Fisheries Production of the Gulf of Mexico

Producción Pesquera del Golfo de México

La Production Halieutique dans le golfe du Mexique

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ABSTRACT

An inventory of the Gulf of Mexico fisheries, based on the statistics of the FAO Fisheries and NOAA (1950 to 2010), was undertaken in order to explore its potential. The relative importance of the main resources exploited in the Gulf was examined describing the main trends in the catch and a preliminary diagnosis of their condition was made as a first approach for management, protection and restoration in the region. The fisheries of the northern and southern Gulf of Mexico exhibit independent tendencies, as those of the north are strongly dominated by the exploitation of a single species, the Gulf menhaden, whose catch volumes have reached nearly one million metric tonnes (mt) in the mid-1980s, with a decline of almost 50% in the last decade; the rest of the northern Gulf fisheries catch recorded are very low in relation to the Gulf menhaden, describing three peaks, one in the mid-50s with more than 40,000 mt, another with about 30,000 mt in the mid-1970s, and another one with a little over 30,000 mt at the end of the 1980s. In recent years, only some 10,000 mt are caught. In the southern Gulf de México, the match approached 24,000 t in recent years, and data suggests more stability than in the northern Gulf, reaching its highest volume with near 100,000 mt in 1999, declining to 59,000 mt en 2009. In both areas, data suggest a posible sustitution of species after 1985, when mullets became more abundant.

KEYWORDS: Gulf of Mexico, fisheries production, catch trends, diagnosis

INTRODUCTION

The Gulf of Mexico (GoM), the study area, is an enclosed sea, delimited by the peninsula of Florida in the eastern boundary; the Yucatan peninsula in the southeastern boundary, and Cuba, between both peninsulas. These geographic features define the Yucatan and the Florida straits, where a strong current from the northwestern Caribbean runs to the north and northeast forming the Gulf stream flowing towards the northeastern Atlantic. This current often plays the role of an effective physical barrier (Monreal-Gomez and Salas de León 1990, Monreal-Gómez et al. 1992, Carrillo et al. 2007). In this study, a comparative analysis of the relative importance of the main exploited stocks of the US and Mexican GoM is provided, where a diagnosis of each of the main fisheries as a baseline of their current status for the management, protection, and restoration of these aquatic resources is presented.

Waters of the southern GoM are tropical, while most of the shoreline of the northern Gulf is warm-temperate, excepting Florida SW, which is also tropical and shares many species with Mexico and the Caribbean (Figure 1). Until recently, the traditional viewpoint regarding declining trends of catch has been to blame fishing intensity for the depletion of exploited stocks (Beaver and Chavez 2007). However, the study of climate change through the last two decades has shown that in the long term, the climate has been playing a significant role in driving these trends; in the case of declines, the fishing intensity and the climate have often played a synergistic role (Gunter 1957). It is important to be aware that these processes are important factors, despite the fact that at this time, it is not easy to evaluate the relative importance of each one.

THE FISHERIES

Status of exploited stocks of the GoM, based on data under the Gulf of Mexico Fisheries Council, is limited to a few species (Kumpf et al. 1999). Sixty six and sixty nine stocks are recorded in fisheries statistics of the northern and southern GoM respectively; however, for the tropical nature of the southern GoM, biodiversity is expected to be higher in this region. Annual catch of all stocks amount to 525 thousand metric tones (mt, average for the years 2000 – 2010), valued in more than $5.2 million US. From this yield, 505,000 mt were caught in the northern Gulf, from which nearly 500,000 mt correspond to the Gulf menhaden; 92,000 mt are caught in the southern Gulf. An approach to the Maximum Sustainable Yield (MSY), the equivalent stock biomass years ago, and the current yield and biomass, are indicated in Table 1, evidencing a significant recent decline. Species composition of the stocks recorded in statistics was compiled and is presented in Table 2; however, many more species are grouped in these records. In many cases a single common name belongs to several species, and it was necessary to compromise the decision of assigning the records to the most common of each set. Statistical catch records on which this paper is based, proceed from FAO (2011) and NOAA (2011). Most population parameter values can be found at FishBase (Froese and Pauly, 2011), the main source of parameter values of most exploited fish species worldwide. In Mexico, the Fisheries Institute (INP), carries-on management programs for the main exploited stocks of the southern Gulf, and diagnosis of the status of their exploitation are published every year in the Diario Oficial de la Federación, also known as Carta Nacional Pesquera.

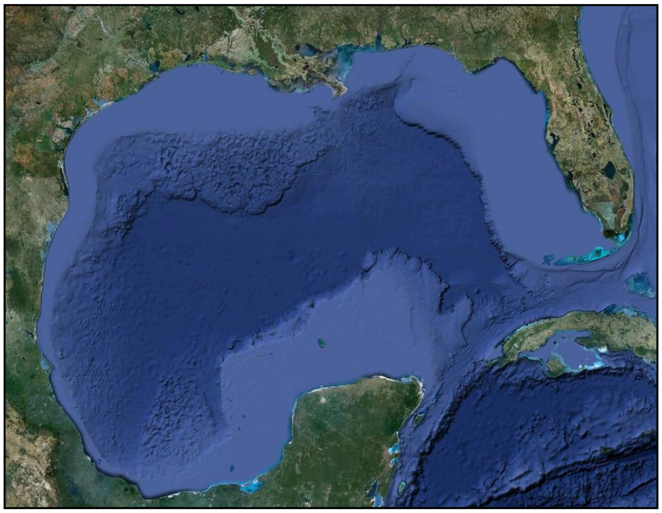

Figure 1. The Gulf of Mexico and adjacent areas.

Table 1. Maximum yields, equivalent to the MSY, of catch data recorded in FAO statistics for the GoM. Biomass estimate of total yield is indicated. Current average yield for the years 2008 – 2010 and their corresponding biomass are also shown on the two right side columns. Values in mt, are rounded (Chavez and Chavez Hidalgo In press).

			Mean 2008 – 2010	
Region	MSY	Biomass	Yield	Biomass
Gulf of Mexico	800,000	1,600,000	550,000	1,100,000

THE EXPLOITED STOCKS

The Northern Gulf

Catch data of the main exploited stocks of the northen GoM recorded for nearly sixty years (NOAA 2011). It is important to remark that the catch of a single species, the Gulf menhaden, accounts for more than 90 per cent of catches of the entire region. The catch of other fisheries recorded usually does not exceed 15,000 mt (average for the years 2000 – 2010), and landings of all these fisheries account to nearly 30 per cent of those from the southern Gulf (Figures 2, 3, 4). In the NOAA web pages (https://www.st.nmfs.noaa.gov/sisPortal/ sisPortalMain.jsp), data are housed within the Species Information System, including the most up-to-date information on the status of managed stocks and stock assessment results, as well as other important associated information. The NOAA carried out assessments of the main stocks, and according to its web page, more than 60 were evaluated in 2008 and 2009. In their summary status information, 69.1% are not overfished respecting to the fishing mortality (*F*), and 53.0% are not overfished respecting to the biomass.

For the graphic representation of the catch of the northern GoM between 1950 and 2011; it is remarkable to see that the Gulf menhaden displays the highest catch (Figure 2); the remaining data are splitted in two gropus, one with 19 secondary stocks, which added to the menhaden catch, account to 98 per cent. Exploitation of menhaden shows wide variation of up to three to four hundred thousand mt around the seventies, the middle eighties and the middle nineties. This is typical of short-lived pelagic, sardine-like stocks, strongly dependent on environmental variability; the industry dependent on this resource must adapt to these variations. In 1984 the whole catch almost reached 1.25 M mt, which is the highest peak in the study period. Afterwards, a consistent decline of menhaden was observed, dropping down to 408,000 mt in 2005, followed by a relative stability of near 450,000 mt during the last four years is displayed.

In the remaining 2%, there are other 93 stocks (Figure 3), it is remarkable to find out that the main trend is ruled by the brown shrimp, the white shrimp and the blue crab, attaining up to 150,000 mt in the year 2000; these catches are hardly significant as compared to the total landings In

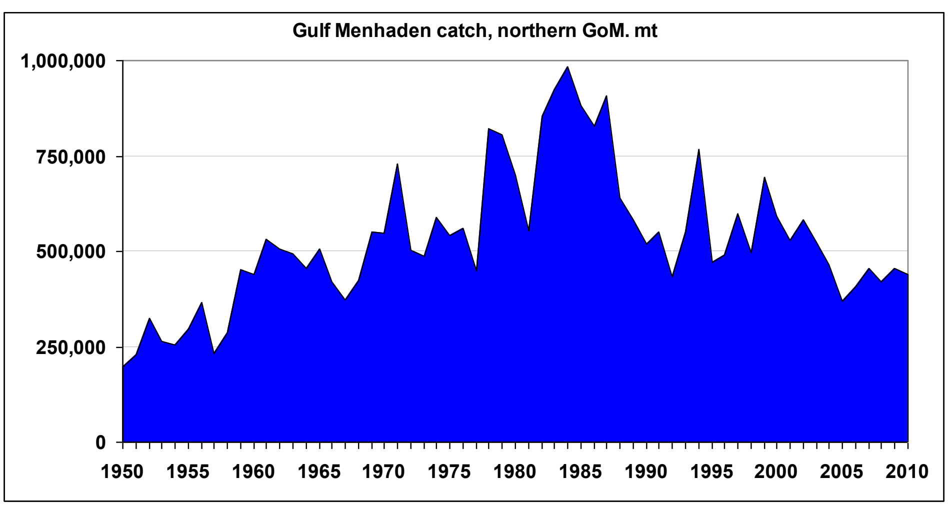

Figure 2. Catch trend (mt) of the of the gulf menhaden exploited at the northern Gulf of Mexico for the period 1950 to 2010.

this figure it is evident that before 1960 and during the years 1972 - 1977, there are no records of the shrimp catch; this is attributed to lack of data recording rather than a suspension of the fisheries. A preliminary diagnosis of the northern GoM fisheries, mean catch values of the 93 stocks is shown in Figure 4, where it is evident again, that the menhaden catch is by far, the most abundant exploited stock in the northen GoM, followed by two species of shrimp and by blue crab. For the entire period of 60 years, the catch was compared to the mean catch values recorded for the last ten years. In twelve finfish fisheries of this set, the mean catch for the period 1950 to 2010 exceeds significantly the mean value of the last decade and in only six stocks, the mean of the last ten years is higher. With no further analysis, it seems desirable to focus on these differences as possible evidence of overexploitation in the cases of black drum, red grouper, yellow fin tuna, sheepshead, yellowtail snapper, greater amberjack, gag, swordfish, and yellowedge grouper

The Southern Gulf

By comparing with the stocks exploited in the Northern Gulf, at first glance, the fisheries of the Southern Gulf seem to be somewhat more stable, as seen in Figure 5. A peak occurred in the middle eighties, reaching its maximum above 100,000 mt, which was caused by a significant increase in the catch of mojarras. The remainder of the trend displays an even increase reaching its maximum with a little more than 100,000 mt in 1999 and then decreasing more or less abruptly until 2009, when the catch of the 28 main stocks (81%) of the 69 recorded as a minimum, barely exceeds 59,000 mt. As in the case of the fisheries of the northern Gulf, the picture looks like a substitution of species after 1985, when the main exploited stocks apparently showed signs of over exploitation and the secondary species became more abundant after that year.

The relative abundance of exploited finfish stocks of the southern GoM (Figure 6) displays that the catch of the four most abundant ranges around 5,000 mt, followed by

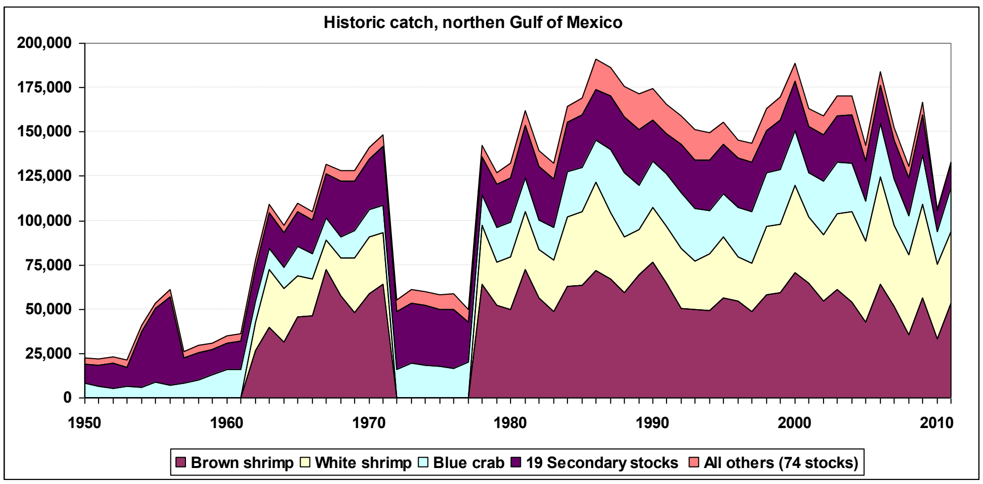

Figure 3. Catch trend (mt) of all fisheries exploited at the northern GoM for the period 1950 to 2011. The menhaden catch is shown in Figure 2.

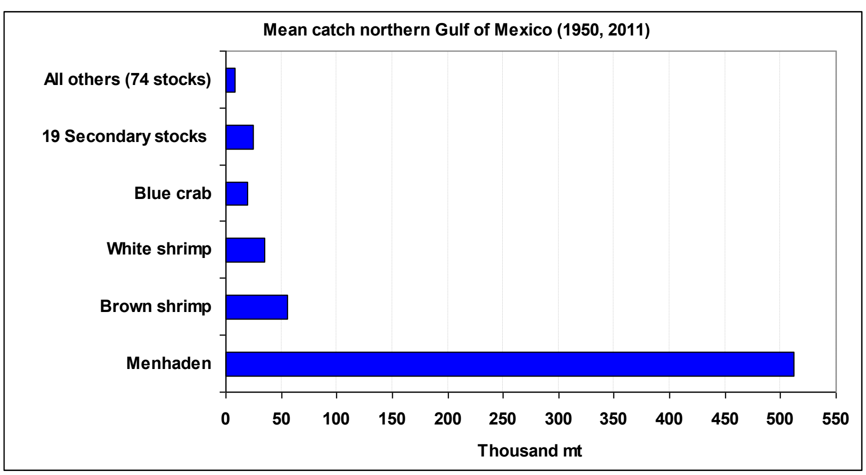

Figure 4. Mean catch of the most abundant exploited stocks of the northern GoM. It is evident the dominance of menhaden and the relative scarcity of 93 other stocks.

eight others whose catch ranges from 2,000 to 3,000 mt. The catch of thirteen secondary stocks amount to nearly 11,000 mt, and that of the 43 remaining ones account to 5,000 mt.

By comparing the average catch of 60 years with the mean of 10-year periods, it was remarkable to realize that in 22 of 28 stocks, the yields of fiinfish were higher in recent years. Of the remaining fisheries, two have a mean that is significantly higher: one is the mojarra, showing a drop of more than 50%, which may indicate a situation of possible overexploitation; the other is grouper, which is not represented in the last decade because of the ban on its capture imposed by the Mexican authorities.

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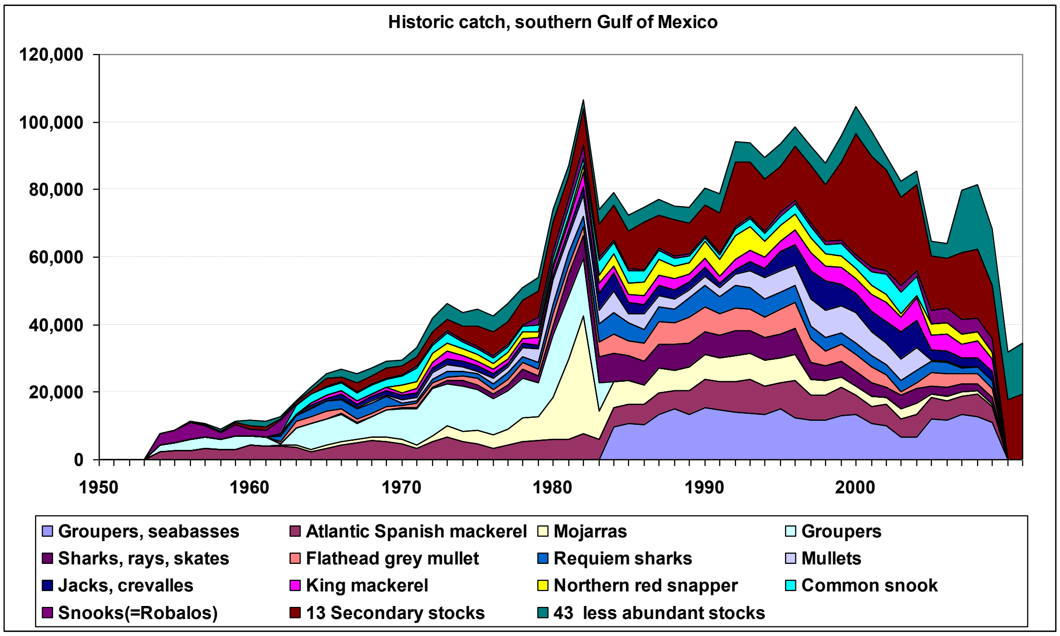

Figure 5. Catch trend (mt) of the fisheries exploited at the southern Gulf of Mexico for the period 1950 to 2010.

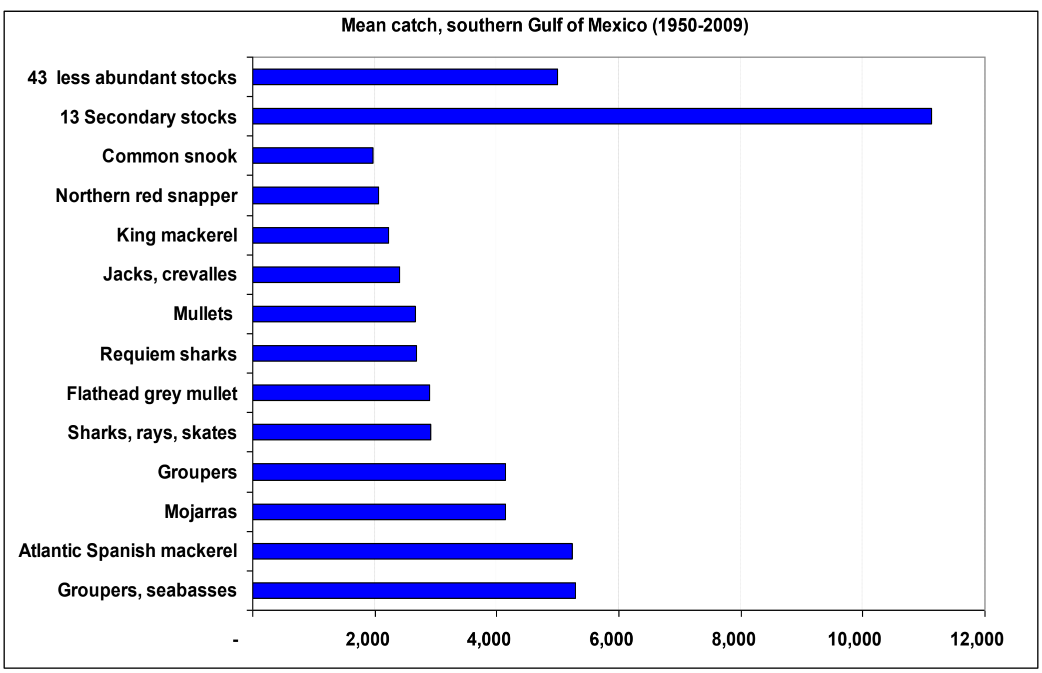

Figure 6. Relative abundance of the main components of the southern Gulf of Mexico fisheries (1950 – 2009).

Table 2. Common names in data basis used as source for the main exploited stocks of the Gulf of Mexico. http://www.fishbase.org version (08/2012).

FAO, NOAA	Species
Yellowtail amberjack	*Seriola lalandi*
Greater amberjack	*Seriola dumerili*
Lesser amberjack	*Seriola fasciata*
Barracudas nei	*Sphyraena barracuda*
Bigeye scad	*Selar crumenophthalmus*
Bluefish	*Pomatomus saltatrix*
Atlantic bonito	*Sarda sarda*
Bearded brotula	*Brotula barbata*
Butterfishes, pomfrets	*Peprilus burti*
Cobia	*Rachycentron canadum*
Atlantic croaker	*Micropogonias undulatus*
Common dolphinfish	*Coryphaena hippurus*
Black drum	*Pogonias cromis*
Red drum	*Sciaenops ocellatus*
American shad	*Alosa sapidissima*
Hogchoker	*Trinectes maculatus*
Gag	*Mycteroperca microlepis*
Red Grouper	*Epinephelus morio*
Snowy grouper	*Epinephelus niveatus*
Warsaw grouper	*Epinephelus nigritus*
Yellowedge grouper	*Epinephelus flavolimbatus*
Yellowfin grouper	*Mycteroperca venenosa*
Groupers	*Epinephelus itajara*
Grunts, sweetlips	*Haemulon album*
Atlantic thread herring	*Opisthonema oglinum*
Bar jack	*Caranx ruber*
Crevalle jack	*Caranx hippos*
Jacks, crevalles	*Pseudocaranx dentex*
Ladyfish	*Elops saurus*
Atlantic chub mackerel	*Scomber colias*
King mackerel	*Scomberomorus cavalla*
Atlantic Spanish mackerel	*Scomberomorus maculatus*
Gulf menhaden	*Brevoortia patronus*
Mojarras (Silver-biddies)	*Eugerres plumieri*

FAO, NOAA	Species
Flathead grey mullet	*Mugil cephalus*
Oilfish	*Ruvettus pretiosus*
Opah	*Lampris guttatus*
Pigfish	*Ortopristis chrysoptera*
Atlantic pomfret	*Brama brama*
Florida pompano	*Trachinotus carolinus*
Blunthead puffer	*Sphoeroides pachygaster*
Rays, stingrays, mantas	*Dasyatis sabina*
Blue runner	*Caranx crysos*
Scamp	*Mycteroperca phenax*
Black seabass	*Centropristis striata*
Blacktip shark	*Carcharhinus limbatus*
Shortfin mako	*Isurus oxyrinchus*
Sharks, rays, skates	*Sphyrna tiburo*
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*
Sheepshead	*Archosargus probatocephalus*
Yellowtail snapper	*Lutjanus argentiventris*
Snappers, jobfishes nei	*Lutjanus apodus*
Atlantic spadefish	*Chaetodipterus faber*
Swordfish	*Xiphias gladius*
Great Northern tilefish	*Lopholatilus chamaeleonticeps*
Tripletail	*Lobotes surinamensis*
Bigeye tuna	*Thunnus obesus*
Blackfin tuna	*Thunnus atlanticus*
Atlantic bluefin tuna	*Thunnus thynnus*
Skipjack tuna	*Katsuwonus pelamis*
Yellowfin tuna	*Thunnus albacares*
Tuna-like fishes nei	*Thunnus alalunga*
Wahoo	*Acanthocybium solandri*
Weakfishes nei	*Cynoscion acoupa*

It is pertinent to mention that some charismatic species are not included in this description, like the blue marlin, which is known to spawn in the central Gulf of Mexico, or the red snapper, because their abundance in catch records is too low to be mentioned.

Regional Stocks

According to Chavez & Chavez-Hidalgo (In press), the catch trend of the western central Atlantic (Figure 7) is not very clear, because it seems to attain a maximum followed by a decline; however, the projection of the regression line suggests that the maximum yield will be reached until the year 2030 with 2.65 M mt. The corresponding biomass is 5.3 M mt (Table 1), and the current stock biomass is 3.68 M mt. From these data source, it was possible to examine with some detail the catch trend of the Gulf of Mexico (Figure 8); in this case, the maximum yield was obtained in the late eighties with 800,000 mt, but the current yield is only 550,000 mt. The global MSY for the Atlantic Ocean is 24.15 M mt, and again, current yields are considerably lower (Chavez and Chavez-Hidalgo, In press).

Respecting the species composition, the Gulf menhaden is the most abundant stock of all fisheries of the GoM with a biomass estimated in 12 M mt (Figure 9). Other fisheries of this area are represented by twelve fisheries as the most abundant, from which five have a stock biomass of more than 50,000 mt, but less than 1,000,000 mt; they are *Pseudocaranx dentex, Coryphaena hippurus, Mycteroperca bonaci, Scomberomorus maculatus,* and *Spyrna tiburo*. Within this range of catch, only the dolphinfish and the Gulf Menhaden are from the northern GoM. Six other stocks biomass range from 10,000 to 50,000 mt.

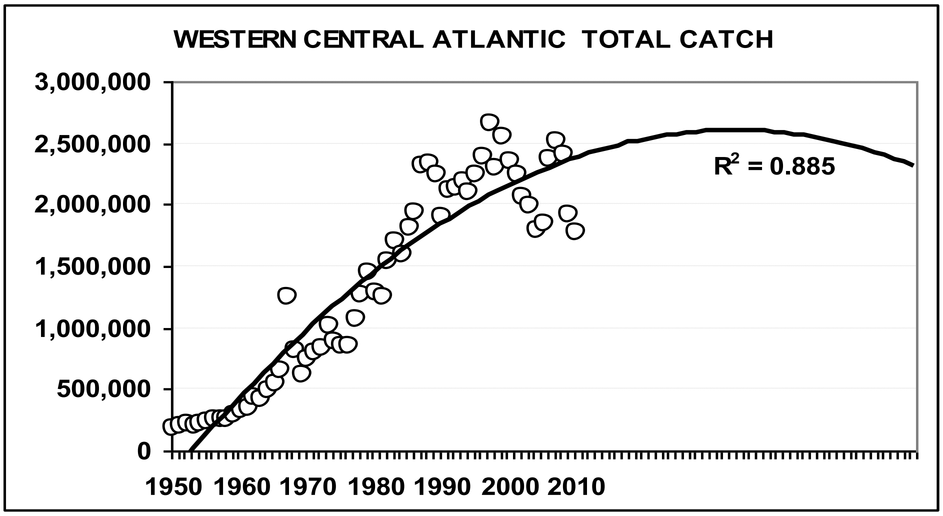

Figure 7. Catch trend of the western central Atlantic; it is not clear whether the maximum yield was attained by the early 2000s, or it still may grow to a maximum near the year 2030. In the Gulf of Mexico, whose data are included in those of this figure, more than 60 species caught and recorded in the statistics, are included in this analysis; here, the MSY was attained in the middle 1980s (after Chávez and Chavez Hidalgo, In press).

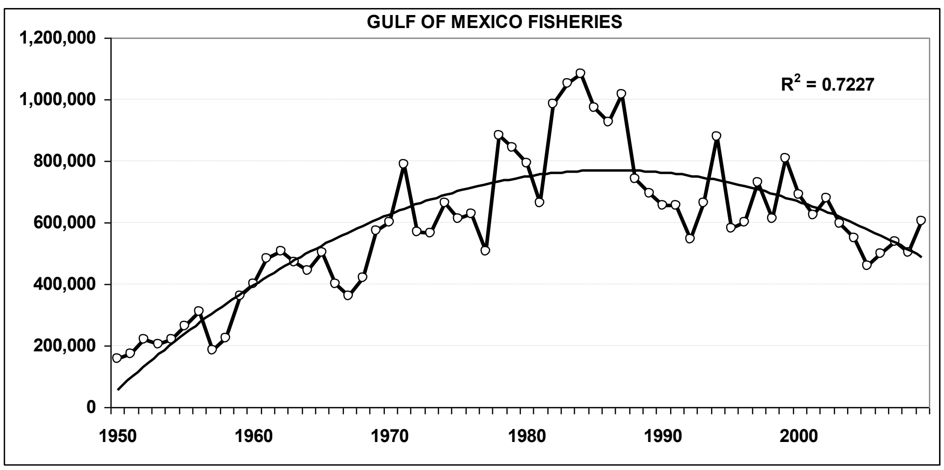

Figure 8. Catch trend of the Gulf of Mexico, mt.

DISCUSSION

Processes governing dynamics of each fishery should be known, as well as its biological and socioeconomic attriibutes in order to guide strategies and management policy for a sustainable exploitation. A common problem for the diagnosis of many fisheries is that they often lack sufficient information to be evaluated. Therefore, optimal management of fisheries should pursue the following goals:

i) To determine the optimum levels of biological and economic yield;
ii) To ascertain the level of direct jobs under each of the two options mentioned above that could create;
iii) To assess the impact (biological, economic and social) of all feasible options for exploitation;
iv) To evaluate the optimal strategies for the exploitation of the resources analyzed;
v) To plan and manage each resource on a strategy so that sustained development is ensured.

Parameters should be evaluated using population sampling data, from the frequency of lengths, or by reading growth marks as well as estimates of abundance from log books or statistical data. Today it is possible to have access to a wealth of databases available for the most important exploited stocks, through FishBase (Froese and Pauly, 2011), complemented with catch data for most world fisheries in FAO records. For quick assessments, such as those described in this paper, they are two sources of valuable time-saving information.

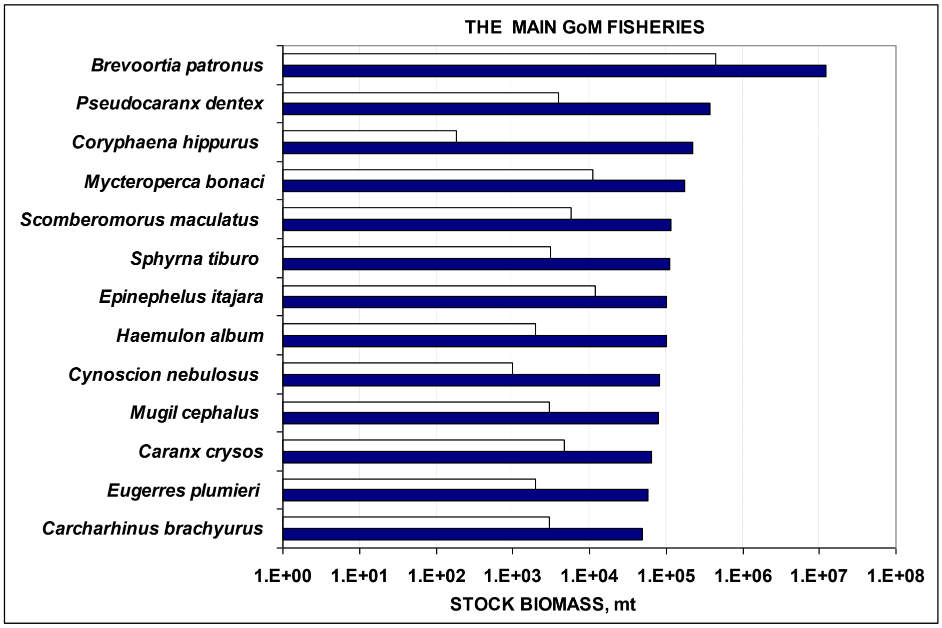

Figure 9. Catch 2006 – 2010 (white bars) and stock biomass (black bars) of the main stocks exploited in the GoM. Based in the assessment of each stock. Only the dolphinfish and the Gulf Menhaden are from the northern GoM. The scale is logarithmic.

Exploitation of fish stocks departs from the implicit assumption that the biomass is stable and its decline depends on the fishing intensity exclusively. This is true to a certain point, particularly in short period of time, because apart from the influence of human development, the environment is fluctuating by nature and its variability may produce sudden increases of short-lived species like sardine and menhaden as consequence of increases in productivity. Long-lived or density-dependent stocks do not display this kind of response, but when there is some factor depleting their biomass, their recovery often takes long time; for this reason depleted stocks caused by overfishing are not able to be restored in short time.

Variability of marine environment is responsible for space and time variability in fish distribution. This is one of the reasons why fishes are distributed in aggregations or schools, as one of the mechanisms to optimize their adaptability to its habitat. Many exploited species if the GoM are associated to the estuarine environment, and this habitat is subject to tidal and seasonal variation, where changes in salinity, temperature, and turbidity have often wiped out populations is estuaries (Hedgepeth 1957).

In the Gulf of Mexico fishing, hypoxia, red tide, climatic change, and oil and gas exploration have been pointed as the main types anthropogenic disturbances (Tunnell 1992, Steele 1998, Beamish et al. 1999, Klyashtorin 2001, Rabalais et al. 2002, Scavia et al. 2003, Walsh et al. 2006, Horta-Puga G. 2007, Coleman and Koenig 2010), which are mixed in complex interaction (predations, consumption, commensals, and mutualists) with other species in their communities. In addition, winter cold waves have been recorded as responsible for mass mortalities of fish in the west GoM (Gunter 1945, 1957).

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