009	0.001	0.013	0.015	0.017	0.054	0.091	0.129	0.168	0.241
Hardtail	0.060	0.060	0.061	0.062	0.063	0.064	0.064	0.065	0.066	0.067	0.069	0.070	0.067	0.075	0.082	0.091	0.101	0.110	0.120	0.111
Big-eyed Scad	0.363	0.368	0.373	0.378	0.383	0.388	0.395	0.399	0.401	0.417	0.411	0.408	0.465	0.395	0.322	0.395	0.471	0.547	0.627	0.594
Round scad	0.706	0.714	0.726	0.734	0.740	0.763	0.758	0.757	0.837	0.742	0.752	1.087	0.442	0.784	1.135	0.998	0.860	0.714	0.566	0.423
Rainbow runner	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.013	0.010	0.012	0.017	0.002	0.017	0.034	0.052	0.041	0.030	0.018	0.006	0.004
Leather jacket	0.026	0.026	0.027	0.027	0.027	0.028	0.028	0.029	0.028	0.029	0.034	0.023	0.031	0.050	0.070	0.064	0.058	0.052	0.046	0.044
Crevalle	0.239	0.243	0.245	0.248	0.254	0.254	0.258	0.270	0.255	0.269	0.308	0.206	0.316	0.431	0.548	0.669	0.794	0.918	1.048	0.861
Mullet	0.312	0.317	0.321	0.324	0.331	0.332	0.335	0.354	0.333	0.346	0.412	0.266	0.388	0.621	0.860	0.868	0.879	0.885	0.894	0.870
Threadfin	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.008	0.011	0.013	0.002	0.017	0.020	0.023	0.019	0.016	0.013	0.010	0.040
Dolphin fish	0.030	0.030	0.031	0.031	0.031	0.033	0.032	0.031	0.039	0.031	0.024	0.065	0.004	0.005	0.005	0.006	0.008	0.009	0.011	0.013
Silverside	0.062	0.063	0.064	0.064	0.065	0.067	0.066	0.068	0.073	0.063	0.073	0.090	0.030	0.104	0.179	0.174	0.169	0.162	0.157	0.256
Garfish	0.139	0.140	0.143	0.144	0.145	0.149	0.150	0.148	0.163	0.152	0.141	0.209	0.119	0.103	0.087	0.092	0.097	0.103	0.108	0.073
Halfbeak	0.143	0.145	0.147	0.149	0.150	0.153	0.155	0.156	0.159	0.164	0.156	0.171	0.178	0.131	0.083	0.084	0.085	0.085	0.086	0.063
Barracuda	0.159	0.161	0.163	0.165	0.167	0.171	0.172	0.171	0.182	0.176	0.168	0.218	0.156	0.144	0.131	0.143	0.155	0.167	0.180	0.150
Sergeant fish	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.012	0.010	0.012	0.014	0.006	0.019	0.034	0.029	0.024	0.020	0.015	0.015
Pomfret	0.126	0.127	0.129	0.131	0.132	0.134	0.137	0.136	0.141	0.144	0.132	0.159	0.153	0.094	0.033	0.028	0.024	0.019	0.013	0.065
Flying fish	1.419	1.434	1.460	1.479	1.478	1.542	1.536	1.477	1.740	1.515	1.288	2.569	0.802	0.566	0.323	0.360	0.400	0.438	0.479	0.284
Smooth scad	0.078	0.079	0.080	0.081	0.082	0.083	0.085	0.086	0.084	0.092	0.089	0.076	0.119	0.079	0.037	0.047	0.057	0.067	0.078	0.037
Big-eye	0.012	0.012	0.013	0.013	0.013	0.013	0.013	0.013	0.014	0.014	0.014	0.014	0.014	0.015	0.016	0.013	0.016	0.021	0.003	0.026
Cavalla	0.140	0.142	0.143	0.145	0.148	0.148	0.152	0.155	0.150	0.162	0.167	0.134	0.198	0.182	0.165	0.174	0.185	0.194	0.205	0.222
Tarpon	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.010	0.012	0.011	0.009	0.017	0.009	0.001	0.002	0.003	0.005	0.006	0.007
Wolf herring	0.081	0.083	0.084	0.084	0.087	0.086	0.087	0.093	0.085	0.091	0.111	0.061	0.107	0.175	0.245	0.309	0.376	0.443	0.512	0.869
Round Herring		0.470	0.476	0.483	0.490	0.494	0.502	0.515	0.505	0.529	0.554	0.471	0.604	0.633	0.661	0.756	0.856	0.953	1.057	1.065

Artisanal Zone C	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sea catfish	0.147	0.137	0.147	0.699	0.323	0.581	0.577	0.300	0.281	0.289	0.262	0.265	0.344	0.333	0.349	0.313	0.340	0.343	0.341	0.350	0.354
Lizard fish	0.204	0.200	0.060	0.036	0.057	0.088	0.088	0.190	0.197	0.105	0.094	0.094	0.175	0.169	0.177	0.159	0.173	0.174	0.173	0.178	0.180
Moray eel	0.075	0.069	0.136	0.210	0.266	0.283	0.280	0.215	0.338	0.303	0.305	0.299	0.225	0.218	0.228	0.205	0.223	0.224	0.223	0.229	0.232
Grouper	0.656	0.712	0.184	0.199	0.138	0.221	0.224	0.172	0.203	0.201	0.192	0.202	0.300	0.299	0.207	0.271	0.336	0.278	0.303	0.314	0.306
Sea bass	0.006	0.005	0.013	0.042	0.022	0.047	0.048	0.015	0.016	0.018	0.019	0.018	0.022	0.021	0.022	0.020	0.022	0.022	0.022	0.023	0.023
Fusilier	0.113	0.109	0.163	0.114	0.106	0.143	0.148	0.106	0.110	0.108	0.107	0.110	0.342	0.354	0.351	0.285	0.265	0.309	0.293	0.296	0.307
Snapper	0.446	0.464	0.203	0.362	0.359	0.438	0.459	0.679	0.687	0.737	0.753	0.731	0.690	0.668	0.675	0.423	0.462	0.535	0.485	0.507	0.522
Threadfin bream	1.964	2.158	1.052	1.500	1.243	1.148	1.132	1.608	1.507	1.594	1.610	1.655	1.862	1.797	1.852	1.645	1.644	1.760	1.727	1.755	1.794
Siganid	0.224	0.229	0.288	0.306	0.469	0.485	0.492	0.453	0.461	0.463	0.487	0.484	0.384	0.519	0.530	2.967	0.820	1.476	1.808	1.400	1.603
Sillago/Whiting	1.115	1.185	0.508	0.512	0.699	0.533	0.525	0.765	0.907	0.927	0.824	0.839	1.046	1.011	1.061	0.952	1.034	1.043	1.036	1.065	1.075
Perchlet/Glassfish	0.135	0.104	0.366	0.361	0.182	0.201	0.203	0.170	0.105	0.078	0.071	0.071	0.197	0.190	0.199	0.179	0.194	0.196	0.195	0.200	0.202
Surgeon fish	0.097	0.085	0.069	0.028	0.031	0.067	0.068	0.071	0.069	0.069	0.072	0.070	0.095	0.092	0.097	0.087	0.094	0.095	0.094	0.097	0.098
Parrot fish/Wrasse	0.148	0.129	0.249	0.282	0.221	0.280	0.288	0.410	0.398	0.259	0.264	0.261	0.294	0.334	0.282	0.293	0.303	0.300	0.307	0.311	0.314
Hairtail	2.023	2.292	1.312	1.526	2.087	1.981	1.948	1.578	2.183	2.363	2.450	2.489	1.738	1.859	2.001	1.532	1.631	1.769	1.687	1.741	1.778
Mojarra	0.417	0.399	0.166	0.225	0.289	0.293	0.291	0.192	0.275	0.276	0.249	0.254	0.390	0.377	0.396	0.355	0.386	0.389	0.386	0.397	0.401
Goatfish	0.665	0.708	0.327	0.530	0.451	0.467	0.470	0.392	0.321	0.351	0.390	0.393	0.287	0.307	0.284	0.358	0.478	0.382	0.417	0.437	0.423
Goby	0.103	0.079	0.286	0.275	0.749	0.866	0.846	0.522	0.425	0.506	0.506	0.496	0.450	0.435	0.457	0.410	0.445	0.449	0.446	0.459	0.463
Moonfish	0.058	0.053	0.040	0.081	0.022	0.014	0.014	0.117	0.015	0.035	0.033	0.033	0.086	0.083	0.087	0.078	0.085	0.086	0.085	0.088	0.089
Spade fish	0.045	0.038	0.024	0.064	0.099	0.183	0.184	0.046	0.053	0.072	0.071	0.070	0.097	0.093	0.098	0.088	0.095	0.096	0.096	0.098	0.099
Flathead	0.006	0.021	0.019	0.030	0.088	0.036	0.036	0.014	0.016	0.016	0.015	0.016	0.029	0.028	0.030	0.027	0.029	0.029	0.029	0.030	0.030
Rudder fish	0.006	0.005	0.006	0.003	0.007	0.028	0.028	0.035	0.041	0.044	0.039	0.040	0.022	0.021	0.022	0.020	0.022	0.022	0.022	0.022	0.023
Croaker	0.679	0.799	0.274	0.245	0.433	0.283	0.276	0.080	0.070	0.069	0.061	0.062	0.498	0.482	0.505	0.453	0.493	0.497	0.493	0.507	0.512
Porgy	0.273	0.280	0.117	0.344	0.093	0.092	0.091	0.221	0.150	0.180	0.168	0.170	0.191	0.254	0.221	0.278	0.269	0.262	0.277	0.276	0.279
Therapon/Grunt	0.652	0.684	0.273	0.433	0.398	0.535	0.536	0.183	0.145	0.190	0.194	0.189	0.562	0.544	0.570	0.512	0.556	0.561	0.557	0.573	0.578
Red bulls eye	0.199	0.134	0.055	0.012	0.020	0.044	0.045	0.019	0.019	0.019	0.019	0.021	0.100	0.097	0.102	0.091	0.099	0.100	0.099	0.102	0.103
Hardtail	0.126	0.134	0.086	0.184	0.092	0.231	0.227	0.603	0.517	0.505	0.529	0.509	0.307	0.296	0.311	0.279	0.303	0.306	0.304	0.312	0.315
Big-eyed Scad	0.635	0.519	0.368	0.345	1.015	0.527	0.550	1.060	0.541	0.654	0.684	0.671	0.622	0.761	0.766	0.838	1.101	0.924	0.980	1.029	1.003
Round scad	0.485	0.534	0.469	0.598	0.378	0.413	0.421	0.327	0.715	0.706	0.766	0.824	1.378	1.673	1.755	2.258	2.767	2.316	2.511	2.600	2.540
Rainbow runner	0.005	0.006	0.012	0.047	0.026	0.024	0.026	0.005	0.004	0.004	0.004	0.004	0.019	0.019	0.020	0.018	0.019	0.019	0.019	0.020	0.020
Leather jacket	0.051	0.053	0.161	0.115	0.151	0.135	0.136	0.049	0.049	0.067	0.061	0.061	0.101	0.098	0.103	0.092	0.100	0.101	0.100	0.103	0.104
Crevalle	0.893	0.878	0.189	0.443	0.879	0.319	0.315	0.541	0.422	0.406	0.379	0.392	1.517	1.124	1.075	0.654	0.730	0.843	0.761	0.798	0.822
Mullet	0.914	0.969	0.400	0.709	1.004	0.763	0.752	0.843	0.871	0.840	0.760	0.781	0.702	0.853	0.849	0.843	0.906	0.889	0.902	0.923	0.928
Threadfin	0.041	0.036	0.049	0.094	0.181	0.323	0.315	0.279	0.262	0.274	0.243	0.247	0.177	0.171	0.179	0.161	0.175	0.176	0.175	0.180	0.182
Dolphin fish	0.015	0.012	0.009	0.005	0.012	0.008	0.008	0.000	0.003	0.004	0.003	0.003	0.014	0.014	0.014	0.013	0.014	0.014	0.014	0.015	0.015
Silverside	0.268	0.346	0.117	0.023	0.027	0.033	0.034	0.029	0.031	0.031	0.034	0.032	0.155	0.150	0.157	0.141	0.153	0.155	0.154	0.158	0.160
Garfish	0.097	0.090	0.191	0.386	0.282	0.251	0.262	0.203	0.212	0.244	0.241	0.240	0.248	0.240	0.252	0.226	0.246	0.248	0.246	0.253	0.255
Halfbeak	0.085	0.079	0.153	0.134	0.098	0.110	0.112	0.145	0.148	0.154	0.151	0.162	0.161	0.156	0.163	0.146	0.159	0.160	0.159	0.164	0.165
Barracuda	0.170	0.189	0.156	0.298	0.198	0.193	0.198	0.128	0.199	0.178	0.166	0.170	0.242	0.234	0.246	0.220	0.239	0.241	0.240	0.246	0.249
Sergeant fish	0.021	0.016	0.019	0.013	0.013	0.010	0.010	0.005	0.004	0.004	0.005	0.005	0.017	0.017	0.017	0.016	0.017	0.017	0.017	0.018	0.018
Pomfret	0.069	0.064	0.096	0.079	0.055	0.038	0.038	0.047	0.035	0.035	0.033	0.035	0.084	0.082	0.086	0.077	0.083	0.084	0.084	0.086	0.087
Flying fish	0.348	0.343	1.173	0.745	0.929	0.890	0.919	0.774	0.830	0.787	0.836	0.812	1.351	1.021	0.629	0.561	0.583	0.607	0.599	0.612	0.622
Smooth scad	0.050	0.049	0.115	0.571	0.405	0.705	0.757	0.844	0.832	0.802	0.650	0.625	0.476	0.461	0.483	0.434	0.471	0.475	0.472	0.485	0.490
Big-eye	0.035	0.045	0.006	0.018	0.018	0.020	0.021	0.014	0.011	0.014	0.015	0.014	0.022	0.021	0.022	0.020	0.021	0.022	0.022	0.022	0.022
Cavalla	0.239	0.247	0.146	0.414	0.595	0.568	0.559	0.130	0.149	0.143	0.135	0.144	0.259	0.303	0.278	0.304	0.480	0.362	0.392	0.423	0.403
Tarpon	0.008	0.007	0.002	0.003	0.009	0.121	0.121	0.033	0.054	0.077	0.070	0.075	0.044	0.043	0.045	0.040	0.044	0.044	0.044	0.045	0.045
Wolf herring	0.895	0.717	0.030	0.007	0.001	0.003	0.004	0.018	0.020	0.020	0.018	0.018	0.350	0.338	0.355	0.318	0.346	0.349	0.346	0.356	0.360
Round Herring	1.108	0.932	0.924	0.076	0.138	0.056	0.058	0.219	0.529	0.469	0.420	0.422	0.068	0.095	0.104	0.103	0.121	0.112	0.115	0.119	0.119

Artisanal Zone C	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Fimbriated Sardine	1.120	1.136	1.151	1.167	1.182	1.198	1.215	1.231	1.248	1.265	1.282	1.299	1.316	1.334	1.352	1.370	1.389	1.408	1.426	1.446
Indian Sardine	0.751	0.761	0.772	0.782	0.793	0.804	0.814	0.825	0.837	0.848	0.859	0.871	0.883	0.895	0.907	0.919	0.931	0.944	0.956	0.969
Anchovy	1.048	1.063	1.077	1.092	1.106	1.121	1.137	1.152	1.168	1.183	1.199	1.215	1.232	1.248	1.265	1.282	1.300	1.317	1.335	1.353
Sardine	5.197	5.268	5.339	5.411	5.485	5.559	5.634	5.710	5.788	5.866	5.945	6.025	6.107	6.189	6.272	6.357	6.442	6.529	6.617	6.705
Spanish Mackerel	0.293	0.297	0.301	0.305	0.309	0.314	0.318	0.322	0.326	0.331	0.335	0.340	0.344	0.349	0.354	0.359	0.363	0.368	0.373	0.378
Frigate Tuna	4.319	4.381	4.444	4.507	4.571	4.637	4.703	4.770	4.838	4.907	4.977	5.048	5.120	5.192	5.266	5.341	5.417	5.494	5.571	5.651
Skipjack	2.853	2.894	2.935	2.977	3.020	3.063	3.107	3.151	3.196	3.242	3.288	3.335	3.382	3.430	3.479	3.528	3.579	3.630	3.680	3.734
Eastern Little Tuna	4.387	4.449	4.513	4.577	4.643	4.709	4.776	4.845	4.914	4.984	5.055	5.127	5.200	5.274	5.348	5.425	5.501	5.579	5.660	5.738
Big-eye Tuna	0.297	0.301	0.305	0.310	0.314	0.319	0.323	0.328	0.332	0.337	0.342	0.347	0.352	0.357	0.362	0.367	0.372	0.377	0.383	0.388
Yellowfin Tuna	1.487	1.508	1.530	1.552	1.574	1.596	1.619	1.642	1.666	1.689	1.713	1.738	1.762	1.788	1.813	1.839	1.865	1.891	1.918	1.946
Indo-Pacific Mackerel	0.449	0.455	0.461	0.468	0.474	0.480	0.487	0.493	0.500	0.507	0.514	0.521	0.528	0.535	0.542	0.549	0.557	0.564	0.572	0.579
Indian Mackerel	0.087	0.088	0.089	0.091	0.092	0.093	0.094	0.096	0.097	0.098	0.099	0.101	0.102	0.104	0.105	0.106	0.108	0.109	0.111	0.112
Japanese Mackerel	0.049	0.049	0.050	0.051	0.051	0.052	0.053	0.053	0.054	0.055	0.056	0.056	0.057	0.058	0.059	0.059	0.060	0.061	0.062	0.063
Hairtail	0.042	0.043	0.044	0.044	0.045	0.045	0.046	0.047	0.047	0.048	0.049	0.049	0.050	0.051	0.051	0.052	0.053	0.053	0.054	0.055
Shark	0.094	0.095	0.097	0.098	0.099	0.101	0.102	0.103	0.105	0.106	0.108	0.109	0.110	0.112	0.113	0.115	0.117	0.118	0.120	0.121
Skates and Rays	0.104	0.106	0.107	0.108	0.110	0.111	0.113	0.114	0.116	0.118	0.119	0.121	0.122	0.124	0.126	0.127	0.129	0.131	0.133	0.134
Misc fish	0.033	0.033	0.034	0.034	0.034	0.035	0.035	0.036	0.036	0.037	0.037	0.038	0.038	0.039	0.039	0.040	0.040	0.041	0.042	0.042
Blue crab	0.374	0.379	0.384	0.389	0.395	0.400	0.405	0.411	0.416	0.422	0.428	0.433	0.439	0.445	0.451	0.457	0.463	0.470	0.476	0.482
White shrimps	0.417	0.422	0.428	0.434	0.440	0.446	0.452	0.458	0.464	0.470	0.476	0.483	0.489	0.496	0.503	0.509	0.516	0.523	0.530	0.537
Endeavor prawn	0.017	0.017	0.018	0.018	0.018	0.018	0.018	0.019	0.019	0.019	0.020	0.020	0.020	0.020	0.021	0.021	0.021	0.021	0.022	0.022
Acetes	0.253	0.257	0.260	0.264	0.267	0.271	0.274	0.278	0.282	0.286	0.290	0.293	0.297	0.301	0.306	0.310	0.314	0.318	0.322	0.326
Squid	0.406	0.412	0.417	0.423	0.429	0.435	0.441	0.446	0.453	0.459	0.465	0.471	0.477	0.484	0.490	0.497	0.504	0.511	0.517	0.524
Misc shells	0.131	0.133	0.135	0.137	0.138	0.140	0.142	0.144	0.146	0.148	0.150	0.152	0.154	0.156	0.158	0.160	0.163	0.165	0.167	0.169
Misc crustaceans	0.050	0.050	0.051	0.052	0.052	0.053	0.054	0.054	0.055	0.056	0.057	0.057	0.058	0.059	0.060	0.061	0.061	0.062	0.063	0.064
Swordfish, sailfish, marlin	0.044	0.045	0.045	0.046	0.047	0.047	0.048	0.049	0.049	0.050	0.051	0.051	0.052	0.053	0.053	0.054	0.055	0.056	0.056	0.057
Misc. marine orgs.	0.085	0.086	0.087	0.089	0.090	0.091	0.092	0.094	0.095	0.096	0.097	0.099	0.100	0.101	0.103	0.104	0.106	0.107	0.108	0.110
Artisanal Zone D																				
Sea catfish	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.038	0.039	0.040	0.041	0.043	0.044	0.046	0.047	0.049
Lizard fish	0.033	0.034	0.035	0.037	0.038	0.039	0.040	0.042	0.043	0.045	0.046	0.048	0.049	0.051	0.053	0.054	0.056	0.058	0.060	0.062
Moray eel	0.021	0.021	0.022	0.023	0.024	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038
Grouper	0.491	0.507	0.524	0.542	0.560	0.579	0.598	0.618	0.639	0.660	0.682	0.705	0.728	0.753	0.778	0.804	0.831	0.858	0.887	0.917
Fusilier	0.186	0.193	0.199	0.206	0.213	0.220	0.227	0.235	0.243	0.251	0.259	0.268	0.277	0.286	0.295	0.305	0.315	0.326	0.337	0.348
Snapper	0.477	0.493	0.510	0.527	0.544	0.563	0.581	0.601	0.621	0.642	0.663	0.685	0.708	0.732	0.756	0.781	0.807	0.834	0.862	0.891
Threadfin bream	0.341	0.353	0.364	0.377	0.389	0.402	0.416	0.430	0.444	0.459	0.474	0.490	0.506	0.523	0.541	0.559	0.577	0.597	0.616	0.637
Siganid	0.457	0.472	0.488	0.505	0.521	0.539	0.557	0.575	0.595	0.615	0.635	0.656	0.678	0.701	0.724	0.749	0.773	0.799	0.826	0.853
Sillago/Whiting	0.017	0.017	0.018	0.018	0.019	0.020	0.020	0.021	0.022	0.022	0.023	0.024	0.025	0.025	0.026	0.027	0.028	0.029	0.030	0.031
Perchlet/Glassfish	0.017	0.017	0.018	0.018	0.019	0.020	0.020	0.021	0.022	0.022	0.023	0.024	0.025	0.025	0.026	0.027	0.028	0.029	0.030	0.031
Surgeon fish	0.122	0.126	0.130	0.134	0.139	0.144	0.148	0.153	0.158	0.164	0.169	0.175	0.181	0.187	0.193	0.199	0.206	0.213	0.220	0.227
Parrot fish/Wrasse	0.212	0.219	0.226	0.234	0.241	0.249	0.258	0.266	0.275	0.285	0.294	0.304	0.314	0.324	0.335	0.347	0.358	0.370	0.382	0.395
Slipmouth	0.334	0.345	0.357	0.369	0.381	0.394	0.407	0.421	0.435	0.449	0.464	0.480	0.496	0.512	0.530	0.547	0.565	0.584	0.604	0.624
Mojarra	0.203	0.210	0.217	0.225	0.232	0.240	0.248	0.256	0.265	0.274	0.283	0.292	0.302	0.312	0.322	0.333	0.344	0.356	0.368	0.380
Goatfish	0.233	0.241	0.249	0.257	0.266	0.274	0.284	0.293	0.303	0.313	0.324	0.334	0.345	0.357	0.369	0.381	0.394	0.407	0.421	0.435
Goby	0.020	0.021	0.022	0.023	0.023	0.024	0.025	0.026	0.027	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.035	0.036	0.037	0.038
Moonfish	0.101	0.104	0.107	0.111	0.115	0.119	0.123	0.127	0.131	0.135	0.140	0.144	0.149	0.154	0.159	0.165	0.170	0.176	0.182	0.188
Spade fish	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.039	0.040	0.041	0.043	0.044	0.046	0.047	0.049	0.050	0.052

Artisanal Zone C	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Fimbriated Sardine	1.465	1.485	1.505	1.525	1.545	1.566	1.587	1.608	1.629	1.652	1.674	1.693	1.722	1.743	1.768	1.793	1.809	1.844	1.871	1.855
Indian Sardine	0.982	0.996	1.009	1.022	1.036	1.050	1.064	1.078	1.092	1.108	1.122	1.135	1.157	1.164	1.188	1.212	1.185	1.265	1.284	1.096
Anchovy	1.371	1.389	1.409	1.426	1.444	1.471	1.479	1.501	1.552	1.502	1.569	1.714	1.341	1.779	2.228	2.049	1.869	1.676	1.483	1.308
Sardine	6.797	6.887	6.977	7.079	7.163	7.256	7.395	7.419	7.541	7.826	7.488	7.916	8.721	6.409	4.029	3.568	3.101	2.606	2.108	1.924
Spanish Mackerel	0.383	0.388	0.394	0.399	0.404	0.409	0.417	0.418	0.425	0.443	0.420	0.447	0.499	0.345	0.187	0.274	0.364	0.455	0.550	0.607
Frigate Tuna	5.732	5.809	5.897	5.980	6.049	6.169	6.234	6.259	6.544	6.433	6.330	7.439	6.071	5.997	5.919	6.043	6.169	6.298	6.429	5.930
Skipjack	3.787	3.835	3.899	3.952	3.983	4.097	4.114	4.076	4.455	4.161	3.952	5.651	3.224	3.283	3.343	3.358	3.372	3.385	3.399	3.620
Eastern Little Tuna	5.819	5.911	5.976	6.068	6.195	6.177	6.351	6.590	6.113	6.896	7.338	4.592	9.373	8.730	8.066	8.704	9.357	10.03	10.71	11.57
Big-eye Tuna	0.394	0.399	0.405	0.410	0.416	0.424	0.426	0.434	0.449	0.432	0.458	0.495	0.380	0.538	0.701	0.622	0.541	0.458	0.372	0.329
Yellowfin Tuna	1.973	2.000	2.031	2.056	2.085	2.125	2.135	2.174	2.248	2.165	2.293	2.481	1.901	2.696	3.513	3.119	2.713	2.295	1.865	1.647
Indo-Pacific Mackerel	0.587	0.595	0.603	0.610	0.622	0.626	0.632	0.658	0.637	0.651	0.741	0.571	0.695	1.022	1.357	1.428	1.505	1.576	1.654	1.307
Indian Mackerel	0.114	0.115	0.117	0.118	0.119	0.123	0.123	0.122	0.134	0.123	0.117	0.173	0.089	0.098	0.107	0.286	0.471	0.658	0.852	0.830
Japanese Mackerel	0.064	0.064	0.065	0.066	0.066	0.069	0.069	0.067	0.077	0.068	0.060	0.110	0.040	0.033	0.026	0.033	0.039	0.046	0.053	0.032
Hairtail	0.056	0.056	0.057	0.058	0.059	0.060	0.060	0.061	0.063	0.060	0.064	0.070	0.052	0.074	0.097	0.116	0.135	0.155	0.175	0.181
Shark	0.123	0.124	0.126	0.128	0.129	0.132	0.133	0.132	0.143	0.137	0.125	0.178	0.120	0.087	0.053	0.094	0.136	0.179	0.224	0.184
Skates and Rays	0.136	0.138	0.140	0.142	0.144	0.145	0.148	0.150	0.147	0.160	0.156	0.138	0.198	0.143	0.087	0.113	0.140	0.167	0.196	0.204
Misc fish	0.043	0.043	0.044	0.044	0.045	0.045	0.046	0.048	0.046	0.046	0.057	0.038	0.046	0.093	0.141	0.121	0.101	0.079	0.057	0.054
Blue crab	0.489	0.495	0.502	0.508	0.515	0.524	0.527	0.536	0.551	0.538	0.564	0.596	0.495	0.645	0.799	0.916	1.039	1.160	1.287	1.026
White shrimps	0.545	0.552	0.559	0.567	0.575	0.581	0.590	0.602	0.598	0.618	0.640	0.583	0.680	0.711	0.742	0.706	0.669	0.629	0.589	0.532
Endeavor prawn	0.022	0.023	0.023	0.023	0.024	0.024	0.024	0.026	0.023	0.025	0.032	0.014	0.032	0.052	0.072	0.061	0.050	0.037	0.025	0.033
Acetes	0.331	0.336	0.339	0.345	0.353	0.346	0.363	0.378	0.325	0.417	0.422	0.159	0.709	0.437	0.158	0.170	0.183	0.196	0.209	0.535
Squid	0.531	0.538	0.546	0.553	0.560	0.568	0.577	0.581	0.592	0.605	0.592	0.629	0.643	0.550	0.453	0.628	0.808	0.989	1.178	1.085
Misc shells	0.172	0.173	0.177	0.178	0.179	0.187	0.184	0.182	0.210	0.174	0.176	0.299	0.060	0.181	0.304	0.253	0.200	0.145	0.090	0.164
Misc crustaceans	0.065	0.066	0.066	0.067	0.069	0.068	0.071	0.074	0.063	0.081	0.086	0.027	0.138	0.101	0.062	0.062	0.063	0.063	0.063	0.071
Swordfish, sailfish, marlin	0.058	0.059	0.059	0.060	0.062	0.060	0.063	0.067	0.056	0.072	0.078	0.023	0.121	0.098	0.075	0.103	0.133	0.162	0.193	0.074
Misc. marine orgs.	0.111	0.113	0.114	0.115	0.118	0.120	0.118	0.125	0.126	0.113	0.145	0.130	0.072	0.247	0.428	0.360	0.290	0.218	0.144	0.128
Artisanal Zone D																				
Sea catfish	0.051	0.052	0.054	0.056	0.058	0.059	0.061	0.065	0.063	0.069	0.077	0.055	0.090	0.102	0.115	0.118	0.122	0.125	0.129	0.140
Lizard fish	0.064	0.066	0.068	0.071	0.073	0.075	0.078	0.081	0.080	0.089	0.092	0.075	0.120	0.099	0.077	0.104	0.132	0.163	0.196	0.322
Moray eel	0.040	0.041	0.042	0.044	0.046	0.047	0.048	0.051	0.050	0.054	0.060	0.045	0.068	0.082	0.097	0.091	0.084	0.077	0.069	0.083
Grouper	0.947	0.978	1.012	1.045	1.077	1.122	1.149	1.177	1.270	1.235	1.265	1.577	1.105	1.359	1.631	1.544	1.447	1.346	1.238	1.822
Fusilier	0.360	0.371	0.385	0.397	0.407	0.429	0.437	0.438	0.499	0.464	0.437	0.705	0.340	0.341	0.343	0.335	0.325	0.315	0.304	0.480
Snapper	0.921	0.951	0.984	1.016	1.046	1.089	1.120	1.143	1.228	1.218	1.211	1.512	1.175	1.179	1.183	1.155	1.121	1.086	1.049	1.425
Threadfin bream	0.658	0.680	0.703	0.726	0.749	0.779	0.799	0.821	0.876	0.864	0.888	1.058	0.818	0.964	1.120	1.210	1.302	1.403	1.510	2.690
Siganid	0.881	0.914	0.938	0.972	1.017	1.015	1.084	1.164	0.999	1.310	1.432	0.430	2.367	1.838	1.275	1.241	1.201	1.159	1.115	1.490
Sillago/Whiting	0.032	0.033	0.034	0.035	0.037	0.038	0.039	0.042	0.040	0.042	0.051	0.034	0.050	0.082	0.117	0.109	0.100	0.091	0.081	0.106
Perchlet/Glassfish	0.032	0.033	0.034	0.035	0.036	0.038	0.039	0.040	0.042	0.044	0.042	0.049	0.049	0.034	0.018	0.027	0.036	0.046	0.057	0.060
Surgeon fish	0.235	0.243	0.251	0.259	0.267	0.278	0.285	0.292	0.315	0.305	0.315	0.392	0.267	0.348	0.434	0.426	0.417	0.407	0.397	0.451
Parrot fish/Wrasse	0.408	0.422	0.435	0.450	0.468	0.476	0.497	0.528	0.500	0.565	0.630	0.401	0.782	0.849	0.921	0.888	0.850	0.811	0.770	1.120
Slipmouth	0.645	0.667	0.688	0.710	0.738	0.758	0.780	0.826	0.823	0.851	0.975	0.807	0.940	1.393	1.879	2.162	2.458	2.777	3.118	3.383
Mojarra	0.392	0.407	0.417	0.433	0.453	0.451	0.483	0.519	0.439	0.591	0.639	0.164	1.105	0.802	0.478	0.491	0.504	0.518	0.533	0.611
Goatfish	0.449	0.464	0.480	0.495	0.512	0.529	0.546	0.567	0.582	0.601	0.635	0.628	0.661	0.747	0.840	0.940	1.044	1.157	1.278	1.785
Goby	0.039	0.041	0.042	0.043	0.045	0.047	0.048	0.048	0.054	0.051	0.049	0.075	0.039	0.041	0.043	0.042	0.041	0.041	0.040	0.084
Moonfish	0.194	0.200	0.207	0.214	0.221	0.229	0.237	0.241	0.256	0.262	0.251	0.309	0.280	0.213	0.140	0.139	0.136	0.134	0.132	0.139
Spade fish	0.054	0.056	0.057	0.059	0.062	0.062	0.066	0.071	0.063	0.077	0.087	0.037	0.124	0.119	0.114	0.116	0.117	0.119	0.121	0.207

Artisanal Zone C	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fimbriated Sardine	1.970	1.980	4.895	1.330	1.692	1.905	1.909	3.603	3.811	3.720	4.087	4.020	1.333	1.440	1.594	1.435	1.555	1.569	1.560	1.603	1.619
Indian Sardine	1.528	1.360	0.504	3.132	0.813	0.821	0.834	1.722	2.154	1.212	1.174	1.226	0.499	0.776	0.825	1.636	1.950	1.504	1.742	1.779	1.718
Anchovy	1.418	1.536	1.227	2.814	1.980	2.347	2.324	1.987	2.401	2.393	2.639	2.692	1.707	1.742	1.782	1.601	1.499	1.672	1.633	1.643	1.693
Sardine	1.710	1.524	1.374	1.151	0.916	0.670	0.414	0.147	0.158	0.160	0.142	0.144	1.803	1.743	1.829	1.641	1.783	1.798	1.786	1.836	1.854
Spanish Mackerel	0.663	0.703	0.206	0.346	0.357	0.417	0.410	0.322	0.334	0.142	0.133	0.141	0.332	0.240	0.243	0.338	0.385	0.330	0.360	0.368	0.362
Frigate Tuna	6.494	6.620	16.52	10.16	7.536	6.057	6.355	13.49	14.96	13.32	16.12	16.46	10.87	10.32	10.16	10.18	10.25	10.48	10.59	10.73	10.90
Skipjack	3.675	3.954	1.012	2.401	3.969	4.315	4.350	2.479	2.859	3.340	2.609	2.746	4.573	3.397	3.572	3.327	2.715	3.304	3.203	3.159	3.313
Eastern Little Tuna	11.21	11.28	3.371	4.328	5.814	6.291	6.228	3.323	2.980	3.552	2.723	2.713	4.367	5.959	5.045	7.527	5.190	6.075	6.445	6.064	6.368
Big-eye Tuna	0.340	0.315	0.530	1.253	1.238	1.405	1.419	1.085	0.894	1.054	0.906	0.892	1.305	1.393	1.135	0.966	2.314	1.503	1.636	1.870	1.714
Yellowfin Tuna	1.703	1.578	2.654	6.280	6.204	7.040	7.108	5.435	4.481	5.277	4.548	4.475	6.544	6.984	8.526	6.836	8.766	8.275	8.176	8.643	8.597
Indo-Pacific Mackerel	1.377	1.326	0.509	0.246	0.336	0.592	0.592	0.261	0.354	0.385	0.420	0.441	1.283	1.484	1.493	1.431	1.659	1.568	1.593	1.650	1.646
Indian Mackerel	0.885	0.895	1.103	1.255	1.559	1.732	1.704	0.676	0.629	0.618	0.617	0.658	0.887	0.989	0.903	0.920	1.133	1.011	1.048	1.093	1.078
Japanese Mackerel	0.042	0.039	0.049	0.059	0.017	0.009	0.009	0.004	0.007	0.007	0.007	0.008	0.039	0.038	0.039	0.035	0.038	0.039	0.038	0.040	0.040
Hairtail	0.200	0.186	0.256	0.274	0.218	0.253	0.250	0.397	0.499	0.471	0.419	0.426	0.223	0.333	0.374	0.472	0.555	0.479	0.515	0.530	0.521
Shark	0.193	0.193	0.041	0.068	0.143	0.190	0.187	0.060	0.086	0.083	0.078	0.078	0.179	0.173	0.182	0.163	0.177	0.179	0.178	0.183	0.184
Skates and Rays	0.216	0.245	0.090	0.279	0.242	0.288	0.285	0.067	0.075	0.088	0.084	0.083	0.235	0.227	0.238	0.214	0.232	0.234	0.233	0.239	0.242
Misc fish	0.057	0.142	0.758	0.099	0.222	0.338	0.341	0.094	0.090	0.116	0.112	0.117	0.161	0.156	0.163	0.147	0.159	0.161	0.160	0.164	0.166
Blue crab	1.088	1.199	4.295	2.435	2.716	2.954	2.899	3.959	2.700	4.429	4.864	4.937	4.032	3.824	3.827	3.398	3.071	3.527	3.420	3.426	3.550
White shrimps	0.581	0.774	0.413	0.670	0.767	0.716	0.707	0.954	0.971	1.010	0.974	1.060	0.983	0.951	0.998	0.895	0.973	0.981	0.974	1.002	1.012
Endeavor prawn	0.034	0.032	0.233	0.220	0.551	0.631	0.618	0.558	0.736	0.674	0.600	0.610	0.407	0.394	0.413	0.371	0.403	0.406	0.404	0.415	0.419
Acetes	0.542	0.441	1.784	0.253	0.476	0.523	0.511	0.875	0.880	0.937	0.842	0.859	0.315	0.486	0.454	0.466	0.421	0.459	0.461	0.458	0.471
Squid	1.132	1.093	2.086	3.284	2.276	2.266	2.849	2.756	2.630	2.257	2.250	2.276	2.168	2.107	2.211	1.995	1.746	2.039	1.977	1.971	2.049
Misc shells	0.182	0.209	0.367	0.217	1.518	0.547	0.576	0.270	0.183	0.229	0.218	0.216	0.438	0.424	0.445	0.399	0.434	0.437	0.434	0.447	0.451
Misc crustaceans	0.076	0.089	0.159	0.227	0.340	0.262	0.260	0.251	0.322	0.317	0.293	0.307	0.243	0.235	0.246	0.221	0.240	0.242	0.241	0.247	0.250
Swordfish, sailfish, marlin	0.121	0.120	0.182	0.177	0.247	0.316	0.167	0.264	0.138	0.124	0.114	0.121	0.199	0.192	0.202	0.181	0.197	0.198	0.197	0.203	0.205
Misc. marine orgs.	0.164	0.171	0.316	0.222	0.185	0.262	0.584	0.255	0.196	0.184	0.178	0.185	0.295	0.286	0.300	0.269	0.292	0.294	0.293	0.301	0.304
Artisanal Zone D																					
Sea catfish	0.147	0.153	0.563	0.327	0.274	0.357	0.353	0.216	0.151	0.148	0.145	0.148	0.275	0.233	0.190	0.127	0.155	0.168	0.160	0.172	0.178
Lizard fish	0.167	0.186	0.230	0.193	0.205	0.315	0.331	0.030	0.055	0.104	0.108	0.106	0.254	0.215	0.175	0.118	0.143	0.156	0.148	0.159	0.164
Moray eel	0.075	0.098	0.222	0.111	0.111	0.245	0.242	0.068	0.050	0.055	0.055	0.055	0.141	0.120	0.098	0.066	0.080	0.087	0.082	0.088	0.092
Grouper	1.522	1.839	1.294	1.309	1.286	1.766	1.785	0.947	1.586	1.560	1.548	1.560	1.598	1.397	1.413	1.948	1.925	1.875	2.047	2.079	2.133
Fusilier	0.392	0.410	0.336	0.658	1.033	0.715	0.753	2.044	1.286	1.168	1.173	1.169	0.513	0.489	0.537	0.722	0.902	0.765	0.850	0.896	0.892
Snapper	1.214	1.435	1.087	2.077	2.135	2.398	2.441	3.125	2.233	3.129	3.254	3.189	1.400	1.213	1.270	1.298	1.353	1.394	1.438	1.488	1.537
Threadfin bream	1.844	1.947	0.646	1.751	1.706	1.985	1.903	0.645	1.079	0.987	1.118	1.133	0.634	1.779	1.762	1.445	1.724	1.755	1.749	1.860	1.907
Siganid	1.157	1.242	0.987	2.425	2.483	2.332	2.345	1.420	2.175	2.114	2.166	2.140	1.377	1.206	1.124	1.852	1.915	1.731	1.958	1.994	2.019
Sillago/Whiting	0.115	0.107	0.103	0.187	0.099	0.065	0.063	0.092	0.019	0.020	0.019	0.019	0.119	0.101	0.082	0.055	0.067	0.073	0.069	0.075	0.077
Perchlet/Glassfish	0.060	0.068	0.373	0.200	0.305	0.301	0.299	0.216	0.210	0.169	0.139	0.137	0.191	0.162	0.132	0.089	0.108	0.117	0.111	0.120	0.124
Surgeon fish	0.443	0.506	0.199	0.782	1.144	0.691	0.651	1.347	1.458	0.731	0.709	0.699	0.825	0.699	0.570	0.383	0.465	0.506	0.480	0.516	0.534
Parrot fish/Wrasse	0.860	1.030	1.066	2.553	4.157	3.671	3.766	3.092	2.831	2.638	2.655	2.662	1.371	1.391	1.422	1.441	1.489	1.548	1.592	1.646	1.702
Slipmouth	3.116	3.071	2.736	1.213	1.068	0.957	0.983	2.111	1.232	1.543	1.496	1.507	1.175	1.675	1.651	2.340	2.278	2.223	2.435	2.466	2.533
Mojarra	0.729	0.716	0.195	0.819	0.952	0.636	0.610	0.169	0.295	0.265	0.269	0.269	0.773	0.654	0.533	0.358	0.435	0.473	0.449	0.483	0.500
Goatfish	1.388	1.581	1.626	2.370	1.893	2.239	2.232	1.443	1.175	1.108	1.131	1.136	2.861	3.040	2.727	2.249	2.637	2.710	2.698	2.862	2.941
Goby	0.065	0.098	0.146	0.217	0.235	0.479	0.573	0.602	0.474	0.451	0.383	0.393	0.280	0.237	0.193	0.130	0.158	0.171	0.163	0.175	0.181
Moonfish	0.178	0.186	0.086	0.091	0.094	0.125	0.141	0.411	0.481	0.487	0.440	0.454	0.302	0.256	0.208	0.140	0.170	0.185	0.176	0.189	0.195
Spade fish	0.156	0.147	0.272	0.444	0.578	0.829	0.807	0.401	0.576	0.478	0.486	0.487	0.431	0.365	0.297	0.200	0.243	0.264	0.251	0.270	0.279

Artisanal Zone D	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Rudder fish	0.023	0.024	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.040	0.041	0.042
Croaker	0.012	0.013	0.013	0.014	0.014	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.019	0.019	0.020	0.020	0.021	0.022	0.023	0.023
Porgy	0.254	0.262	0.271	0.280	0.290	0.299	0.309	0.320	0.330	0.342	0.353	0.365	0.377	0.389	0.402	0.416	0.430	0.444	0.459	0.474
Therapon/Grunt	0.178	0.184	0.190	0.196	0.203	0.210	0.217	0.224	0.231	0.239	0.247	0.255	0.264	0.273	0.282	0.291	0.301	0.311	0.321	0.332
Red bulls eye	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
Butterfly fish	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.011
Hardtail	0.078	0.081	0.084	0.086	0.089	0.092	0.095	0.098	0.102	0.105	0.109	0.112	0.116	0.120	0.124	0.128	0.132	0.137	0.141	0.146
Big-eyed Scad	0.740	0.765	0.790	0.817	0.844	0.872	0.901	0.931	0.963	0.995	1.028	1.062	1.098	1.134	1.172	1.211	1.252	1.294	1.337	1.381
Round scad	0.823	0.851	0.879	0.909	0.939	0.971	1.003	1.037	1.071	1.107	1.144	1.182	1.222	1.263	1.305	1.348	1.393	1.440	1.487	1.537
Rainbow runner	0.076	0.078	0.081	0.084	0.087	0.090	0.093	0.096	0.099	0.102	0.106	0.109	0.113	0.116	0.120	0.124	0.128	0.133	0.137	0.142
Leather jacket	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.014	0.014	0.015	0.015	0.016	0.016	0.017	0.017	0.018
Crevalle	0.102	0.106	0.109	0.113	0.116	0.120	0.124	0.129	0.133	0.137	0.142	0.147	0.152	0.157	0.162	0.167	0.173	0.179	0.184	0.191
Mullet	0.086	0.089	0.092	0.095	0.099	0.102	0.105	0.109	0.112	0.116	0.120	0.124	0.128	0.133	0.137	0.142	0.146	0.151	0.156	0.161
Dolphin fish	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Silverside	0.018	0.019	0.019	0.020	0.021	0.021	0.022	0.023	0.024	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034
Garfish	0.281	0.291	0.301	0.311	0.321	0.332	0.343	0.354	0.366	0.378	0.391	0.404	0.418	0.431	0.446	0.461	0.476	0.492	0.508	0.525
Halfbeak	0.185	0.191	0.198	0.204	0.211	0.218	0.226	0.233	0.241	0.249	0.257	0.266	0.275	0.284	0.293	0.303	0.313	0.324	0.335	0.346
Barracuda	0.094	0.097	0.100	0.104	0.107	0.111	0.114	0.118	0.122	0.126	0.130	0.135	0.139	0.144	0.149	0.154	0.159	0.164	0.170	0.175
Sergeant fish	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.016	0.016	0.017	0.018	0.018	0.019	0.019	0.020	0.021	0.021	0.022	0.023	0.024
Pomfret	0.027	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.035	0.036	0.037	0.038	0.039	0.041	0.042	0.043	0.045	0.046	0.048	0.050
Flying fish	0.756	0.781	0.807	0.834	0.862	0.891	0.921	0.952	0.983	1.016	1.050	1.085	1.122	1.159	1.198	1.238	1.279	1.322	1.366	1.411
Big-eye	0.013	0.014	0.014	0.014	0.015	0.015	0.016	0.017	0.017	0.018	0.018	0.019	0.019	0.020	0.021	0.022	0.022	0.023	0.024	0.025
Wolf herring	0.163	0.168	0.174	0.180	0.186	0.192	0.198	0.205	0.212	0.219	0.226	0.234	0.242	0.250	0.258	0.267	0.276	0.285	0.294	0.304
Round Herring	0.613	0.634	0.655	0.677	0.700	0.723	0.747	0.772	0.798	0.825	0.852	0.881	0.910	0.940	0.972	1.004	1.038	1.072	1.108	1.145
Fimbriated Sardine	1.950	2.015	2.083	2.152	2.224	2.299	2.376	2.455	2.537	2.622	2.710	2.800	2.894	2.990	3.090	3.193	3.300	3.410	3.523	3.641
Indian Sardine	0.662	0.684	0.707	0.731	0.755	0.780	0.807	0.834	0.861	0.890	0.920	0.951	0.982	1.015	1.049	1.084	1.120	1.158	1.196	1.236
Anchovy	1.635	1.690	1.746	1.805	1.865	1.927	1.992	2.059	2.127	2.198	2.272	2.348	2.426	2.507	2.591	2.677	2.767	2.859	2.954	3.053
Spanish Mackerel	0.198	0.205	0.211	0.218	0.226	0.233	0.241	0.249	0.258	0.266	0.275	0.284	0.294	0.304	0.314	0.324	0.335	0.346	0.358	0.370
Frigate Tuna	2.494	2.574	2.657	2.742	2.830	2.921	3.015	3.112	3.212	3.315	3.421	3.531	3.644	3.761	3.882	4.006	4.135	4.267	4.404	4.546
Big-eye Tuna	2.001	2.065	2.132	2.200	2.271	2.344	2.419	2.497	2.577	2.660	2.745	2.833	2.924	3.018	3.115	3.215	3.318	3.424	3.534	3.647
Yellowfin Tuna	4.015	4.145	4.278	4.415	4.557	4.704	4.855	5.011	5.172	5.338	5.509	5.686	5.868	6.057	6.251	6.451	6.658	6.872	7.091	7.320
Skipjack	2.275	2.348	2.424	2.502	2.582	2.665	2.751	2.839	2.930	3.024	3.122	3.222	3.325	3.432	3.542	3.655	3.773	3.893	4.018	4.147
Eastern Little Tuna	3.020	3.117	3.217	3.320	3.427	3.537	3.651	3.768	3.889	4.014	4.143	4.276	4.413	4.555	4.701	4.852	5.007	5.167	5.334	5.502
Indo-Pacific Mackerel	0.144	0.148	0.153	0.158	0.164	0.169	0.175	0.181	0.187	0.193	0.199	0.206	0.213	0.220	0.227	0.235	0.243	0.251	0.259	0.268
Indian Mackerel	0.408	0.421	0.435	0.450	0.465	0.480	0.497	0.513	0.530	0.548	0.566	0.585	0.605	0.625	0.646	0.667	0.690	0.713	0.736	0.761
Japanese Mackerel	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
Hairtail	0.137	0.142	0.146	0.151	0.156	0.162	0.167	0.173	0.178	0.184	0.190	0.197	0.203	0.210	0.217	0.224	0.232	0.240	0.248	0.256
Shark	0.292	0.302	0.312	0.322	0.333	0.344	0.356	0.368	0.380	0.393	0.406	0.419	0.433	0.448	0.463	0.478	0.494	0.511	0.528	0.545
Skates and Rays	0.119	0.123	0.127	0.131	0.135	0.140	0.144	0.149	0.154	0.159	0.165	0.170	0.176	0.182	0.188	0.194	0.201	0.207	0.214	0.221
Trigger fish	0.059	0.061	0.063	0.066	0.068	0.070	0.072	0.075	0.077	0.080	0.083	0.085	0.088	0.091	0.094	0.097	0.100	0.104	0.107	0.111
Misc. fish	0.769	0.795	0.822	0.849	0.877	0.907	0.937	0.968	1.001	1.034	1.069	1.104	1.141	1.179	1.219	1.260	1.301	1.345	1.390	1.436
Blue crab	0.051	0.052	0.054	0.056	0.058	0.060	0.062	0.064	0.066	0.068	0.070	0.073	0.075	0.078	0.080	0.083	0.086	0.088	0.091	0.094
Mangrove or Mud crab	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.037	0.038	0.039	0.040	0.042	0.043	0.044	0.046	0.047	0.049	0.051
White shrimps	0.083	0.086	0.089	0.092	0.095	0.098	0.101	0.105	0.108	0.112	0.115	0.119	0.123	0.127	0.132	0.136	0.140	0.145	0.150	0.155
Acetes	0.019	0.020	0.020	0.021	0.022	0.022	0.023	0.024	0.025	0.026	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035
Misc. crustaceans	0.039	0.040	0.042	0.043	0.044	0.046	0.047	0.049	0.051	0.052	0.054	0.056	0.058	0.060	0.062	0.064	0.066	0.068	0.070	0.073

Artisanal Zone D	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Rudder fish	0.044	0.045	0.047	0.048	0.051	0.050	0.054	0.058	0.050	0.066	0.070	0.022	0.120	0.084	0.045	0.055	0.065	0.077	0.089	0.026
Croaker	0.024	0.025	0.026	0.026	0.028	0.028	0.029	0.032	0.030	0.031	0.040	0.023	0.037	0.071	0.107	0.225	0.350	0.485	0.628	0.045
Porgy	0.490	0.506	0.523	0.541	0.557	0.579	0.597	0.610	0.648	0.653	0.653	0.772	0.667	0.646	0.625	0.735	0.850	0.974	1.107	1.437
Therapon/Grunt	0.343	0.355	0.366	0.378	0.394	0.400	0.417	0.446	0.417	0.472	0.543	0.316	0.656	0.783	0.919	0.803	0.678	0.545	0.402	1.106
Red bulls eye	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.005	0.006	0.035	0.065	0.097	0.131	0.153
Butterfly fish	0.012	0.012	0.012	0.013	0.013	0.014	0.014	0.014	0.016	0.015	0.014	0.022	0.013	0.009	0.005	0.007	0.010	0.013	0.016	0.016
Hardtail	0.151	0.156	0.161	0.167	0.171	0.179	0.184	0.185	0.207	0.197	0.187	0.281	0.163	0.149	0.135	0.180	0.229	0.280	0.336	0.375
Big-eyed Scad	1.428	1.474	1.525	1.576	1.621	1.691	1.737	1.765	1.916	1.885	1.848	2.419	1.764	1.709	1.651	1.589	1.517	1.443	1.363	1.121
Round scad	1.589	1.640	1.697	1.754	1.804	1.880	1.938	1.959	2.130	2.121	2.018	2.699	2.075	1.650	1.197	1.388	1.588	1.803	2.034	1.417
Rainbow runner	0.146	0.151	0.157	0.161	0.167	0.174	0.177	0.183	0.197	0.185	0.206	0.243	0.142	0.274	0.417	0.419	0.421	0.423	0.426	0.788
Leather jacket	0.018	0.019	0.020	0.020	0.021	0.022	0.022	0.023	0.025	0.024	0.024	0.034	0.019	0.023	0.028	0.049	0.072	0.096	0.122	0.072
Crevalle	0.197	0.204	0.211	0.217	0.224	0.233	0.239	0.248	0.260	0.256	0.277	0.302	0.240	0.347	0.462	0.423	0.380	0.335	0.287	0.336
Mullet	0.167	0.173	0.178	0.183	0.192	0.195	0.201	0.218	0.205	0.222	0.272	0.162	0.277	0.440	0.614	0.576	0.533	0.488	0.440	0.665
Dolphin fish	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.006	0.004	0.002	0.004	0.005	0.007	0.009	0.012
Silverside	0.035	0.036	0.037	0.039	0.040	0.041	0.043	0.044	0.046	0.046	0.047	0.056	0.045	0.048	0.052	0.057	0.062	0.067	0.073	0.067
Garfish	0.543	0.561	0.580	0.598	0.620	0.638	0.659	0.692	0.694	0.724	0.801	0.695	0.823	1.059	1.313	1.214	1.104	0.989	0.866	0.551
Halfbeak	0.357	0.369	0.382	0.394	0.406	0.424	0.433	0.444	0.482	0.461	0.477	0.609	0.388	0.527	0.677	0.643	0.604	0.564	0.521	0.621
Barracuda	0.181	0.187	0.193	0.200	0.207	0.213	0.221	0.229	0.230	0.248	0.256	0.233	0.308	0.280	0.250	0.343	0.442	0.548	0.662	0.357
Sergeant fish	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.031	0.033	0.037	0.029	0.040	0.049	0.058	0.065	0.072	0.079	0.087	0.049
Pomfret	0.051	0.053	0.055	0.056	0.059	0.060	0.062	0.066	0.063	0.070	0.080	0.051	0.095	0.113	0.133	0.128	0.123	0.117	0.111	0.122
Flying fish	1.458	1.507	1.558	1.608	1.662	1.720	1.770	1.836	1.905	1.929	2.050	2.127	1.996	2.452	2.940	2.620	2.269	1.898	1.501	0.963
Big-eye	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.033	0.032	0.033	0.039	0.031	0.038	0.056	0.004	0.060	0.120	0.183	0.251	0.157
Wolf herring	0.314	0.325	0.335	0.347	0.360	0.366	0.387	0.400	0.386	0.454	0.444	0.333	0.685	0.405	0.106	0.200	0.300	0.407	0.521	0.673
Round Herring	1.183	1.221	1.266	1.305	1.340	1.412	1.429	1.450	1.650	1.478	1.512	2.318	0.878	1.619	2.411	2.110	1.782	1.435	1.063	1.634
Fimbriated Sardine	3.762	3.887	4.017	4.151	4.289	4.432	4.579	4.732	4.888	5.051	5.223	5.387	5.574	5.774	5.969	6.120	6.432	6.571	6.593	7.752
Indian Sardine	1.277	1.320	1.364	1.409	1.456	1.504	1.555	1.607	1.659	1.716	1.773	1.827	1.898	1.954	2.021	2.109	2.136	2.230	2.394	2.305
Anchovy	3.154	3.260	3.367	3.480	3.600	3.709	3.842	3.984	4.056	4.271	4.441	4.275	4.977	4.991	5.011	5.536	6.078	6.665	7.294	9.214
Spanish Mackerel	0.382	0.395	0.408	0.421	0.435	0.450	0.466	0.478	0.500	0.515	0.515	0.571	0.562	0.515	0.464	0.416	0.364	0.308	0.249	0.571
Frigate Tuna	4.690	4.840	5.000	5.152	5.317	5.512	5.638	5.841	6.140	6.032	6.494	7.119	5.624	8.023	10.57	10.90	11.24	11.58	11.94	12.73
Big-eye Tuna	3.764	3.883	4.011	4.137	4.261	4.424	4.537	4.654	4.952	4.893	5.020	5.936	4.659	5.421	6.228	5.953	5.654	5.330	4.980	4.641
Yellowfin Tuna	7.554	7.792	8.050	8.302	8.550	8.879	9.105	9.339	9.938	9.819	10.07	11.91	9.35	10.88	12.50	11.95	11.35	10.70	9.993	9.313
Skipjack	4.280	4.417	4.557	4.705	4.857	5.001	5.180	5.342	5.461	5.754	5.859	5.829	6.716	6.178	5.600	6.088	6.601	7.140	7.707	8.210
Eastern Little Tuna	5.680	5.868	6.039	6.246	6.471	6.582	6.909	7.197	6.916	7.978	8.130	5.917	11.54	8.593	5.447	6.746	8.123	9.580	11.12	12.31
Indo-Pacific Mackerel	0.277	0.286	0.295	0.305	0.317	0.324	0.338	0.354	0.345	0.384	0.405	0.313	0.515	0.475	0.433	0.416	0.396	0.375	0.353	0.203
Indian Mackerel	0.786	0.812	0.840	0.868	0.894	0.929	0.958	0.978	1.042	1.050	1.039	1.253	1.068	0.997	0.922	1.527	2.167	2.853	3.587	0.579
Japanese Mackerel	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.001	0.003	0.004	0.006	0.007	0.009	0.011	0.007
Hairtail	0.265	0.273	0.283	0.292	0.299	0.314	0.322	0.322	0.363	0.348	0.321	0.498	0.293	0.225	0.153	0.223	0.297	0.376	0.461	0.239
Shark	0.564	0.582	0.602	0.622	0.641	0.666	0.687	0.701	0.745	0.756	0.742	0.891	0.789	0.688	0.579	0.599	0.618	0.640	0.663	0.413
Skates and Rays	0.229	0.237	0.244	0.252	0.262	0.268	0.278	0.294	0.286	0.312	0.345	0.255	0.401	0.455	0.513	0.617	0.727	0.845	0.972	0.486
Trigger fish	0.115	0.118	0.122	0.127	0.131	0.134	0.140	0.145	0.144	0.161	0.159	0.141	0.217	0.153	0.085	0.098	0.112	0.126	0.142	0.079
Misc. fish	1.484	1.536	1.581	1.637	1.702	1.727	1.816	1.914	1.800	2.107	2.234	1.401	3.141	2.655	2.137	1.933	1.709	1.473	1.219	1.235
Blue crab	0.098	0.101	0.104	0.108	0.111	0.115	0.119	0.122	0.130	0.128	0.132	0.156	0.122	0.144	0.167	0.162	0.156	0.150	0.144	0.084
Mangrove or Mud crab	0.052	0.054	0.056	0.058	0.060	0.060	0.065	0.069	0.060	0.078	0.082	0.031	0.139	0.093	0.044	0.047	0.050	0.053	0.056	0.029
White shrimps	0.160	0.166	0.171	0.177	0.183	0.188	0.195	0.202	0.206	0.218	0.223	0.218	0.258	0.240	0.220	0.204	0.187	0.169	0.150	0.083
Acetes	0.037	0.038	0.039	0.040	0.042	0.043	0.045	0.046	0.046	0.052	0.051	0.043	0.074	0.046	0.017	0.040	0.063	0.089	0.116	0.063
Misc. crustaceans	0.075	0.078	0.080	0.083	0.086	0.088	0.092	0.095	0.097	0.102	0.104	0.104	0.119	0.111	0.103	0.096	0.088	0.080	0.070	0.042

Artisanal Zone D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rudder fish	0.045	0.022	0.028	0.018	0.014	0.014	0.415	0.340	0.396	0.308	0.320	0.231	0.138	0.117	0.095	0.064	0.078	0.085	0.080	0.086	0.089
Croaker	0.077	0.192	0.033	0.080	0.043	0.054	0.057	0.028	0.081	0.089	0.088	0.090	0.155	0.132	0.107	0.072	0.088	0.095	0.090	0.097	0.101
Porgy	0.927	1.030	0.502	0.757	1.466	1.685	1.714	0.842	0.908	0.756	0.714	0.748	0.718	0.938	0.987	0.962	1.146	1.099	1.140	1.205	1.224
Therapon/Grunt	0.874	0.901	0.482	0.436	0.340	0.207	0.219	0.637	0.836	0.216	0.803	0.844	0.927	0.785	0.639	0.430	0.522	0.568	0.539	0.579	0.600
Red bulls eye	0.181	0.168	0.388	0.854	0.166	0.322	0.314	0.131	0.220	0.207	0.211	0.214	0.280	0.237	0.193	0.130	0.158	0.172	0.163	0.175	0.181
Butterfly fish	0.017	0.022	0.126	0.015	0.036	0.032	0.032	0.139	0.182	0.172	0.181	0.207	0.076	0.065	0.053	0.035	0.043	0.047	0.044	0.048	0.049
Hardtail	0.417	0.366	0.879	0.501	0.381	0.288	0.306	0.429	0.490	0.573	0.577	0.581	0.557	0.471	0.384	0.258	0.314	0.341	0.324	0.348	0.360
Big-eyed Scad	1.553	1.934	2.985	2.670	5.006	4.756	5.111	6.331	8.090	8.941	9.911	10.37	19.42	16.78	17.70	13.94	13.40	16.08	15.42	15.95	16.89
Round scad	2.226	2.325	2.841	2.131	3.230	2.742	3.174	6.019	5.913	6.668	6.947	7.036	7.230	9.066	10.43	8.982	9.813	10.41	10.38	10.88	11.26
Rainbow runner	0.684	0.684	0.253	2.237	0.751	1.009	0.984	0.348	0.341	0.252	0.247	0.254	0.859	0.728	0.593	0.399	0.484	0.527	0.500	0.537	0.556
Leather jacket	0.134	0.139	0.030	0.043	0.069	0.046	0.045	0.014	0.064	0.062	0.063	0.062	0.091	0.077	0.063	0.042	0.051	0.056	0.053	0.057	0.059
Crevalle	0.306	0.340	0.353	0.430	0.098	0.177	0.191	0.479	0.541	1.017	1.006	1.009	0.718	0.689	0.685	1.482	1.397	1.260	1.475	1.470	1.494
Mullet	0.648	0.636	1.639	0.756	1.114	0.952	1.150	1.023	1.284	1.263	1.263	1.329	1.716	1.623	1.619	1.582	1.893	1.809	1.878	1.986	2.017
Dolphin fish	0.023	0.021	0.165	0.282	0.436	1.119	1.086	0.087	0.046	0.051	0.048	0.048	0.221	0.187	0.152	0.102	0.124	0.135	0.128	0.138	0.143
Silverside	0.077	0.069	0.137	0.561	0.051	0.058	0.073	0.147	0.138	0.143	0.113	0.111	0.152	0.128	0.105	0.070	0.085	0.093	0.088	0.095	0.098
Garfish	0.833	0.797	0.861	1.384	1.308	0.998	0.839	1.872	1.340	1.315	1.298	1.284	1.400	1.185	0.966	0.649	0.789	0.857	0.814	0.875	0.906
Halfbeak	0.731	0.669	0.151	0.200	0.311	0.278	0.437	0.089	0.211	0.190	0.194	0.198	0.621	0.526	0.429	0.288	0.350	0.381	0.361	0.388	0.402
Barracuda	0.642	0.790	0.660	0.867	1.023	0.978	1.016	0.206	0.300	0.297	0.290	0.296	0.741	0.628	0.512	0.344	0.418	0.454	0.431	0.464	0.480
Sergeant fish	0.084	0.101	0.154	0.155	0.202	0.165	0.200	0.042	0.059	0.053	0.051	0.050	0.124	0.105	0.085	0.057	0.070	0.076	0.072	0.077	0.080
Pomfret	0.132	0.119	0.245	0.087	0.074	0.195	0.243	0.112	0.293	0.354	0.368	0.358	0.224	0.190	0.155	0.104	0.126	0.137	0.130	0.140	0.145
Flying fish	1.553	1.973	6.231	1.311	1.087	1.395	1.683	3.335	3.774	5.716	5.550	5.726	3.808	3.455	3.617	3.348	3.707	3.797	3.856	4.040	4.158
Big-eye	0.278	0.274	0.036	0.084	0.087	0.088	0.113	0.113	0.374	0.102	0.346	0.342	0.204	0.173	0.141	0.095	0.115	0.125	0.119	0.128	0.132
Wolf herring	0.534	0.430	0.014	0.152	0.079	0.000	0.000	0.001	0.010	0.014	0.014	0.013	0.405	0.343	0.279	0.188	0.228	0.248	0.236	0.253	0.262
Round Herring	1.677	1.856	0.799	0.009	0.170	0.007	0.008	0.030	0.036	0.040	0.038	0.040	0.019	0.490	0.619	0.456	0.540	0.576	0.558	0.595	0.615
Fimbriated Sardine	7.263	6.863	2.909	1.618	2.295	1.767	1.926	4.491	4.299	3.699	3.895	3.850	3.036	4.874	5.663	5.857	5.207	5.958	6.056	6.118	6.450
Indian Sardine	2.629	3.051	1.849	3.956	4.800	5.860	7.163	6.432	6.771	6.357	6.804	6.881	5.514	7.217	8.728	15.27	11.98	12.76	14.27	13.85	14.54
Anchovy	8.308	7.229	6.822	4.691	3.138	3.016	3.447	4.578	4.570	4.937	5.049	5.020	5.283	4.697	4.976	5.403	7.130	6.206	6.659	7.120	7.101
Spanish Mackerel	0.565	0.594	0.405	0.973	0.569	0.789	0.842	0.462	0.539	0.586	0.576	3.311	1.007	0.956	1.006	1.217	1.259	1.236	1.321	1.357	1.391
Frigate Tuna	12.56	12.34	25.32	29.09	25.48	25.22	24.14	34.92	36.07	36.00	37.54	40.13	38.79	44.45	31.92	19.13	32.13	29.62	28.61	32.10	32.04
Big-eye Tuna	5.311	6.056	3.629	3.900	5.332	5.625	6.113	3.927	4.618	4.999	5.131	4.532	4.606	4.610	3.893	3.564	7.522	5.259	5.781	6.601	6.245
Yellowfin Tuna	10.66	12.15	7.283	7.826	10.70	11.29	12.27	7.880	9.267	10.03	10.30	9.094	9.243	9.250	28.01	8.556	12.75	17.91	13.84	15.80	16.91
Skipjack	9.464	10.52	11.45	8.623	9.443	12.44	13.64	7.830	7.351	7.794	8.030	12.12	12.71	11.16	9.023	7.987	14.57	11.13	11.92	13.37	12.90
Eastern Little Tuna	10.71	9.185	4.180	4.076	4.262	2.412	2.641	6.103	5.284	5.764	5.644	2.881	5.589	3.730	2.675	38.69	13.43	19.04	25.44	20.43	23.01
Indo-Pacific Mackerel	0.432	0.937	1.419	0.493	0.574	0.559	0.592	1.582	1.656	2.210	2.292	1.641	0.760	1.210	1.420	1.351	1.571	1.543	1.587	1.673	1.708
Indian Mackerel	1.312	1.201	2.894	2.327	2.266	1.627	1.702	2.375	2.732	2.999	3.256	2.548	3.007	3.444	3.956	4.051	4.718	4.519	4.723	4.968	5.051
Japanese Mackerel	0.014	0.016	0.247	0.706	1.259	0.544	0.553	0.347	0.270	0.290	0.290	0.252	0.306	0.259	0.211	0.142	0.173	0.188	0.178	0.191	0.198
Hairtail	0.477	0.462	0.493	0.429	0.640	0.564	0.576	0.722	0.633	0.650	0.615	0.623	0.608	0.895	0.906	0.889	0.925	0.968	0.989	1.025	1.060
Shark	0.875	0.929	0.384	0.387	0.260	0.379	0.401	0.221	0.280	0.288	0.268	0.278	0.746	0.632	0.515	0.346	0.420	0.457	0.434	0.467	0.483
Skates and Rays	1.018	1.186	0.752	0.569	0.411	0.318	0.339	0.239	0.275	0.273	0.272	0.275	0.777	0.658	0.536	0.360	0.438	0.476	0.452	0.486	0.503
Trigger fish	0.176	0.186	0.152	0.453	0.441	0.897	0.893	0.181	0.202	0.196	0.202	0.198	0.344	0.292	0.238	0.160	0.194	0.211	0.200	0.215	0.223
Misc. fish	1.497	1.773	2.423	2.012	3.055	3.369	3.462	4.489	3.056	3.804	3.692	4.021	1.241	1.649	1.649	3.847	4.455	3.509	4.207	4.334	4.278
Blue crab	0.171	0.203	0.560	0.700	0.544	0.543	0.541	0.282	0.460	0.516	0.547	0.588	0.311	0.743	0.797	0.937	0.974	0.961	1.022	1.051	1.079
Mangrove or Mud crab	0.054	0.060	1.410	1.192	1.211	0.885	0.859	0.120	0.221	0.210	0.215	0.212	0.496	0.420	0.342	0.230	0.279	0.304	0.288	0.310	0.321
White shrimps	0.166	0.192	0.745	1.295	0.843	0.795	0.829	0.222	0.304	0.315	0.309	0.318	0.532	0.450	0.367	0.247	0.300	0.326	0.309	0.332	0.344
Acetes	0.120	0.141	0.175	0.077	0.083	0.015	0.078	0.256	0.448	0.412	0.367	0.362	0.260	0.538	0.419	0.616	0.830	0.659	0.748	0.797	0.783
Misc. crustaceans	0.080	0.141	0.170	0.189	0.236	0.140	0.159	0.100	0.056	0.073	0.074	0.065	0.142	0.120	0.098	0.066	0.080	0.087	0.083	0.089	0.092

Artisanal Zone D	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Misc. shells	0.117	0.121	0.125	0.129	0.133	0.138	0.142	0.147	0.152	0.157	0.162	0.168	0.173	0.179	0.185	0.191	0.198	0.204	0.211	0.218
Squid	0.449	0.464	0.479	0.495	0.512	0.529	0.547	0.565	0.584	0.603	0.624	0.644	0.666	0.688	0.711	0.735	0.759	0.785	0.811	0.838
Cuttlefish	0.105	0.108	0.112	0.116	0.120	0.124	0.128	0.132	0.136	0.141	0.146	0.151	0.156	0.161	0.166	0.172	0.177	0.183	0.189	0.196
Octopus	0.049	0.050	0.052	0.054	0.056	0.057	0.059	0.061	0.063	0.066	0.068	0.070	0.072	0.075	0.077	0.080	0.082	0.085	0.088	0.091
Sea cucumber	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006
Sardine	1.373	1.419	1.466	1.515	1.566	1.618	1.672	1.728	1.786	1.846	1.907	1.971	2.037	2.105	2.175	2.248	2.323	2.400	2.480	2.563
Swordfish, sailfish, marlin	0.084	0.087	0.090	0.093	0.096	0.099	0.103	0.106	0.110	0.113	0.117	0.121	0.125	0.129	0.134	0.138	0.143	0.147	0.152	0.157
Misc. marine orgs.	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.013	0.013	0.013	0.014	0.014	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.019

Artisanal Zone D	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Misc. shells	0.225	0.232	0.241	0.249	0.254	0.270	0.273	0.272	0.321	0.281	0.265	0.489	0.141	0.210	0.284	0.353	0.426	0.504	0.588	0.329
Squid	0.866	0.893	0.926	0.956	0.978	1.034	1.052	1.045	1.220	1.107	1.013	1.807	0.712	0.687	0.661	0.691	0.720	0.753	0.788	0.433
Cuttlefish	0.202	0.209	0.217	0.223	0.229	0.242	0.246	0.244	0.286	0.258	0.237	0.425	0.159	0.166	0.173	0.168	0.163	0.157	0.151	0.085
Octopus	0.094	0.097	0.100	0.104	0.108	0.110	0.114	0.120	0.119	0.127	0.140	0.113	0.154	0.183	0.214	0.220	0.226	0.233	0.240	0.128
Sea cucumber	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.009	0.010	0.006	0.015	0.012	0.009	0.111	0.220	0.336	0.461	0.269
Sardine	2.648	2.737	2.827	2.920	3.024	3.114	3.219	3.357	3.400	3.556	3.805	3.525	4.064	4.631	5.240	5.330	5.408	5.500	5.598	5.361
Swordfish, sailfish, marlin	0.163	0.168	0.173	0.179	0.186	0.190	0.198	0.209	0.204	0.221	0.245	0.185	0.279	0.324	0.372	0.373	0.374	0.375	0.376	0.637
Misc. marine orgs.	0.019	0.020	0.020	0.021	0.022	0.022	0.024	0.026	0.021	0.029	0.033	0.004	0.057	0.044	0.031	0.031	0.032	0.033	0.034	0.023

Artisanal Zone D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Misc. shells	0.751	0.708	0.914	0.808	0.958	0.580	0.551	0.566	0.702	0.589	0.569	0.492	0.785	0.665	0.542	0.364	0.442	0.481	0.457	0.491	0.508
Squid	0.894	1.000	2.475	4.302	4.353	6.579	5.645	5.618	5.627	4.845	4.787	4.124	6.043	6.221	6.802	8.091	7.774	8.055	8.512	8.653	8.967
Cuttlefish	0.180	0.266	0.112	0.111	0.201	0.336	0.308	0.345	0.547	0.495	0.465	0.459	0.340	0.288	0.234	0.158	0.191	0.208	0.198	0.212	0.220
Octopus	0.258	0.290	0.367	1.326	0.845	1.154	0.683	0.703	0.505	0.569	0.566	0.557	0.608	0.515	0.419	0.282	0.342	0.372	0.354	0.380	0.393
Sea cucumber	0.616	0.565	0.644	0.613	0.238	0.326	0.388	0.199	0.174	0.179	0.155	0.165	0.427	0.362	0.295	0.198	0.241	0.262	0.249	0.267	0.277
Sardine	4.942	4.475	4.188	3.621	2.993	2.309	1.554	0.733	0.627	0.297	0.295	0.548	2.013	1.704	1.389	0.934	1.134	1.233	1.171	1.259	1.303
Swordfish, sailfish, marlin	0.674	0.650	1.263	1.507	0.821	1.516	1.769	1.032	1.808	1.969	1.972	2.807	1.353	1.146	0.934	0.628	0.763	0.829	0.787	0.846	0.876
Misc. marine orgs.	0.050	0.054	0.037	0.047	0.075	0.202	0.211	0.174	0.154	0.158	0.144	0.142	0.104	0.088	0.072	0.048	0.058	0.064	0.060	0.065	0.067