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EQUATORIAL GUINEA: A CATCH RECONSTRUCTION (1950-2010)

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ABSTRACT

Despite a scarcity of pertinent information, it has been possible to tentatively reconstruct time series of marine fisheries catches for Equatorial Guinea for the years 1950 to 2010. Small-scale fisheries, industrial large-scale fisheries, domestic and legal and illegal foreign fisheries and their discards are all included. Total catches within Equatorial Guinea's EEZ were estimated at 2.7 million tonnes over the time period considered, of which 653,000 tonnes were domestically caught compared to 165,000 tonnes reported by FAO. The present study shows that fisheries have more importance for Equatorial Guinea's food security than the official data suggest. In contrast to what is suggested by official figures, fisheries were shown to be strongly impacted by civil and political unrest; notably, they declined overall because of civil and political conflicts, socio-demographic dynamics, and a growing role of the newly discovered oil resources, which directly and indirectly threaten the food security of the people of Equatorial Guinea.

INTRODUCTION

Equatorial Guinea consists of a mainland component, Río Muni, located between Cameroon and Gabon (and where 80% of the population live), nearby islands (Corsico and the Elobay group) and more distant islands including Bioko (the former Fernando Pó, off the coast of Cameroon) and Annobón (off the coast of Gabon). Bioko, the site of the capital of Equatorial Guinea, Malabo, used to serve as a refuge for freed slaves from the neighbouring countries (Fegley 1981).

Equatorial Guinea, the only country of sub-Saharan Africa colonized by Spain, gained independence in 1968. During the Spanish colonial period, Equatorial Guinea had the highest per capita income in Africa (Kümpel *et al.* 2010). After independence, a reign of terror under President Francisco Macias Nguema began (Fegley 1981); Equatorial Guinea became, between the late 1960s and the late 1970s, the most repressive dictatorship Africa had ever known. The country was then qualified as "worse than Nazi occupied Europe" by Fegley (1981) and "a large torture camp" by Liniger-Goumaz (1985). In the 1970s, 50,000 people (10% of the population) were murdered (Fegley 1981), and 125,000 people (a quarter of the population) became refugees in other countries (Liniger-Goumaz 1985), while immigrants were treated abominably. By 1976, 40,000 Nigerians brought to Equatorial Guinea to work on cocoa plantations (Fegley 1981) were sent back home. This situation drove the economy to a slump (Aworawo 2010), and Macias was overthrown in a military coup in 1979 by members of his own clan (Fegley 1981). From 1979 to the mid-1980s, the rebuilding of Equatorial Guinea's economy has focused on immediate benefits from extensive resource exploitation (Castroviejo *et al.* 1994). This is further illustrated by the nickname used to refer to the Minister of Forestry, i.e., "Minister Responsible for Chopping Down Trees" (Wood 2004). With the discovery of substantial offshore oil reserves, Equatorial Guinea shifted from cocoa to the petroleum business in the mid-1990s (Liniger-Goumaz 1985). Today, earnings from oil and gas represent some 97% of the country's exports, and thus Equatorial Guinea has been dubbed the "Kuwait of West Africa" (Wood 2004). Although the country is sometimes referred to as 'rich', a large part of the population remains extremely poor, a result of the former government having forced the population to revert to subsistence agriculture (Wood 2004).

Of the few major ethnic groups in the country, the Fang are the dominant group (80% of the population). They inhabit the mainland (Rio Muni), and are primarily hunters and subsistence farmers (East *et al.* 2005; Fa *et al.* 2009). The *Playeros* (Beach people, Spanish word used for the Ndowe ethnic group), practice fishing and subsistence agriculture as their main activities. The Bubi live on the island of Bioko, and represents 9% of the population. The Bubi, previously fishers and whale hunters, have now converted to agriculture (Liniger-Goumaz 1985). The Fernandinos –descendants of freed slaves, originally from Sierra Leone, Ghana and Nigeria - and the Annobón are other two minority groups (Fegley 1981; Fernandez Moreno 1996). Today, most of the livelihoods in Equatorial Guinea are based on subsistence activities and the population struggles to meet basic needs; Equatorial Guinea thus ranks among the least developed countries in the world based on the purchasing power parity (PPP) per capita (Fernandez Moreno 1996).

With the collapse of the former post-independence government, international relations improved. In 1982, Nigeria and Equatorial Guinea signed an agreement focusing on trade but also resource exploitation notably fishing and agriculture. Other agreements followed, notably with the EU, Spain, France and China.

Other than socio-anthropological reports, and political analyses that barely hint at the existence of a fishery sector, very scarce qualitative and quantitative data and published reports are publicly available on the fisheries of Equatorial Guinea. Indeed, up to 1976, the Spanish government classified all information as “*materia reservada*” (Fegley 1981; Liniger-Goumaz 1985). As for Macias’ oppressive rule, it stopped any flow of information up until he was overthrown. Today, “all publications are subject to censorship” (Wood 2004), hence causing difficulties with accessing fisheries information. Thus, the catch data found in the FAO database for Equatorial Guinea consist largely of estimates designated by the letter ‘F’, i.e., dubious data that are often the result of *ad hoc* working groups generating numbers in response to some external demands (SOFRECO 2011). There is no efficient statistical system for data collection (PMC 2007), except a few sporadic development surveys in the 1980s (Matthes 1980; FAO and WHO 1985; FAO 1986; UNCED 1992; FAO 2003), most of which are fragmentary, when not contradicting each other. While statistical monitoring of artisanal fisheries remains rudimentary (FAO 2010) to non-existent (Kebe *et al.* 2007), industrial fisheries statistical monitoring relies on agents onboard industrial vessels (FAO 2010).

The FAO statistics, featuring relatively low numbers, suggest that the fisheries are under-developed, but the over-exploited/depleted status of the marine fisheries of Equatorial Guinea suggests the opposite (East *et al.* 2005). Literature refers to the creation of marine protected areas which purpose was to rebuild marine fish populations, such as in Rio Muni Estuary and on Annobón (Castroviejo *et al.* 1994).

When an online search is made for “Equatorial Guinea” and “history of fishing”, what appears are studies on either bushmeat or whaling. Whaling was indeed an important activity particularly at the local small-scale level, until it collapsed in 1951, due to a rapid reduction in the targeted whale population caused by over-exploitation (Aguilar 1985; Liniger-Goumaz 1985). Whaling, which was described to be mainly for subsistence, was then replaced by fishing, also conducted at subsistence level, given the very nature of an under-developed economy (Matthes 1980). While the waters of Equatorial Guinea are productive (Fadayomi 1984), and possibly could sustain a catch of as much as 240,000 t-year⁻¹ (East 2003), the post-independence government under the presidency of Macias outlawed fishing and destroyed all fishing infrastructure, in a bid to stop the beleaguered population from escaping by sea (East 2003).

Currently, the animal protein supply in Equatorial Guinea is ensured by bushmeat and fish, both of which being essential to the Equatoguinean diet (East *et al.* 2005). Freshwater and estuarine fish caught mostly by women and children in continental Equatorial Guinea plays a major role in supplying the population with animal protein (Perpiñá Grau 1945; Matthes 1980; Keylock 2002). This is particularly true for the poor communities who cannot afford other types of animal protein (Fa *et al.* 2009). This, along with relatively low prices (Keylock 2002; East 2003), makes fish an important substitute for other types of animal protein such as bushmeat to ensure food security of the Equatorial Guinea’s populations (Wilkie *et al.* 2005). Therefore, both to understand Equatorial Guinea’s dependence on fisheries and its contribution to global fish catches, we attempt herein to reconstruct the history of fisheries and marine fisheries catches in Equatorial Guinea using the scant available literature, following the approach defined by Zeller *et al.* (2007).

METHODS

Human population

When data on the fishing effort lacks, population data might be used as a proxy to realistically assess both trends of fishing and catches, as population movements (e.g. coastal migrations) could be directly related to fisheries exploitation (Pauly 1990). Population data was extracted from Populstat (www.populstat.info [2013]) for the period from 1950 to 1979, and from the WorldBank database (www.worldbank.org [2013]) for the subsequent years. Although a recent census by the *Ministerio de Planificación y Desarrollo Económico* in 2002 shows a population of 1 million (Kümpel *et al.* 2010) compared to 551,400 estimated by the WorldBank, this census - which incidentally coincided with a presidential election - is believed to have been drastically inflated to facilitate ballot stuffing (Wood 2004). Data were interpolated to fill in the gaps. Coastal population was estimated at 263,480 persons living within 10 km from the coast in 2012 (CIESIN 2012) for a total population of 736,296, i.e., 36%. The description of the population on the island of Bioko, along with socio-demographic events (e.g. the departure of Nigerians), and political events, e.g. the prohibition from approaching the coastline for the island populations, imposed by the 1969-1979 regime (East 2003), were all combined to estimate the population on the islands at different points in time (Appendix Table A1). Subtracting island population from the total population allowed for the estimation of the population in Rio Muni (i.e., continental Equatorial Guinea).

Given the relatively small size of the islands, we assumed that all of their population was coastal and applied the previous coastal population proportion (36%) to the population on Rio Muni. We could then estimate the magnitude of two population segments: the insular segment (assumed all coastal) and the coastal population on the continent (Rio Muni). For 2010, we multiplied the population by the coastal population proportion (36%). Then we interpolated linearly to fill in the gaps (Appendix Table A1).

Small-scale fisheries

Small-scale fisheries include subsistence fisheries, also referred to as traditional fisheries, where the fishing activity is driven by personal consumption (Fond Africains de Développement 1997) or trade for food and staples, in contrast to artisanal fisheries which are mostly aimed at supplying Equatoguinean markets, associated with higher costs, and return on investment. Small-scale fisheries may have been aimed mainly at subsistence in the past, due to their “archaic” gear (Carrasco Saiz 1966). Although their gears have improved, small-scale fisheries are still thought to be of a lower importance in terms of catches than industrial fisheries (Anon 2008), and therefore, they are still disregarded. The artisanal fishery operates canoes called ‘*cayucos*’, ranging from 2 to 11 m, with or without an outboard motor and carrying trammel nets, gill nets or other gear. Cast nets, hooks and lines, driftnets, traps, baskets and buckets, weirs and barriers and other gear are also used, especially in estuaries (FAO 2003).

During Macias’ rule, a fishing ban designed to prevent escape from the country was enforced, which bankrupted the island of Fernando Pó (the oppressed minorities being the Bubi and the Fernandinos living there). The people of the islands were prevented from going near shore (Fegley 1981), canoes were destroyed (Matthes 1980), and all information had to remain on the islands. This, in addition to the extortion of whatever fish managed to be caught at maritime military ‘checkpoints’ called *barreras* (Campos-Serrano 2013), contributed to a massive decrease of small-scale fisheries from 1969-1979 (Morillas Gómez 2004).

Nigerian, Gabonese and Cameroon migrants were also acting as fishers in the past on the islands (Everett 1991), but the constraints on fishing off the islands and the civil disorder of the late 1970s pushed these fishers to leave, leading to a decline of fishing pressure (Everett 1991). On the other hand, during the 1970-1980 time period, a massive number of people moved to the coast of the mainland (Rio Muni), which contributed to overfishing and resource depletion of some marine and brackish water fisheries (Castroviejo *et al.* 1994).

A household consumption survey, as opposed to apparent fish consumption given by FAO and calculated as the fish supply (i.e., landings and imports) divided by the total population, undertaken by (Carrasco Saiz 1966) in the former Spanish Guinea in 1963, sampling around 2,150 people (307) households revealed that on average, 85 % of animal protein consumed came from fish for a total of 34 g of protein (meat and fish) per person per day, i.e., 29 g of fish protein. Taking into account that 18 g of animal

protein resulted from the consumption of 100 g of fish (Albrechtsen *et al.* 2005), the daily per capita consumption of fish would have been around 161 g·day⁻¹, i.e., 58.6 kg·capita⁻¹ for 1963.

On the other hand, fresh fish consumption, i.e., originating exclusively from domestic small-scale fisheries was estimated by (Fa *et al.* 2009) by species per Adult Male Equivalent (AME) equivalent to 0.96 capita, for which we estimated the weighted average and added 0.8 t·year⁻¹ of molluscs provided separately by divided by the total number of AME. We therefore, estimated 12.97 kg·AME⁻¹·year⁻¹ (13.5 kg·capita⁻¹·year⁻¹, after converting AME to capita) from small-scale fisheries in Equatorial Guinea. We multiplied the previous rates (58.6 kg·capita⁻¹ for 1963 and 13.46 kg·capita⁻¹ for 2003) by the total population for the two years respectively to estimate the total supply from small-scale fisheries, and then divided these by the coastal population for 1963 and 2003 to derive per capita consumption rates as per capita catches by the coastal population. The per capita catch (for coastal population) was therefore derived as 104 kg·capita⁻¹ for 1963 and 36.1 kg·capita⁻¹ for 2003. Using the coastal rather than the total population allowed us to take into consideration some of the historical and socio-demographical events described previously. We interpolated these per capita catch estimates, assuming they were constant between 1950 and 1963, and 2003 and 2010 respectively. We then multiplied per capita catch estimates by the coastal population (Appendix Table A1) and obtained total catches from small-scale fisheries between 1950 and 2010.

Consumption surveys conducted in the 2000s revealed that of the total fish consumed, between 4% (Albrechtsen *et al.* 2005; East *et al.* 2005; Allebone-Webb 2009; Fa *et al.* 2009) and 25% (Keylock 2002) were either caught directly by a member of the household or received. This means that on average 14.5% were caught directly as fish could only be bought (in which case it is from artisanal fisheries and/or imports) or caught by one member of the household (Allebone-Webb 2009). We assumed this rate was 50% in the 1950s and 1960s prior to the post-independence government restriction on fishing in the islands. Back then, small-scale fisheries were primarily for subsistence (Carrasco Saiz 1966). The 50% estimate was then increased slightly (to 55%) during the mid-1970s and 1980s, to account for the migrations of people towards the coast of Rio-Muni (Castroviejo *et al.* 1994), which compensated for the restrictions imposed upon the insular parts of the country. The rates estimated using literature had some limitations, notably due to the fact that most but not all households sampled were either in urban centres or near urban centres. Furthermore, our choice of 50% is based on the fact that most small-scale fisheries were mostly directed towards subsistence in the past, although we assumed that “mostly” is at least half of small-scale fisheries, there is a range of other equally probable rates that are higher that could be used. However, it is reasonable to assume that such conservative averages grasp the picture of the evolution of the contribution of subsistence fisheries to small-scale fisheries. We interpolated linearly these rates and multiplied the latter by the total small-scale catch to estimate subsistence catches. The difference between total small-scale catches and subsistence catches yields the artisanal catch.

Our estimation did not take into account dried/tinned fish consumed at a lesser extent (Kümpel *et al.* 2010), which in one hand makes it conservative and on the other hand, avoids a bias caused by these fishes originating from the neighbouring countries via informal import channels (Tall 2007). Furthermore, using consumption surveys to estimate small-scale catches also accounts for the fish caught and consumed by bushmeat hunters while in the hunter camps because these surveys also targeted this segment of the population (Kümpel *et al.* 2010). The latter would only bring the bushmeat to villages and fish catches, although very low, would be completely unreported. Although these would be suspected to be freshwater catches, using coastal population data allows filtering out these from the dataset. Furthermore, Matthes (1980) reported large amounts of exports to Gabon and Cameroon that might be informal, and therefore not accounted for.

The subsistence fishery of Rio Muni mainly consists of estuarine catches of catfishes (*Chrysichthys* spp.), tilapia (*Oreochromis* spp.), snappers (*Lutjanus* spp.) and pampanos (*Trachinotus* spp.) (FAO 2003), for which we assumed equal proportions, while the taxonomic breakdown for artisanal fisheries was derived from data on the frequency of fish categories reported as the three most important catches in the 2011 fishing season (Hellebrandt and Allison 2012). The frequency reported for each species is then multiplied by the average weight obtained using FishBase, for which the percentage was then estimated in proportion to the total (Table 1).

Recreational fishing

Recreational fishing is primarily conducted by tourists (PMC 2007). A hotel in the *Parc National de Mont Alén* received 200 tourists per year in 2007 (Anon 2007). We assumed only 80% (160) of these fished for three days per year, assuming an average vacation stay of one week. While data on the number of tourists visiting Equatorial Guinea were scarce, total tourist expenditure was available for the years 1996 to 1999 (AFRISTAT 2008). Similar data available online¹ suggest the start of tourist activities date back to 1995, but we assumed here the number of recreational fishers for 1995 was zero. We used the expenditure data by AFRISTAT (2008) to extrapolate the trend forward to 2007, i.e., 166% increase compared to 1999, and then to 2010, i.e., 19% increase compared to 2007. We applied the trend in tourist expenditure to the previous number of recreational fishers for 2007 (160), and estimated the number of recreational fishers at 60 for 1999 and at 192 for 2010. We interpolated from zero in 1995, to 60 fishers in 1999, and then to 160 fishers in 2007 and 192 in 2010. Since all travellers to Equatorial Guinea need a travel and a photographic permit², videos on YouTube were very scarce, and only two videos, documenting four fishers could be used to estimate an average CPUE of 14 kg·fisher⁻¹·trip⁻¹. We assumed this CPUE was constant between 1995 and 2010, and multiplied it by the number of fishers and the number of trips per fisher per year, and estimated the total recreational marine catch in Equatorial Guinea. The documented catch showed on average 52% of barracudas (*Sphyraena* spp.), 18% of groupers (*Epinephelus* spp.), 9% of jacks (Carangidae) and 21% of other fishes.

Industrial fisheries

Domestic industrial fisheries are reported as completely non-existent (Beaudry *et al.* 1993; Anon 2004), but there are a few domestic companies, i.e., owned by the state or firms based in Equatorial Guinea, that operate industrial vessels, i.e., *Guinea Pesca S.A*, *Alfa Marina S.A*, *Armement de Pêche-Gabon* (OECD 2008). Monitoring of industrial vessels relies on statistics communicated directly by these vessels (when indicated in agreements) and/or agents onboard, in which case, data produced could be highly dubious (FAO 2010).

There is no clear evidence documenting the start year of industrial fishing, and colonial archives made available only recently (www.opensourceguinea.org [2013]) with detailed economic exploitation potential only referred to fisheries as a mean of subsistence for the local population, while emphasizing forestry and agriculture, notably cocoa (Perpiñá Grau 1945). Thus, it is likely the only fleet present at the time was of Spanish origin and ownership for which trawlers of 40 GRT were documented in 1941 (Government of Spain 1941). Fishing vessels from other countries, notably trawlers, joined later. The effort was retraced using different sources for 9 countries. The former Soviet Union (USSR) had unlimited fishing access between 1970 and 1979 (Fegley 1981; Fadayomi 1984; Aworawo 2010), when no statistics were supplied other than data documenting a few landings of low-value fish (Matthes 1980); Spain was operating in Equatorial Guinea since the early 1940s even when the Soviet Union was granted exclusive rights to fish in Equatorial Guinea (Government of Spain 1941; FAO 2003), while France started as soon as the Soviet Union left in the early 1980s (FAO 1986; Churchill 1987; Ministerio de Defensa 2006). Nigeria and Cameroon signed agreements with Equatorial Guinea right after the coup d'état in 1979 (Carroz and Savini 1983; Mangatalle 1996) and São Tomé and Príncipe in 1983 (Carroz and Savini 1983) and then the European Economic Community (EEC) in 1984 (Anon 2004) along with a series of EU-Equatorial Guinea agreements (Appendix Table A2). Here, we assumed the number of vessels from Spain was constant from 1950 to 1960. We also conservatively assumed the number of fishing vessels was 1 for São Tomé and Príncipe.

The CPUE for Nigerian trawlers and purse-seiners of 1,000 GRT (Mangatalle 1996) was conservatively estimated at 600 t·boat⁻¹ for 1985 (Fadayomi 1984), whose estimate is based on official numbers. We assumed the CPUE was 10% higher in 1950 (660 t·boat⁻¹·year⁻¹) and 20% lower in 2010 (480 t·boat⁻¹·year⁻¹) relatively to the CPUE for 1985, given clear signs of overexploitation (Morillas Gómez 2004). We interpolated linearly to complete the time series. Thereafter, we assumed the CPUE for domestic vessels and those from Cameroon and São Tomé and Príncipe was half the CPUE of the vessels from Nigeria because of their lower efficiency and size, e.g. the GRT per vessel was half the GRT for Nigerian vessels

¹ <http://www.indexmundi.com/facts/equatorial-guinea/international-tourism> [Accessed on August 06, 2013]

² <http://www.lonelyplanet.com/equatorial-guinea> [Accessed on August 06, 2013]

(Mangatalle 1996). Similarly, because vessels from Europe were more efficient, we assumed the CPUE for European and Chinese vessels to be 20% higher than that of the Nigerian vessels. Between 1982 and 1986, we divided the CPUE for Spain by two, to account for the fact that Spanish vessels (although under agreement with Equatorial Guinea) did not all operate exclusively in the EEZ of Equatorial Guinea (Matthes 1980). As for the Soviet Union, five shrimpers landed 3,840 t·year⁻¹ of “trash fish” in 1978 while most of the catch remained unreported (Matthes 1980). Therefore, we assumed this catch represented 30% of the total Soviet catches for 1978 (Matthes 1980). Therefore, we assumed this catch represented 30% of the total Soviet catches for 1978, i.e., a total of 12,800 divided by the number of vessels (5), and obtained a CPUE of 2,560 t·vessel⁻¹·year⁻¹. We applied the same rates as for other countries to reflect on over-exploitation and estimated a CPUE of 2,761 t·vessel⁻¹ for 1950 and 2008 t·vessel⁻¹ for 2010, which we interpolated linearly to fill in the gaps. We obtained industrial catches by multiplying the effort per country by the respective CPUE.

Illegal fishing

Illegal fishing encompasses all activities by vessels that are not authorized to fish in Equatorial Guinea's EEZ. Regarding illegal fishing, the literature refers to Equatorial Guinea as an irresponsible flag state (Österblom *et al.* 2010). Indeed, as Equatorial Guinea emerges as a flag of convenience state in the early 2000s (Österblom *et al.* 2010), a few vessels appeared to be on most common IUU lists, mostly from China (Gianni and Simpson 2005). Despite multiple sanctions, vessel blacklisting and bans, Equatorial Guinea remains a low-standard ship registration country (Wood 2004; Österblom *et al.* 2010; Robin *et al.* 2010), which can only begin to illustrate the low level of fisheries control, monitoring and surveillance prevailing in the country itself. This suggests high rates of illegal fishing. Furthermore, Equatorial Guinea has also become a narco-state, acting as a staging post for drug operation where cargos are received from the high seas (Wood 2004); thus, the presence of illegal fishing vessels should be strongly suspected. However, in the particular case of Equatorial Guinea, a number of officials and military are often involved in drug dealing (Wood 2004) which would provide a reason to monitor the Equatorial Guinea's EEZ, if only to keep a tab on their operations, implying that illegal fishing, although high, would be relatively lower than in the neighbouring countries. The presence of intensely protected offshore oil exploitation platforms monitored by the Navy supports this assumption. Finally, illegal presence of fishing vessels in Equatorial Guinea's EEZ is potentially dangerous in a country whose malicious government is cautious of any coup attempts given a rich history of such attempts (Wood 2004), e.g. Nigerian fishers claiming to be lost were accused of preparing a *coup d'état* (Amnesty International 2010).

In 1952, Spain created the *Guardia Maritima Colonial de los Territorios de España en Guinea Ecuatorial* with the mission of monitoring coasts and fisheries (Ministerio de Defensa 2006). Thereafter, in the early 1970s, Soviet agreements with Equatorial Guinea included a strong military presence, notably in form of three highly sophisticated intelligence vessels (Baynham 1980). Their presence, along with high security levels imposed by Macias suggests that illegal fishing could have started only in the early 1980s. In the last decade, patrolling at sea by *barreras* increased due to incursions and recent attacks from the Niger Delta (Campos-Serrano 2013). However, these patrols are of a relatively low efficiency and illegal fishing has probably increased (see also Morillas Gómez 2004). While the main objective of these is the surveillance of offshore oil exploitation platforms (Bricola 2008), the patrol vessels initially donated by the US to monitor the fishing ban along the coast are more involved in controlling and monitoring the potential infiltrations and return of refugees from Cameroon and Gabon rather than illegal fishing (Liniger-Goumaz 1996).

Illegal, unreported and unregulated (IUU) fisheries catches in Equatorial Guinea were estimated at 61% of declared catches (MRAG 2005), of which 14% was illegal fishing as defined in the present contribution, estimated using MRAG (2005) data (five cases against a total of 36 IUU activity reports in Africa). We assumed illegal fishing began in 1980 (zero in 1979), and interpolated linearly to 14% in 2005, which we kept constant between 2005 and 2010. We first smoothed the landing data supplied to the FAO and used these as a baseline, then applied the previous rates of illegal fishing to the baseline data, to estimate total illegal catches. Industrial illegal catches are believed to be exclusively Soviet between 1980 and 1985, to reflect the lack of monitoring during those years, and decreased linearly until they were zero at the collapse of the former Soviet Union in 1990, gradually replaced by illegal catches by Chinese vessels, which are now prevalent in the area (FCWC 2011).

Discards

Little information is found on discards in the waters of Equatorial Guinea. While Kelleher (2005) provides an extremely low discard rate of 0.5% for that country, which was applied to the domestic catches estimated here. Bricola (2008) indicated that discarded by-catch was often very high in the Gulf of Guinea and in Equatorial Guinea, and that a small portion of the unwanted by-catch that would otherwise be discarded is bought by artisanal fishers from industrial vessels while at sea. Therefore, we conservatively assumed the equivalent of 30% of the catch by industrial Spanish, Soviet and Chinese trawlers were discarded. We applied a discard rate of 0.5% to the remaining Italian, French and Portuguese tuna vessels, and the vessels from Cameroon, Nigeria, and São Tomé and Príncipe.

Taxonomically, there was no available information specifically on industrial fisheries of Equatorial Guinea, nor their discards. Therefore, we assumed the species breakdown of neighboring Cameroon would apply to industrial fisheries of Equatorial Guinea, given similarities in the industrial fleets operating in both countries (Table 2).

RESULTS

Artisanal catch

Artisanal catches between 1950 and 2010 from Equatorial Guinea's EEZ were estimated at around 338,800 tonnes (t). Artisanal catches increased slightly from 5,300 t in 1950 to around 7,400 t in 1970, and then decreased to remain at a minimum of around 3,200 t-year⁻¹ in a decade (1970s) when massive restrictions were imposed on marine fishing by the former Equatorial Guinea's government (Figure 2). Artisanal catches increased thereafter to 7,700 t in 2010 (Figure 2).

Subsistence catch

Subsistence catches were estimated at over 249,000 t between 1950 and 2010. In contrast to artisanal catches, subsistence catches decreased from around 5,300 t in 1950 to 1,300 t in 2010 (Figure 2), highlighting a tendency toward market-orientated fisheries. The first drastic decrease in subsistence catches coincides with onset of Macias' rule in the late 1960s, when catches decreased from 7,800 t in 1970 to 3,500 t in 1980 (Figure 2). Catches remained relatively stable during the 1980s, and then decreased with the beginning of oil exploitation which drove important migrations towards urban centres in the late 1980s (Figure 2).

The contribution of subsistence fisheries to total small-scale fisheries has declined over time (Figure 2) compensated by an increase in the contribution of artisanal fisheries.

Women go fishing typically less than once a month (Keylock 2002), mainly in brackish-waters and along rivers (Perpiñá Grau 1945), while men spend an estimated 152 days per year fishing (Anon. 2007). Furthermore, for each woman fishing, there are, on average, 3 fishermen (Keylock 2002). Therefore, in addition to most of the subsistence catch being taken by women, at least 2.3% of the artisanal catch (7,800 t) is taken by women, i.e., a total of 243,000 t between 1950 and 2010, or 37% of the domestic catch.

Recreational catch

Recreational catches were estimated at 68 t since they began in 1996, and consist mostly of barracudas (*Sphyraena* spp.), groupers (*Epinephelus* spp.) and various species of jacks (Carangidae) along with other unidentified fish species. These catches increased rapidly from 1 t in 1996 to 8 t in 2010 (Figure 3).

Industrial

Legal fleets

Industrial domestic

Industrial domestic catches from Equatorial Guinea waters were estimated at around 65,000 t between 1986, when they began, and 2010. Industrial domestic catches, although highly variable over time due to a changing fishing effort, were marked by two peaks, the first one of 4,100 t in 1989, and the second, with 3,700 t in 2007, after which catches declined to 2,900 t in 2010 (Figure 4).

Industrial foreign

Industrial foreign catches were estimated at 2.0 million t between 1950 and 2010, and represented the bulk of catches in the EEZ of Equatorial Guinea. Foreign catches, which were relatively constant during the 1950s and 1960s at around 14,000 t, increased to 37,000 t in 1978 when Equatorial Guinea and the Soviet Union signed a fishing agreement, then decreased drastically to less than 1,500 t in 1979, following the end of Macias' rule (Figure 5). Industrial catches increased drastically with the first agreement with Spain, then with the EU, to 88,000 t in 1990, after which the fluctuations were due to changes in the number of vessels allowed to fish in Equatorial Guinea (Figure 5).

Industrial foreign catches had a different profile in the past than that of today. In the 1950s and the 1960s, all foreign vessels were of Spanish origin. With the exclusive fishing rights handed to the Soviet Union, all foreign vessels between 1973 and 1978 were Soviet. At the departure of the Soviet fleet, after the collapse of Macias' rule, the foreign vessels were all French in 1979, then Spanish in 1980, after which African states' (notably Nigeria and Cameroon) contribution to total foreign catches reached around 20%. Foreign vessels were mostly of European origin during the 1980s and the 1990s, but at the cancellation of fishing agreements with the EU in 2001, China along with African states (Cameroon, Nigeria and São Tomé and Príncipe) emerged as having the largest fishing fleets in Equatorial Guinea (Figure 5).

Illegal fleets

Illegal catches between 1950 and 2010 were estimated at 13,000 t. Illegal catches increased from zero in 1979 to around 1,200 t in 2010 (Figure 6). Illegal catches were taken by Soviet vessels in the past, which were gradually replaced by Chinese illegal catches of 1,200 t in 2010 (Figure 6).

Discards

Domestic industrial discards were estimated at 320 t between 1950 and 2010 (Figure 7). Domestic discards followed the same pattern as industrial domestic catches which are mostly driven by effort changes, i.e., changes in the number of vessels. On the other hand, foreign discards were estimated at 275,400 t between 1950 and 2010, most of which was generated by the legal fleet (99%). Foreign discards were relatively constant between 1950s and the mid-1960s at around 3,100 t·year⁻¹ (Figure 8). Discards increased with the presence of Soviet vessels to 8,400 t in 1978, after which the agreements with the Soviet Union were cancelled, which drove the industrial catch to its lowest levels. Discards increased again to a peak of 16,100 t in 1981, when Spain and Equatorial Guinea signed the first fishing agreement for around a hundred trawlers and varied thereafter, following fluctuations of fishing effort and catches, before reaching 2,100 t in 2010 (Figure 8).

Reconstructed total catch

Total removals from Equatorial Guinea's EEZ were estimated at 2.7 million t between 1950 and 2010, a quarter of which were by the domestic sectors, i.e., 653,000 t compared to the 165,000 reported by FAO, the remainder (2.1 million t) being generated by foreign fleets. Small-scale sector caught around 588,000 t between 1950 and 2010, which represented 90% of domestic catches. Total removals from the waters of Equatorial Guinea were relatively constant during the 1950s and the 1960s at around 26,000 t·year⁻¹ on average, increased to a first peak of 43,000 t in 1978, before the departure of the Soviet trawlers, decreased to their historical minimum of 8,000 t in 1979 driven by political changes, and increased to a historical maximum of 99,700 t in 1990 when fishing effort (notably foreign fishing effort) was at its

highest levels. Catches decreased thereafter, though with some fluctuations, to around 33,200 t-year⁻¹ on average during the late 2000s (Figure 9a). Domestic catches included mostly jacks, groupers and snappers (Figure 9b), while foreign catches targeted mainly croakers, sparids and grunts (Figure 8b).

DISCUSSION

Total catches from Equatorial Guinea's EEZ were estimated at 2.7 million t between 1950 and 2010, of which 653,000 t were caught domestically, in stark contrast to the figure of 187,000 t based on official data recorded in FAO's global fisheries statistical databases (FishStat). The small-scale sector caught around 588,000 t between 1950 and 2010, which represented 90% of domestic catches, twice higher than the figures reported in FAO FishStat.

Equatorial Guinea is classified as 'food insecure' in that most of the animal protein consumed appears to be imported (East 2003). However, we show here that imported fish (114,000 tonnes according to the FAO database) constitutes less than 50% of available fish supply.³ The importance of domestic fish supply is further illustrated by the fact that the population of Equatorial Guinea, particularly the one living in the areas classified as "food insecure" consumes animal protein –mostly fish and bushmeat–on a daily basis. Thus, the overexploitation of bushmeat species (East *et al.* 2005) adds an interesting and dangerous twist to the situation where fish is increasingly used as a substitute. While FAO and WHO (1985) recommend an average daily allowance of 52 g of protein per day, fish alone in Equatorial Guinea supplies 39 g of protein daily on average (Albrechtsen *et al.* 2005; Fa *et al.* 2009) which represent 75% of the protein allowance recommended in contrast to official figures of 58% (FAO 1997). This further illustrates the importance of fisheries to food security in Equatorial Guinea, as also highlighted by Keylock (2002).

Equatorial Guinea is not only a country where human rights are trampled upon (Wood 2004), but its population is poor and relies on subsistence activity and the informal economy for their food and livelihoods. Indeed, in contrast to official statements regarding the provenance of seafood, which state that 90% of the fish consumed comes from imports (East 2003), the results obtained here showed the domestic marine fisheries contribute about 50% of fish consumption, which drives the contribution of imports down by 40%. The latter may be further driven down if freshwater fish catches were accounted for in the present study.³

Although fishing in Equatorial Guinea is perceived as "another male-dominated livelihood" (Kümpel *et al.* 2010), women fishing with nets in groups contribute to feeding village populations (Nse Angüe 2010); this occurs commonly among the Fang (Mbama Nchama 1990). The latter describe fishing as a mean to bring food home and one of the major occupations of women of Equatorial Guinea in the past (Romero Moliner 1952). Of the total domestic catch of 653,000 t over the 1950-2010 time period, women caught 243,000 t, or 37% of the domestic catch. Neither the catch, nor the effort of these women has ever been reported, other than barely mentioned *en passant*, illustrating how overlooking women's fishing can bias fisheries statistics (Harper *et al.* 2013).

Fisheries in Equatorial Guinea were significantly impacted by the major socio-political events the country went through. This is not reflected in either the official figures nor the FAO statistics, which show constant catches during the 1968-1979 time period. This illustrates the unreliability of these figures. On the one hand, killings, migrations, destruction of boats and other constraints to fishing caused domestic fisheries to decline drastically in the 1970s, while industrial fisheries increased due to fisheries agreements bartered for military assistance. On the other hand, after the departure of the Nigerians working on cocoa plantations during the same years, massive numbers of people migrated towards the coast in search for other livelihood alternatives, notably fisheries (Castroviejo *et al.* 1994), which eventually contributed to increasing domestic catches.

From the government perspective, newly developed oil exploitation contributed to disregarding fisheries as a source of foreign investment, as illustrated by the decreasing foreign catches resulting from decreasing fishing effort. Furthermore, one may suspect that military abuses (Campos-Serrano 2013) and the lack of security within Equatorial Guinea's waters, leading to the emergence of piracy (Blumberg

³ This doesn't account for freshwater fish, which is likely to also be consumed, notably in Rio Muni.

2013), could constitute a high risk for foreign investors. These developments have drastic effects and implications for the long-suffering population of Equatorial Guinea.

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Table 1. Species composition of small-scale artisanal fisheries in Equatorial Guinea.

| Local name | Scientific name | % |
|------------------------------|---|-------|
| Bacalao/bocacerdo | Serranidae | 17.22 |
| Merluza | <i>Sphyraena</i> spp. | 16.58 |
| Colorado | <i>Lutjanus</i> spp. | 14.76 |
| Capitan | <i>Pentanemus quinquarius</i> | 8.54 |
| Raya | Dasyatidae | 7.69 |
| Besugo | <i>Pomadasys jubelini</i> and <i>Pagrus africanus</i> | 5.31 |
| Dorado | <i>Coryphaena hippurus</i> | 4.73 |
| Disco | Carangidae | 3.98 |
| Corvina | <i>Pseudolithus</i> spp. | 2.85 |
| Atun | <i>Caranx senegallus</i> | 2.52 |
| Guitara | Rhinobatidae | 1.09 |
| Lenguado | <i>Cynoglossus</i> spp. | 0.85 |
| Pez alicate | Tetraodontidae | 0.83 |
| Bonito | Scombridae | 0.64 |
| Arregue | <i>Ethmalosa fimbriata</i> | 0.32 |
| Langostas | <i>Panulirus regius</i> | 0.09 |
| Sardina | <i>Ilisha africana</i> | 0.01 |
| Marine fishes not identified | - | 11.99 |

Table 2. Species composition of large-scale fisheries catches in Equatorial Guinea (Laure 1969)

| English name | Scientific name | % |
|------------------------------|---------------------------------|-------|
| Bigeye grunt | <i>Brachydeuterus auritus</i> | 38.99 |
| Senegal seabream | <i>Diplodus bellottii</i> | 26.04 |
| Sea catfishes | <i>Carlarius</i> spp. | 7.24 |
| Bobo croaker | <i>Pseudolithus elongatus</i> | 6.22 |
| Giant African threadfin | <i>Polydactylus quadrifilis</i> | 3.55 |
| Soles | <i>Solea</i> spp. | 3.43 |
| Canary drum | <i>Umbrina canariensis</i> | 2.77 |
| Longneck croaker | <i>Pseudolithus typus</i> | 2.55 |
| Rays | Rajiformes | 2.17 |
| African sicklefish | <i>Drepane africana</i> | 1.90 |
| Seabreams | Sparidae | 0.88 |
| Sharks | - | 0.51 |
| Shrimps | Peneidae | 0.32 |
| European barracuda | <i>Sphyraena sphyraena</i> | 0.28 |
| Crabs | Brachyura | 0.23 |
| Conger | <i>Conger</i> spp. | 0.09 |
| Cuttlefish | Sepiidae | 0.05 |
| Lobsters | Palinuridae | 0.01 |
| Garfish | <i>Belone belone</i> | 0.01 |
| Marine fishes not identified | - | 2.76 |

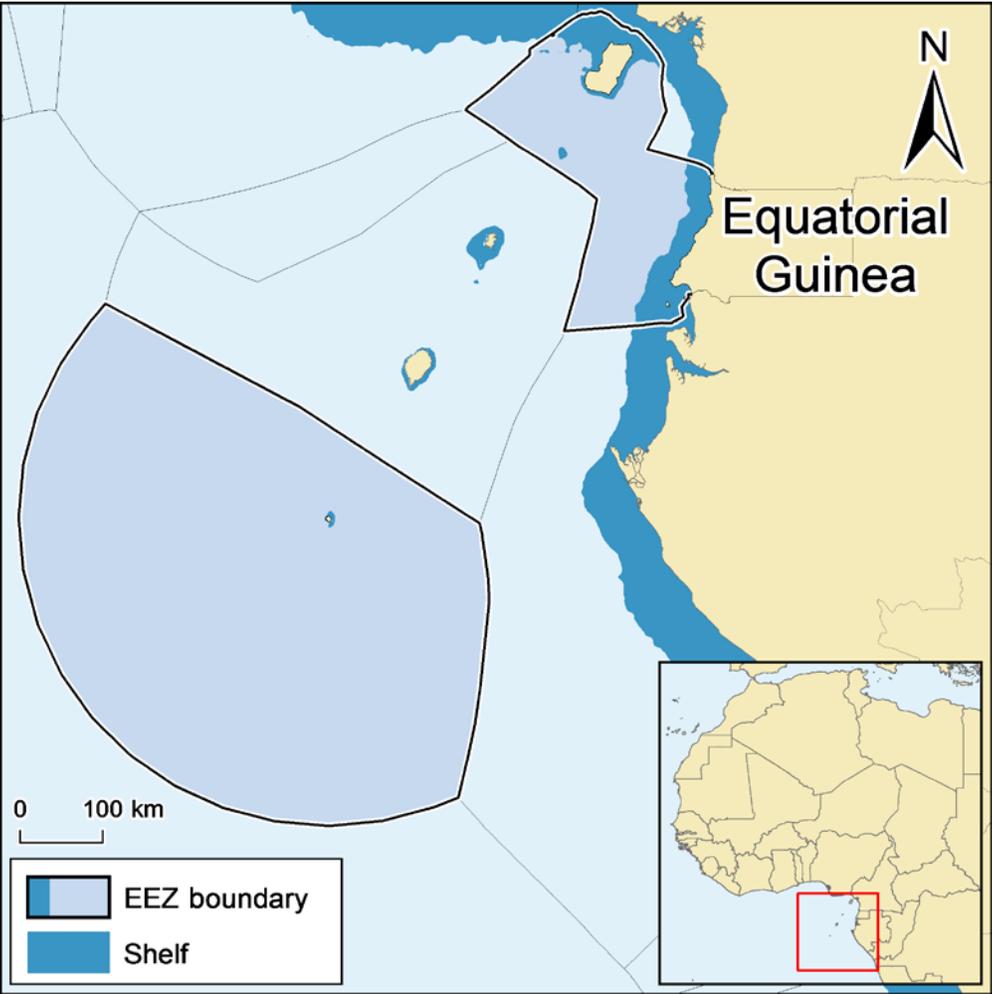


Figure 1. Map of Equatorial Guinea with its Exclusive Economic Zone (EEZ).

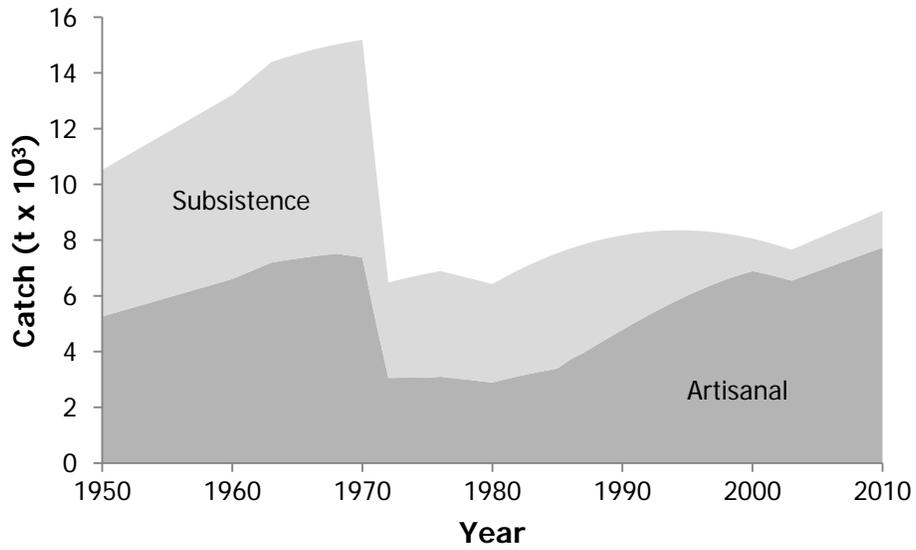


Figure 2. Artisanal and subsistence catch of Equatorial Guinea from 1950-2010.

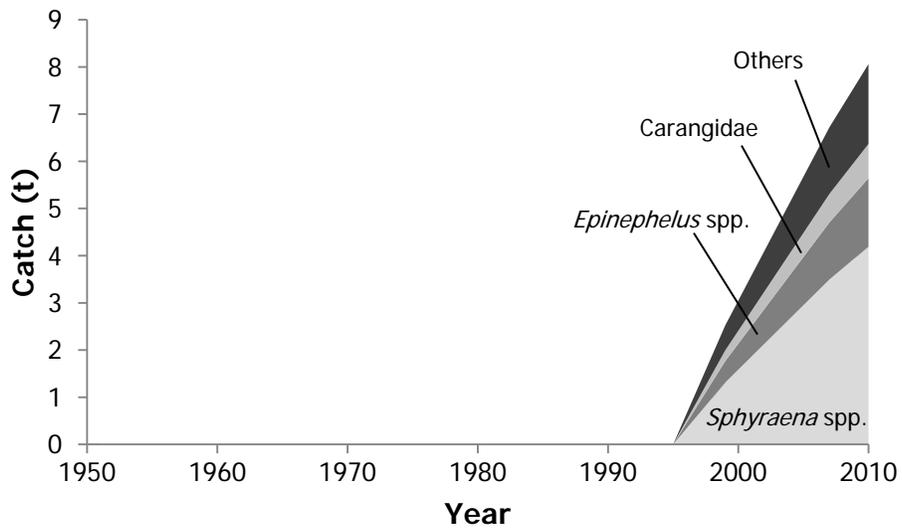


Figure 3. Recreational catch of Equatorial Guinea by taxonomic composition, 1950-2010.

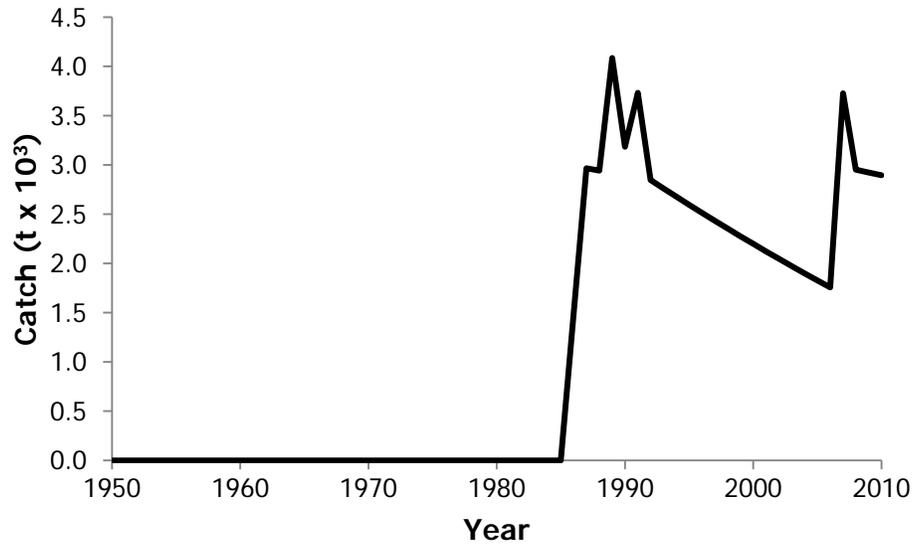


Figure 4. Industrial domestic fleets of Equatorial Guinea, 1950-2010.

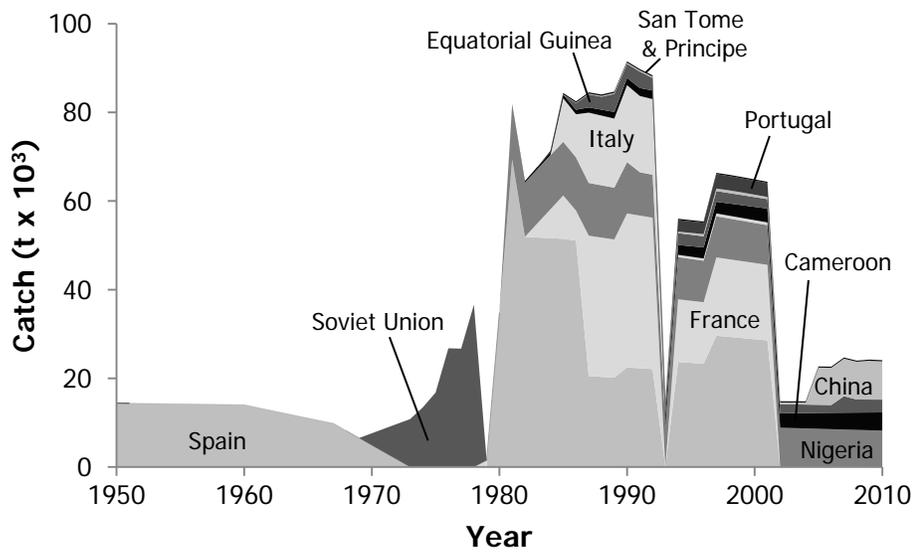


Figure 5. Foreign industrial catch in the EEZ of Equatorial Guinea, 1950-2010.

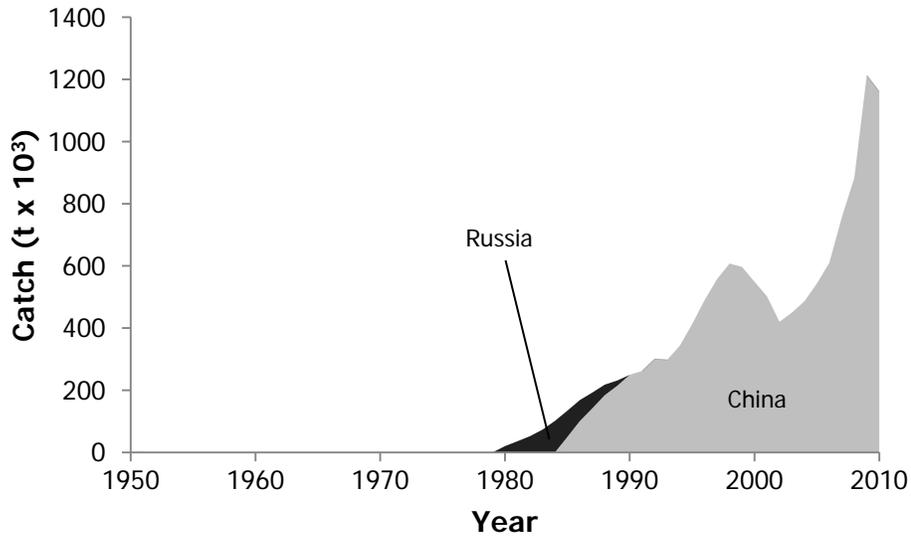


Figure 6. Reconstructed total catch from foreign illegal fleets in the EEZ of Equatorial Guinea.

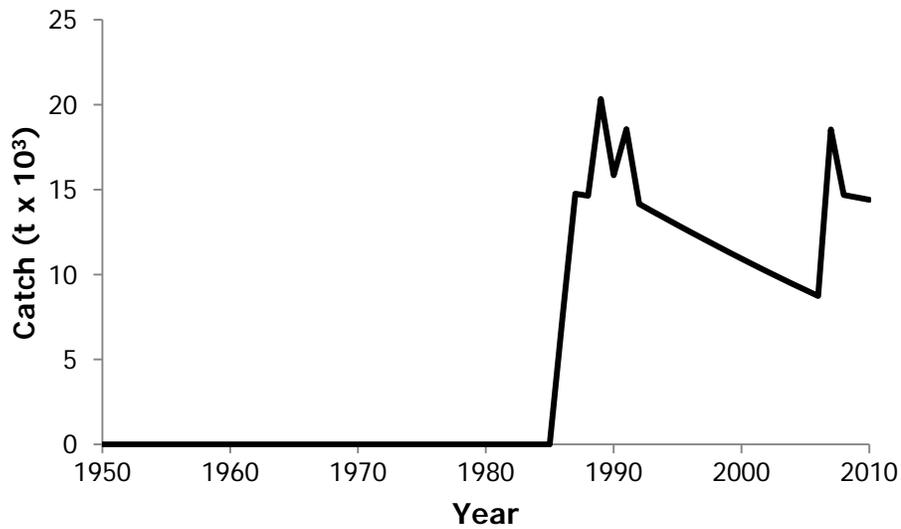


Figure 7. Industrial discards in Equatorial Guinea EEZ, 1950-2010.

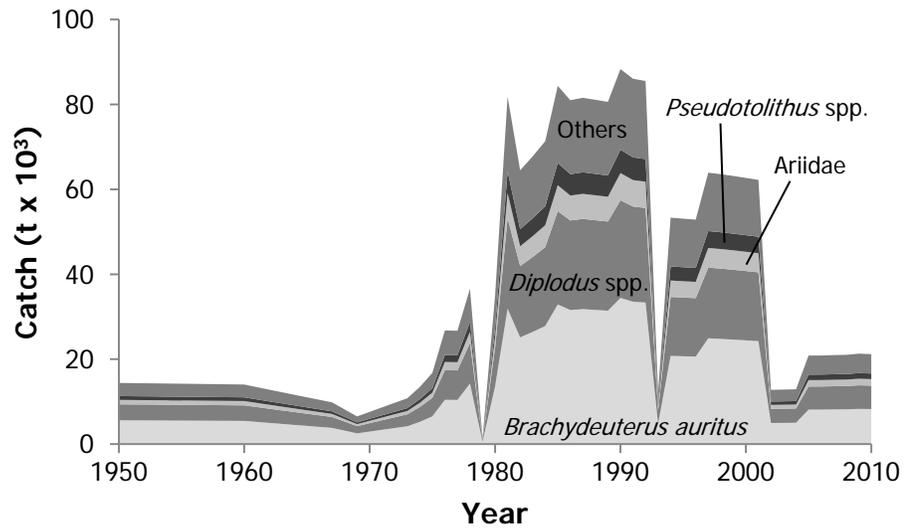
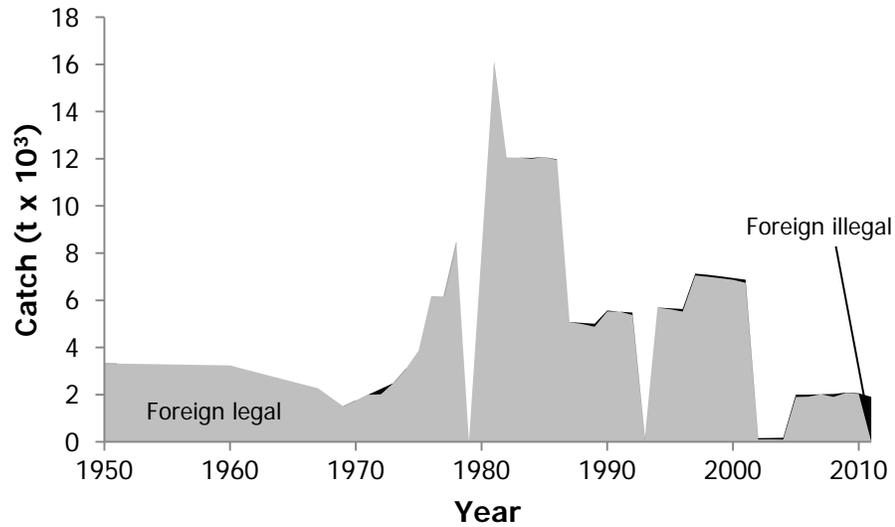


Figure 8. Reconstructed total foreign catches within Equatorial Guinea EEZ, 1950 to 2010 by a) legal vs illegal and b) by taxa. Others consist of 16 additional taxonomic categories.

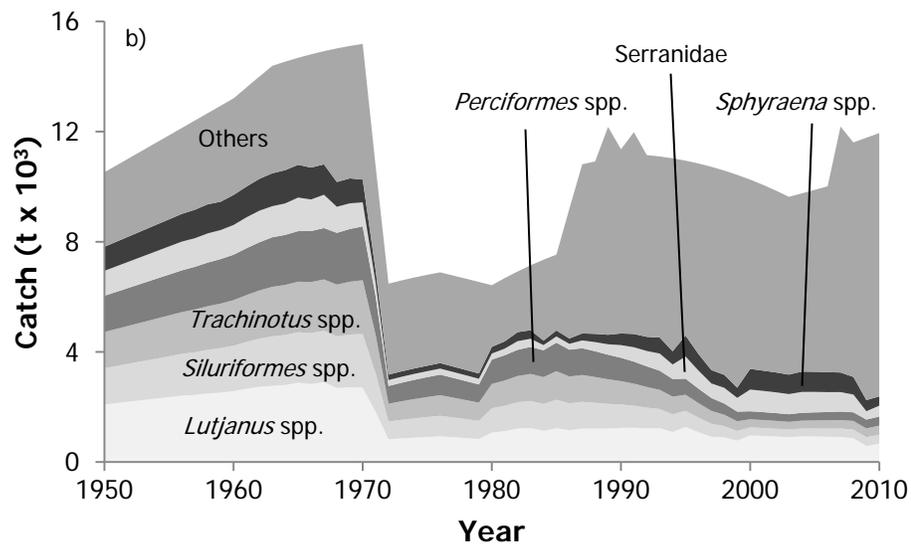
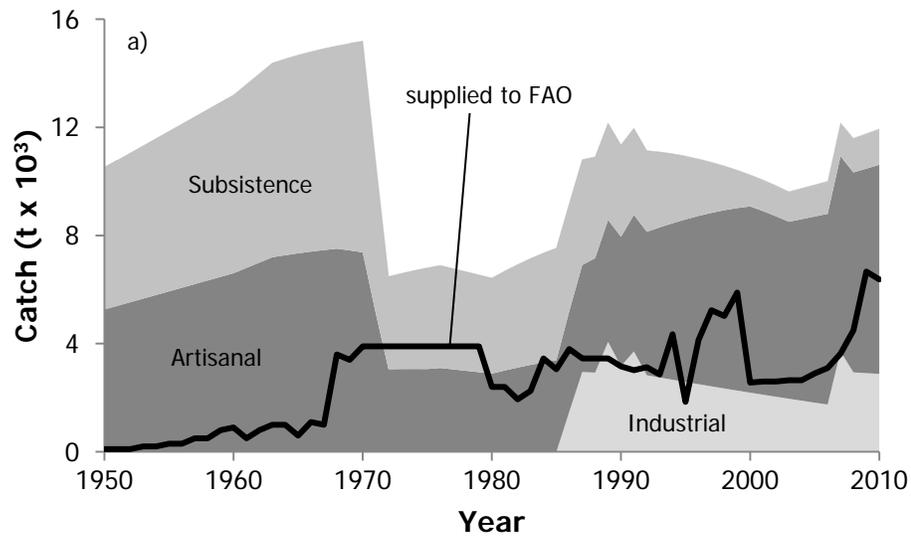


Figure 9: Reconstructed total catch for Equatorial Guinea, 1950 to 2010, by a) sector with official reported data overlaid as line graph. Note: recreational catches and discards are plotted but not visible on graph; and b) by taxa. Others consist of 47 additional taxonomic categories.

Appendix Table A1. Population ('pop. ') data used for the catch reconstruction. Italics indicate interpolations.

| Year | Total pop. (10 ³) | Islands pop. (10 ³) | Island pop. available for fishing | Total Rio Muni | Rio Muni Coast. | Total available for fishing |
|------|-------------------------------|---------------------------------|-----------------------------------|----------------|-----------------|-----------------------------|
| 1950 | 196.0 | 47.8 | 47.8 (b) | - | 53.4(c) | 101.2 |
| 1951 | <i>200.8</i> | - | - | - | - | <i>103.7</i> |
| 1952 | <i>205.6</i> | - | - | - | - | <i>106.3</i> |
| 1953 | <i>210.4</i> | - | - | - | - | <i>108.9</i> |
| 1954 | <i>215.2</i> | - | - | - | - | <i>111.5</i> |
| 1955 | <i>220.0</i> | - | - | - | - | <i>114.1</i> |
| 1956 | <i>225.2</i> | - | - | - | - | <i>116.6</i> |
| 1957 | <i>230.4</i> | - | - | - | - | <i>119.2</i> |
| 1958 | <i>235.6</i> | - | - | - | - | <i>121.8</i> |
| 1959 | <i>240.8</i> | - | - | - | - | <i>124.4</i> |
| 1960 | 246.0 | 60.0 | 60.0 (h) | 186.0 | 66.9 (d) | 127.0 |
| 1961 | <i>246.2</i> | - | - | - | - | <i>130.7</i> |
| 1962 | <i>246.4</i> | - | - | - | - | <i>134.5</i> |
| 1963 | <i>246.5</i> | - | - | - | - | <i>138.3</i> |
| 1964 | <i>246.7</i> | - | - | - | - | <i>142.1</i> |
| 1965 | <i>246.9</i> | - | - | - | - | <i>145.9</i> |
| 1966 | <i>258.3</i> | - | - | - | - | <i>149.7</i> |
| 1967 | <i>269.6</i> | - | - | - | - | <i>153.5</i> |
| 1968 | 281.0 | - | - | - | - | <i>157.2</i> |
| 1969 | 286.0 | - | - | - | - | <i>161.0</i> |
| 1970 | <i>280.1</i> | 100.0 | 100.0 (h) | 180.1 | 64.8(d) | 164.8 |
| 1971 | 274.1 | - | - | - | - | <i>118.9</i> |
| 1972 | 268.2 | 80.0 | 0 (h; e) | 188.2 | 73.0(d) | 73.0 |
| 1973 | 262.2 | - | - | - | - | <i>75.8</i> |
| 1974 | 256.3 | - | - | - | - | <i>78.5</i> |
| 1975 | 250.3 | - | - | - | - | <i>81.3</i> |
| 1976 | 244.4 | 55.0 | 0 (h; f) | 189.4 | 84.1(d) | 84.1 |
| 1977 | 238.4 | - | - | - | - | <i>84.4</i> |
| 1978 | 232.5 | - | - | - | - | <i>84.8</i> |
| 1979 | 226.5 | - | - | - | - | <i>85.1</i> |
| 1980 | 220.6 | - | 0 (h) | 170.9 | 85.5 (g) | 85.5 |
| 1981 | 232.7 | - | - | - | - | <i>91.0</i> |
| 1982 | 250.8 | - | - | - | - | <i>96.5</i> |
| 1983 | 272.3 | - | - | - | - | <i>102.0</i> |
| 1984 | 293.8 | - | - | - | - | <i>107.5</i> |
| 1985 | 312.8 | - | - | - | - | <i>113.0</i> |
| 1986 | 328.3 | - | - | - | - | <i>118.6</i> |
| 1987 | 340.9 | - | - | - | - | <i>124.1</i> |
| 1988 | 351.8 | - | - | - | - | <i>129.6</i> |
| 1989 | 362.4 | - | - | - | - | <i>135.1</i> |
| 1990 | 373.9 | - | - | - | - | <i>140.6</i> |
| 1991 | 386.4 | - | - | - | - | <i>146.1</i> |
| 1992 | 399.6 | - | - | - | - | <i>151.6</i> |
| 1993 | 413.3 | - | - | - | - | <i>157.1</i> |
| 1994 | 427.5 | - | - | - | - | <i>162.7</i> |
| 1995 | 441.8 | - | - | - | - | <i>168.2</i> |
| 1996 | 456.4 | - | - | - | - | <i>173.7</i> |
| 1997 | 471.3 | - | - | - | - | <i>179.2</i> |
| 1998 | 486.5 | - | - | - | - | <i>184.7</i> |
| 1999 | 502.2 | - | - | - | - | <i>190.2</i> |
| 2000 | 518.2 | - | - | - | - | <i>195.7</i> |
| 2001 | 534.6 | - | - | - | - | <i>201.2</i> |
| 2002 | 551.4 | - | - | - | - | <i>206.8</i> |
| 2003 | 568.6 | - | - | - | - | <i>212.3</i> |
| 2004 | 586.0 | - | - | - | - | <i>217.8</i> |
| 2005 | 603.6 | - | - | - | - | <i>223.3</i> |
| 2006 | 621.5 | - | - | - | - | <i>228.8</i> |
| 2007 | 639.6 | - | - | - | - | <i>234.3</i> |
| 2008 | 658.0 | - | - | - | - | <i>239.8</i> |
| 2009 | 676.9 | - | - | - | - | <i>245.4</i> |
| 2010 | 696.9 | - | - | - | - | 250.9 |

(a) Subtraction; (b) Percentage of the population in the islands by the total applied to the total population of 1950; (c) Percentage of the coastal population in Rio Muni in 1960 by the total population of 1960 applied to the total population of 1950; (d) We interpolated the percentage of the coastal population from 36% in 1970 to an assumed 50% in 1980, given a massive migration towards the coast of Rio Muni (Castroviejo *et al.* 1994), which we then multiplied by the total population of Rio Muni; (e) Prohibition of approaching the coast, out of 80,000 people; (f) Prohibition of approaching the coast, out of 55,000 people after the departure of 25,000 Nigerians; (g) Total population in Rio Muni estimated based on the percentage of the Rio Muni population of 1976; (h) (Liniger-Goumaz 1985).

Appendix Table A2. Industrial fishing vessels operating in Equatorial Guinea, per flag; interpolations are indicated by italics.

| Year | E. Guinea | Spain | France | Italy | Portugal | Soviet Union | China | S. Tomé & Príncipe | Cameroon | Nigeria | Reference |
|------|-----------|-----------|------------|-------|----------|--------------|-------|--------------------|-----------|---------|--|
| 1950 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1951 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1952 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1953 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1954 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1955 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1956 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1957 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1958 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1959 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1960 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Fa (1991) |
| 1961 | 0 | <i>13</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1962 | 0 | <i>13</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1963 | 0 | <i>12</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1964 | 0 | <i>12</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1965 | 0 | <i>11</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1966 | 0 | <i>11</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1967 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | FAO (1986) |
| 1968 | 0 | <i>8</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1969 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Aworawo (2010) (a) |
| 1970 | 0 | 5 | 0 | 0 | 0 | <i>1</i> | 0 | 0 | 0 | 0 | |
| 1971 | 0 | <i>3</i> | 0 | 0 | 0 | <i>2</i> | 0 | 0 | 0 | 0 | |
| 1972 | 0 | <i>2</i> | 0 | 0 | 0 | <i>2</i> | 0 | 0 | 0 | 0 | |
| 1973 | 0 | 0 | 0 | 0 | 0 | <i>3</i> | 0 | 0 | 0 | 0 | FAO (1986) |
| 1974 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | FAO (1986) |
| 1975 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | FAO (1986) |
| 1976 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | FAO (1986) |
| 1977 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | FAO (1986) |
| 1978 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | FAO (1986) |
| 1979 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Ministerio de Defensa (2006); FAO (1986) (b) |
| 1980 | 0 | <i>37</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Carroz and Savini (1983); Aworawo (2010); FAO (1986) |
| 1981 | 0 | <i>73</i> | 0 | 0 | 0 | 0 | 0 | 0 | <i>1</i> | 20 | Carroz and Savini (1983) (c); Mangatalle (1996) (d); FAO (1986) |
| 1982 | 0 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | <i>1</i> | 20 | Carroz and Savini (1983); Matthes (1980) |
| 1983 | 0 | 110 | <i>4.5</i> | 0 | 0 | 0 | 0 | 0 | <i>2</i> | 20 | Carroz and Savini (1983); Matthes (1980); Churchill (1987) |
| 1984 | 0 | 110 | <i>9</i> | 0 | 0 | 0 | 0 | 1 | <i>2</i> | 20 | Carroz and Savini (1983); Matthes (1980) |
| 1985 | 0 | 110 | 14 | 14 | 0 | 0 | 0 | 1 | <i>3</i> | 20 | Fadayomi (1984); Matthes (1980); (Treinen 1990)) |
| 1986 | <i>5</i> | 110 | 9 | 14 | 0 | 0 | 0 | 1 | <i>3</i> | 20 | Matthes (1980)(e); Treinen (1990) (f) |
| 1987 | 10 | 22 | 45 | 22 | 0 | 0 | 0 | 1 | <i>4</i> | 20 | Anon. (2004); Fa (1991); Treinen (1990) (f) |
| 1988 | 10 | 22 | 45 | 22 | 0 | 0 | 0 | 1 | <i>5</i> | 20 | Anon. (2004); Fa (1991); Treinen (1990) |
| 1989 | 14 | 22 | 45 | 22 | 0 | 0 | 0 | 1 | <i>5</i> | 20 | Anon. (2004); Fa (1991); Treinen (1990) |
| 1990 | 11 | 25 | 50 | 25 | 0 | 0 | 0 | 1 | <i>6</i> | 20 | Assumption (g); Fa (1991) |
| 1991 | 13 | 25 | 50 | 25 | 0 | 0 | 0 | 1 | <i>6</i> | 17 | Beaudry <i>et al.</i> (1993); Fa (1991); Assumption (g) |
| 1992 | 10 | 25 | 50 | 25 | 0 | 0 | 0 | 1 | <i>7</i> | 17 | Beaudry <i>et al.</i> (1993); Fa (1991); Assumption (g) |
| 1993 | <i>10</i> | 0 | 0 | 0 | 0 | 0 | 0 | 1 | <i>7</i> | 17 | Beaudry <i>et al.</i> (1993); (European Union 1990a, 1990b, 1990c) |
| 1994 | <i>10</i> | 27 | 21 | 1 | 4 | 0 | 0 | 1 | <i>8</i> | 17 | Beaudry <i>et al.</i> (1993); Assumption (h) |
| 1995 | <i>9</i> | 27 | 21 | 1 | 4 | 0 | 0 | 1 | <i>9</i> | 17 | Beaudry <i>et al.</i> (1993); Assumption (h) |
| 1996 | <i>9</i> | 27 | 21 | 1 | 4 | 0 | 0 | 1 | <i>9</i> | 17 | Beaudry <i>et al.</i> (1993); Assumption (h) |
| 1997 | <i>9</i> | 35 | 27 | 1 | 5 | 0 | 0 | 1 | <i>10</i> | 17 | Beaudry <i>et al.</i> (1993); (European Union 1995, 1998) |
| 1998 | <i>9</i> | 35 | 27 | 1 | 5 | 0 | 0 | 1 | <i>10</i> | 17 | Beaudry <i>et al.</i> (1993); (European Union 1995, 1998) |
| 1999 | <i>9</i> | 35 | 27 | 1 | 5 | 0 | 0 | 1 | <i>11</i> | 17 | Beaudry <i>et al.</i> (1993); (European Union 1995, 1998) |
| 2000 | <i>8</i> | 35 | 27 | 1 | 5 | 0 | 0 | 1 | <i>11</i> | 17 | Beaudry <i>et al.</i> (1993); (European Union 1995, 1998) |
| 2001 | <i>8</i> | 35 | 27 | 1 | 5 | 0 | 0 | 1 | <i>12</i> | 17 | Beaudry <i>et al.</i> (1993);(European Union 2000, 2001) |
| 2002 | <i>8</i> | 0 | 0 | 0 | 0 | 0 | 0 | 1 | <i>12</i> | 17 | Beaudry <i>et al.</i> (1993) |
| 2003 | <i>8</i> | 0 | 0 | 0 | 0 | 0 | 0 | 1 | <i>13</i> | 17 | Beaudry <i>et al.</i> (1993) |
| 2004 | <i>7</i> | 0 | 0 | 0 | 0 | 0 | 0 | 1 | <i>14</i> | 17 | Beaudry <i>et al.</i> (1993); (i) |
| 2005 | <i>7</i> | 0 | 0 | 0 | 0 | 0 | 10 | 1 | <i>14</i> | 17 | Beaudry <i>et al.</i> (1993) |
| 2006 | <i>7</i> | 0 | 0 | 0 | 0 | 0 | 10 | 1 | <i>15</i> | 17 | Beaudry <i>et al.</i> (1993); Bricola (2008) |
| 2007 | 15 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | <i>15</i> | 17 | Beaudry <i>et al.</i> (1993); PMC (2007) |
| 2008 | 12 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | <i>16</i> | 17 | Beaudry <i>et al.</i> (1993); AFRISTAT (2008) |
| 2009 | 12 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | <i>16</i> | 17 | Beaudry <i>et al.</i> (1993); AFRISTAT (2008) |
| 2010 | 12 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | <i>17</i> | 17 | Morillas Gómez (2004) (j); AFRISTAT (2008) |

(a) Soviet fishery project and naval base - Exclusive rights and high military presence started here; (b) only shrimpers (FAO 1986); (c) 10 Nigerian trawlers and 10 purse-seiners of less than 1000 GRT each (Mangatalle 1996); (d) Agreement with Cameroon started here and is renewable unless notice given, vessels operating are less than 500 GRT; (e) Here Spain joined the EU (FAO 2003); (f) EEC tuna vessels were mostly French and Italian (Folsom *et al.* 1993); (g) To disaggregate EEC effort onto per country, we applied the proportion per flag for the previous year; (h) To disaggregate EEC effort onto per country, we applied flag proportions for the subsequent years; (i) <http://finance.sina.com.cn/roll/20041124/19411178503.shtml> [Accessed on August 06, 2013]; (j) we assumed the same number of vessels than for Nigeria.

Appendix Table A3. FAO landings vs. reconstructed total catch (in tonnes), and catch by sector with discards shown separately for Equatorial Guinea, 1950-2010.

| Year | FAO landings | Reconstructed total catch | Industrial | Artisanal | Subsistence | Recreational | Discards |
|------|--------------|---------------------------|------------|-----------|-------------|--------------|----------|
| 1950 | 100 | 10,500 | 0 | 5,300 | 5,300 | 0 | 0 |
| 1951 | 100 | 10,800 | 0 | 5,400 | 5,400 | 0 | 0 |
| 1952 | 100 | 11,100 | 0 | 5,500 | 5,500 | 0 | 0 |
| 1953 | 200 | 11,300 | 0 | 5,700 | 5,700 | 0 | 0 |
| 1954 | 200 | 11,600 | 0 | 5,800 | 5,800 | 0 | 0 |
| 1955 | 300 | 11,900 | 0 | 5,900 | 5,900 | 0 | 0 |
| 1956 | 300 | 12,100 | 0 | 6,100 | 6,100 | 0 | 0 |
| 1957 | 500 | 12,400 | 0 | 6,200 | 6,200 | 0 | 0 |
| 1958 | 500 | 12,700 | 0 | 6,300 | 6,300 | 0 | 0 |
| 1959 | 800 | 12,900 | 0 | 6,500 | 6,500 | 0 | 0 |
| 1960 | 900 | 13,200 | 0 | 6,600 | 6,600 | 0 | 0 |
| 1961 | 500 | 13,600 | 0 | 6,800 | 6,800 | 0 | 0 |
| 1962 | 801 | 14,000 | 0 | 7,000 | 7,000 | 0 | 0 |
| 1963 | 1,001 | 14,400 | 0 | 7,200 | 7,200 | 0 | 0 |
| 1964 | 1,001 | 14,500 | 0 | 7,300 | 7,300 | 0 | 0 |
| 1965 | 601 | 14,700 | 0 | 7,300 | 7,300 | 0 | 0 |
| 1966 | 1,101 | 14,800 | 0 | 7,400 | 7,400 | 0 | 0 |
| 1967 | 1,001 | 14,900 | 0 | 7,500 | 7,500 | 0 | 0 |
| 1968 | 3,600 | 15,000 | 0 | 7,500 | 7,500 | 0 | 0 |
| 1969 | 3,400 | 15,100 | 0 | 7,400 | 7,700 | 0 | 0 |
| 1970 | 3,900 | 15,200 | 0 | 7,400 | 7,800 | 0 | 0 |
| 1971 | 3,900 | 10,800 | 0 | 5,100 | 5,600 | 0 | 0 |
| 1972 | 3,900 | 6,500 | 0 | 3,100 | 3,400 | 0 | 0 |
| 1973 | 3,900 | 6,600 | 0 | 3,100 | 3,500 | 0 | 0 |
| 1974 | 3,900 | 6,700 | 0 | 3,100 | 3,600 | 0 | 0 |
| 1975 | 3,900 | 6,800 | 0 | 3,100 | 3,700 | 0 | 0 |
| 1976 | 3,900 | 6,900 | 0 | 3,100 | 3,800 | 0 | 0 |
| 1977 | 3,900 | 6,800 | 0 | 3,000 | 3,700 | 0 | 0 |
| 1978 | 3,900 | 6,700 | 0 | 3,000 | 3,700 | 0 | 0 |
| 1979 | 3,900 | 6,500 | 0 | 2,900 | 3,600 | 0 | 0 |
| 1980 | 2,400 | 6,400 | 0 | 2,900 | 3,500 | 0 | 0 |
| 1981 | 2,400 | 6,700 | 0 | 3,000 | 3,700 | 0 | 0 |
| 1982 | 1,939 | 6,900 | 0 | 3,100 | 3,800 | 0 | 0 |
| 1983 | 2,251 | 7,100 | 0 | 3,200 | 3,900 | 0 | 0 |
| 1984 | 3,450 | 7,300 | 0 | 3,300 | 4,000 | 0 | 0 |
| 1985 | 3,050 | 7,500 | 0 | 3,400 | 4,100 | 0 | 0 |
| 1986 | 3,800 | 9,200 | 1,490 | 3,700 | 4,000 | 0 | 7 |
| 1987 | 3,450 | 10,800 | 2,950 | 4,000 | 3,900 | 0 | 15 |
| 1988 | 3,450 | 10,900 | 2,930 | 4,200 | 3,700 | 0 | 15 |
| 1989 | 3,450 | 12,200 | 4,070 | 4,500 | 3,600 | 0 | 20 |
| 1990 | 3,160 | 11,400 | 3,170 | 4,800 | 3,400 | 0 | 16 |
| 1991 | 3,020 | 12,000 | 3,710 | 5,000 | 3,200 | 0 | 19 |
| 1992 | 3,130 | 11,100 | 2,830 | 5,300 | 3,000 | 0 | 14 |
| 1993 | 2,857 | 11,100 | 2,750 | 5,600 | 2,800 | 0 | 14 |
| 1994 | 4,349 | 11,000 | 2,660 | 5,800 | 2,600 | 0 | 13 |
| 1995 | 1,846 | 10,900 | 2,580 | 6,000 | 2,300 | 0 | 13 |
| 1996 | 4,135 | 10,800 | 2,500 | 6,200 | 2,100 | 1 | 13 |
| 1997 | 5,235 | 10,700 | 2,420 | 6,400 | 1,900 | 1 | 12 |
| 1998 | 5,026 | 10,600 | 2,340 | 6,600 | 1,600 | 2 | 12 |
| 1999 | 5,890 | 10,400 | 2,260 | 6,700 | 1,400 | 3 | 11 |
| 2000 | 2,557 | 10,300 | 2,190 | 6,900 | 1,200 | 3 | 11 |
| 2001 | 2,599 | 10,100 | 2,110 | 6,800 | 1,200 | 4 | 11 |
| 2002 | 2,599 | 9,900 | 2,040 | 6,700 | 1,100 | 4 | 10 |
| 2003 | 2,649 | 9,600 | 1,960 | 6,500 | 1,100 | 5 | 10 |
| 2004 | 2,648 | 9,800 | 1,890 | 6,700 | 1,100 | 5 | 9 |
| 2005 | 2,898 | 9,900 | 1,820 | 6,900 | 1,200 | 6 | 9 |
| 2006 | 3,098 | 10,000 | 1,750 | 7,100 | 1,200 | 6 | 9 |
| 2007 | 3,630 | 12,200 | 3,710 | 7,200 | 1,200 | 7 | 19 |
| 2008 | 4,495 | 11,600 | 2,940 | 7,400 | 1,300 | 7 | 15 |
| 2009 | 6,667 | 11,800 | 2,910 | 7,600 | 1,300 | 8 | 15 |
| 2010 | 6,376 | 11,900 | 2,880 | 7,700 | 1,300 | 8 | 14 |

Appendix Table A4. Reconstructed total catch (in tonnes) by major taxonomic categories for Equatorial Guinea, 1950-2010. Others contain 47 additional taxonomic categories.

| Year | Lutjanus | Siluriformes | Trachinotus | Perciformes | Serranidae | Sphyraena | Others |
|------|----------|--------------|-------------|-------------|------------|-----------|--------|
| 1950 | 2,090 | 1,320 | 1,320 | 1,320 | 910 | 870 | 2,710 |
| 1951 | 2,150 | 1,350 | 1,350 | 1,350 | 930 | 890 | 2,780 |
| 1952 | 2,200 | 1,380 | 1,380 | 1,380 | 950 | 920 | 2,840 |
| 1953 | 2,250 | 1,420 | 1,420 | 1,420 | 980 | 940 | 2,910 |
| 1954 | 2,310 | 1,450 | 1,450 | 1,450 | 1,000 | 960 | 2,980 |
| 1955 | 2,360 | 1,480 | 1,480 | 1,480 | 1,020 | 980 | 3,050 |
| 1956 | 2,410 | 1,520 | 1,520 | 1,520 | 1,040 | 1,010 | 3,120 |
| 1957 | 2,440 | 1,550 | 1,550 | 1,550 | 1,040 | 1,030 | 3,240 |
| 1958 | 2,490 | 1,580 | 1,580 | 1,580 | 1,060 | 1,060 | 3,310 |
| 1959 | 2,520 | 1,620 | 1,620 | 1,620 | 1,050 | 1,030 | 3,490 |
| 1960 | 2,580 | 1,650 | 1,650 | 1,650 | 1,080 | 1,090 | 3,510 |
| 1961 | 2,660 | 1,700 | 1,700 | 1,700 | 1,120 | 1,120 | 3,600 |
| 1962 | 2,730 | 1,750 | 1,750 | 1,750 | 1,150 | 1,160 | 3,710 |
| 1963 | 2,770 | 1,800 | 1,800 | 1,800 | 1,130 | 1,200 | 3,900 |
| 1964 | 2,800 | 1,820 | 1,820 | 1,820 | 1,140 | 1,210 | 3,940 |
| 1965 | 2,880 | 1,840 | 1,840 | 1,840 | 1,220 | 1,190 | 3,890 |
| 1966 | 2,830 | 1,850 | 1,850 | 1,850 | 1,150 | 1,160 | 4,110 |
| 1967 | 2,900 | 1,870 | 1,870 | 1,870 | 1,210 | 1,100 | 4,110 |
| 1968 | 2,690 | 1,880 | 1,880 | 1,880 | 950 | 900 | 4,850 |
| 1969 | 2,720 | 1,920 | 1,920 | 1,920 | 930 | 910 | 4,810 |
| 1970 | 2,700 | 1,950 | 1,950 | 1,950 | 870 | 830 | 4,930 |
| 1971 | 1,820 | 1,400 | 1,400 | 1,400 | 490 | 460 | 3,780 |
| 1972 | 830 | 640 | 640 | 640 | 210 | 200 | 3,300 |
| 1973 | 860 | 670 | 670 | 670 | 220 | 200 | 3,300 |
| 1974 | 890 | 700 | 700 | 700 | 220 | 200 | 3,300 |
| 1975 | 910 | 730 | 730 | 730 | 220 | 200 | 3,300 |
| 1976 | 930 | 750 | 750 | 750 | 220 | 200 | 3,300 |
| 1977 | 900 | 720 | 720 | 720 | 210 | 200 | 3,310 |
| 1978 | 870 | 690 | 690 | 690 | 210 | 190 | 3,320 |
| 1979 | 840 | 660 | 660 | 660 | 210 | 190 | 3,330 |
| 1980 | 1,070 | 880 | 880 | 880 | 220 | 240 | 2,240 |
| 1981 | 1,120 | 920 | 920 | 920 | 240 | 260 | 2,300 |
| 1982 | 1,220 | 950 | 950 | 950 | 310 | 330 | 2,200 |
| 1983 | 1,240 | 980 | 980 | 980 | 300 | 310 | 2,360 |
| 1984 | 1,140 | 970 | 970 | 970 | 190 | 160 | 2,940 |
| 1985 | 1,230 | 1,040 | 1,040 | 1,040 | 230 | 220 | 2,750 |
| 1986 | 1,160 | 970 | 970 | 970 | 210 | 190 | 4,710 |
| 1987 | 1,220 | 970 | 970 | 970 | 280 | 250 | 6,140 |
| 1988 | 1,220 | 940 | 940 | 940 | 330 | 300 | 6,260 |
| 1989 | 1,220 | 890 | 890 | 890 | 380 | 350 | 7,550 |
| 1990 | 1,240 | 850 | 850 | 850 | 460 | 420 | 6,690 |
| 1991 | 1,250 | 800 | 800 | 800 | 520 | 480 | 7,330 |
| 1992 | 1,230 | 750 | 750 | 750 | 560 | 510 | 6,600 |
| 1993 | 1,230 | 700 | 700 | 700 | 620 | 580 | 6,570 |
| 1994 | 1,090 | 640 | 640 | 640 | 530 | 480 | 7,010 |
| 1995 | 1,270 | 580 | 580 | 580 | 800 | 760 | 6,350 |
| 1996 | 1,090 | 530 | 530 | 530 | 650 | 600 | 6,920 |
| 1997 | 920 | 470 | 470 | 470 | 530 | 480 | 7,380 |
| 1998 | 900 | 410 | 410 | 410 | 570 | 470 | 7,420 |
| 1999 | 780 | 350 | 350 | 350 | 500 | 370 | 7,730 |
| 2000 | 970 | 290 | 290 | 290 | 790 | 750 | 6,870 |
| 2001 | 950 | 290 | 290 | 290 | 770 | 730 | 6,750 |
| 2002 | 930 | 280 | 280 | 280 | 750 | 720 | 6,600 |
| 2003 | 900 | 280 | 280 | 280 | 730 | 710 | 6,460 |
| 2004 | 930 | 280 | 280 | 280 | 760 | 740 | 6,470 |
| 2005 | 930 | 290 | 290 | 290 | 740 | 730 | 6,610 |
| 2006 | 920 | 300 | 300 | 300 | 720 | 730 | 6,750 |
| 2007 | 910 | 310 | 310 | 310 | 710 | 710 | 8,930 |
| 2008 | 870 | 310 | 310 | 310 | 640 | 640 | 8,520 |
| 2009 | 580 | 320 | 320 | 320 | 300 | 400 | 9,530 |
| 2010 | 670 | 330 | 330 | 330 | 400 | 340 | 9,570 |