Venezuelan marine fisheries catches in space and time: 1950-1999

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ABSTRACT

The FAO FISHSTAT landings for Venezuela were compared to data obtained independently directly from the primary collection authority. The major fisheries target small pelagics, snappers and groupers, ark shell, shrimp, and large pelagics. Total landings corresponded well, reflecting a good transfer of landings data from national sources to FAO's database. However, taxonomic breakdown of landings did not transfer as effectively as their tonnage, with FAO listing 62 taxa compared to 120 reported by the national source. Thus, FAO data reflect a higher degree of data pooling than original national source data, resulting in a loss of biodiversity information. In the present report, the spatial allocation of Venezuelan landings, based on state-boundary specific landings record for the period 1984-1999 have been improved. Given the often small coastal extent of some states, we pooled data from several states, resulting in eight spatial zones for landing records. Thus, we created an updated dataset for incorporation into the *Sea Around Us* project global database, combining better taxonomic breakdown as well as improved spatial landings allocation.

INTRODUCTION

Venezuelan fisheries are characterized by a very large small-scale, artisanal sector servicing local consumption as well as supplying some processing and export industries. Species caught include small and medium pelagics, primarily sardine (mainly *Sardinella aurita*), as well as snappers (Lutjanidae) and groupers (Serranidae), other demersal fish and invertebrates. Most components (over 60%) of the small-scale fisheries sector operate close to home ports and in relatively shallow waters within the EEZ (Anon., 2000a). For example, the large sardine fishery generally uses small boats deploying seine nets, with operations usually restricted to waters < 50 m deep in a narrow belt rarely exceeding 5 nm from the coastline (Fréon, *et al.*, 1997). Some components, however, such as the snapper and grouper fishery, operate also over extensive areas of the continental shelf and slope of Venezuela, Trinidad and Tobago, Suriname and French Guiana (Figure 1). Commercial fisheries consist primarily of shrimp trawl fisheries and large tuna/billfish fisheries.

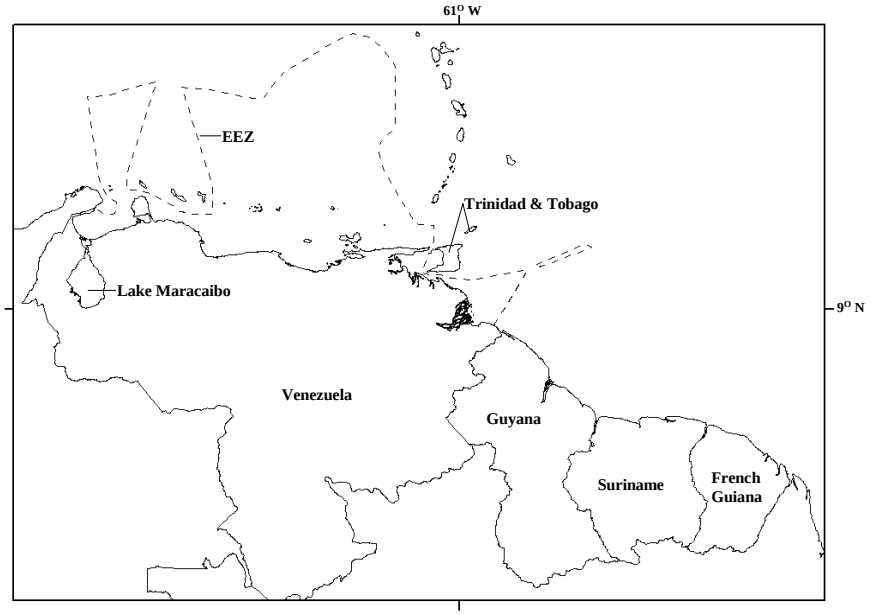
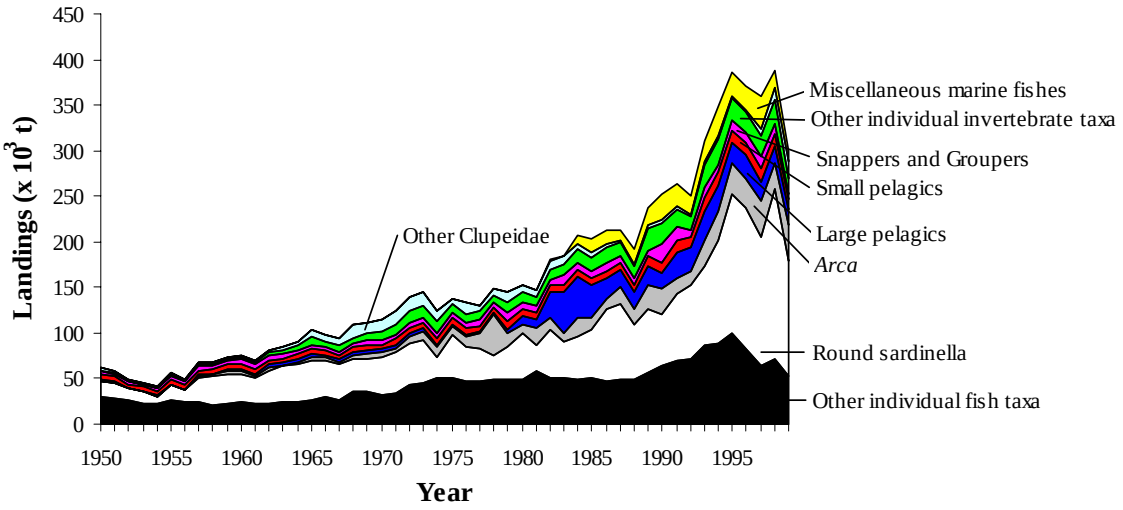


Figure 1: Map of Venezuela, showing EEZ, Orinoco delta, Lake Maracaibo, Trinidad and Tobago, Guyana, Suriname and French Guyana.

In terms of landings (Figure 2a), the artisanal sardine fishery forms the bulk of Venezuelan catches (reported mainly as 'round sardinella', *Sardinella aurita*,) followed by large pelagics (mainly yellowfin tuna, *Thunnus albacares*) and ark shell (*Arca zebra*).

(a)



(b)

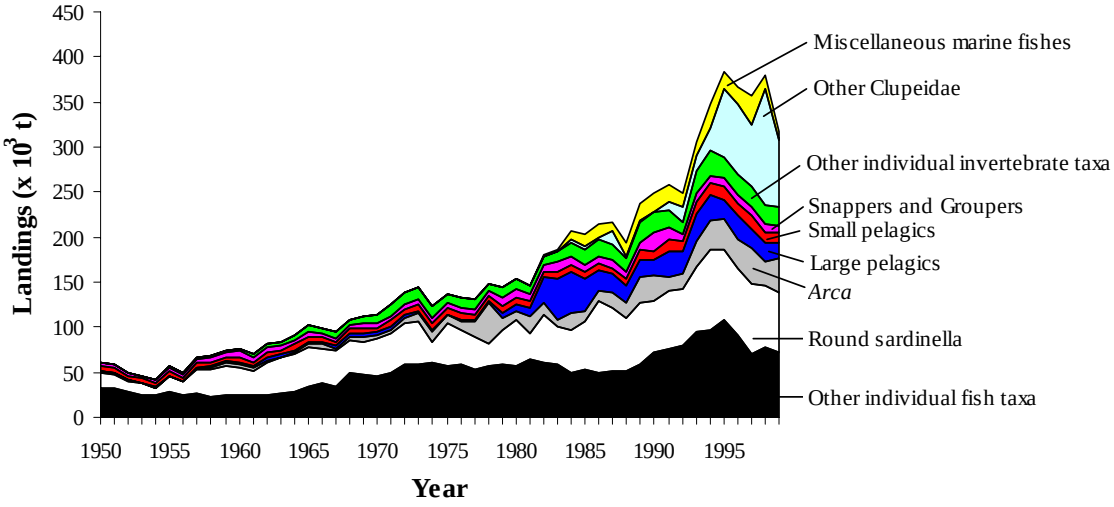


Figure 2: General catch time trend (1950-1999); a) Original FAO data (n = 62 taxa, source: FAO FISHSTAT), and b) FAO data (1950-1983) and Venezuelan national data (1984-19999, n = 112 taxa) showing general trend through time. Taxonomic breakdown was simplified through pooling for visual clarity.

The eastern Venezuelan shelf areas (Figure 1) are more productive due to the upwellings in the dry season (January to larger shelf area, as well as seasonal nutrient inputs due to localized wind-induced June) and river discharge from the Orinoco in the rainy season (Fréon, *et al.*, 1997). The central region of Venezuela is characterized by a narrower shelf area, and contains only sparse resources (Strømme and Saetersdal, 1989), resulting in low fishery yields. The most productive waters in western Venezuela are the Gulf of Venezuela and Lake Maracaibo (a large, shallow estuary) with the latter supporting a significant shrimp and crab fishery. In terms of landed value, yellowfin tuna and shrimp are the leading products, followed by crab and sardine fisheries.

Historically, until the middle of the 20th century Venezuelan fisheries were exclusively artisanal, with hook and line, and trap and gillnets being the dominant gears, along with a few large beach seine operations known locally as 'trenes de chinchorro', operated by as many as 200 fishers (Suarez and Bethencourt, 1994). In 1940, total catches reached 32,500 t of mainly demersal and medium-sized pelagic fish. With the construction of the first canneries during this

period, an artisanal fishery for sardines developed, and became the largest in the country. By 1960, its catches had reached over 80,000 t, of which approximately 40% was sardine for human consumption and other small pelagic species such as *Cetengraulis edentulus* and *Opisthonema oglinum*, used for fish meal (Novoa, 2000). The introduction of the outboard engine during the 1950s with public assistance for the small-scale fisheries represented a revolutionary change at the time, allowing many fishers to become independent producers, and leading to the configuration of the fishing fleets that is known today.

The Venezuelan industrial fisheries started their development in the early 1950s with the introduction by European immigrants of trawling for penaeid shrimps in the Gulf of Venezuela and longlining for tuna and related species in the Caribbean and western Atlantic. The shrimp trawl fisheries expanded their activities during the 1960s and 1970s to the eastern Venezuelan shelf and Orinoco delta area. During this period, public investment in port and landing facilities and financial assistance led to a rapid development of this fishery, which peaked in the 1980s. During the late 1970s and early 1980s, government policies and a favorable international context permitted the development of the tuna purse seine fisheries, allowing the country to become one of the major producers in the eastern tropical Pacific, representing around 15% of the total catch in this area (Novoa, 2000). From 1983 onwards, Venezuela's economic crisis led to increasing unemployment with a resultant shift towards increased natural resource exploitation, with indications of unsustainable catches (Rodríguez, 2000).

Fishing fleets

The artisanal fleet consists of approximately 20,000 small vessels (<10 m, open deck, outboard engines) and approximately 1,000 medium- and long-range vessels. The medium and long-range artisanal fleet targets snappers and groupers inside and outside the EEZ using handline and demersal longline gear, as well as medium pelagics mainly within the Venezuelan EEZ using pelagic longline. The commercial fleet consists of approximately 400 shrimp trawlers operating essentially within the continental shelf area, and about 30 long-distance, large pelagic purse seine vessels (average fishing capacity 900 t) targeting large tuna. Only 5-6 of these vessels operate within Atlantic waters (mainly FAO area 31), the rest fish in the eastern Pacific (Anon., 2000a).

Research/Management authority

According to Prado and Drew (1999), the Government agency assigned responsibility for oversight and support of scientific research is the Fondo Nacional de Ciencia, Tecnología e Innovación, FONACIT (National Fund for Science, Technology and Innovation). In 1982 the fisheries research section of the National Fisheries Office of Venezuela, as it was then called, was moved to the National Fund for Agriculture and Husbandry Research (FONAIAP), which has recently become the National Institute of Agricultural Research (INIA). These days, the two institutions responsible for fisheries are the National Institute for Fisheries and Aquaculture (INAPESCA) and the National Institute of Agricultural Research (INIA). INAPESCA is responsible for overall catch data collection and fisheries management, while INIA provides more detailed catch and effort data for some fisheries (e.g., sardine, shrimp, tuna) and management advice.

Aims

The aims of this report were to:

Improve on the Venezuelan national catch data series documented in "El Atlas Pesquero Marítimo de Venezuela" of Novoa et al. (1998), both by extending the time series it contains, as well as improving the data quality and species composition, using national data sources;

Improve the spatial allocation of catches, currently assigned to FAO area 31 (Western Central Atlantic), through allocation to eight national zones based on landing records from the 13 coastal states of Venezuela; and

Use this modified national database to suggest adjustments to the FAO catch database, thus contributing to the SAUP database.

RESULTS

We have been able to obtain the complete Venezuelan landing records (National Dataset) from 1984-1999, directly from the government agencies collecting the data (INAPESCA and INIA). For most artisanal fisheries earlier data are not available in electronic form, and the location of much of

Table 1: Taxonomic entities used for Venezuelan fisheries landings in FAO FISHSTAT (n=62) and Venezuelan national data (n=112)

FAO	Venezuela	FAO	Venezuela
Acanthocybium solandri	*Acanthocybium solandri*	*Istiophorus albicans* (continued)	Istiophoridae*
Ariidae	Ariidae	Jacks, mullets, sauries	Miscellaneous pelagics
	Cathorops spixii	*Katsuwonis pelamis*	*Katsuwonis pelamis**
Arca	*Arca zebra*	*Loligo*	*Loligo* spp.
Auxis	*Auxis thazard*	Lutjanidae	*Lutjanus* spp.
Auxis thazard			*Lutjanus analis*
Brachyura	Brachyura		*Lutjanus griseus*
Carangidae	*Chloroscombrus chrysurus*		*Lutjanus purpureus*
	Decapterus punctatus		*Lutjanus synagris*
	Decapterus tabl		*Pristipomoides* spp.
	Elagatis bipinnulata		*Rhomboplites aurorubens*
	Oligoplites sp.	*Makaira nigricans*	*Makaira nigricans**
	Trachurus spp.	*Micropogonias furnieri*	*Micropogonias furnieri*
Caranx	*Caranx*	Miscellaneous marine fishes	*Albula vulpes*
	Caranx hipppos		*Elops saurus*
	Caranx latus		*Hemirhamphus spp.*
Carcharhinidae	Carcharhinidae		*Holocentrus* sp.
	Galeocerdo cuvier		*Lepophidium profundorum*
	Mustellus spp.		*Megalops atlanticus*
	Various sharks		*Merluccius albidus*
Centropomus undecimalis	*Centropomus* spp.		Miscellaneous pelagic fishes
Cetengraulis edentulus	*Cetengraulis edentulus*		Various fishes
Coryphaena hippurus	*Coryphaena hippurus*	Miscellaneous marine molluscs	Miscellaneous marine molluscs
Crassostrea rhizophorae	*Crassostrea rhizophorae*		*Citarium I*
	Pinctada imbricata		*Donax* spp.
Cynoscion	*Cynoscion* spp.		Scallops
	Cynoscion jamaicensis	*Mugil cephalus*	*Mugil curema*
		Mugil liza	*Mugil liza*
Epinephelus	*Epinephelus* spp.	Octopodidae	*Octopus* spp.
	Epinephelus itajara	*Ocyurus chrysurus*	*Ocyurus chrysurus*
	Epinephelus guttatus	*Opisthonema oglinum*	*Opisthonema oglinum*
	Epinephelus niveata	*Panulrus argus*	*Panulirus argus*
Euthynnus alleteratus	*Euthynnus alleteratus*	*Penaeus*	*Penaeus brasiliensis*
Gerreidae	Gerreidae		*Penaeus schmitti*
	Eugerres spp.		*Penaeus subtilis*
Haemulidae	*Haemulon aurolineatum*		Penaeidae
	Haemulon chrysargyreum	*Peprilus*	*Oligoplites palometa*
	Haemulon steindachneri	Perciformes	*Acanthurus spp.*
	Orthopristis ruber		*Calamus* sp.
Istiophorus albicans	*Istiophorus albicans**		*Erythrocles monodi*

*These taxa were not compared in this report due to uncertainty of reported values and location of catches.

Table 1: (cont'd)

FAO	Venezuela	FAO	Venezuela
Perciformes (continued)	*Halichoeres* spp.	*Tetrapturus albidus* (continued)	Various swordfish or billfish*
	Larimus breviceps	*Thunnus alalunga*	*Thunnus alalunga**
	Lobotes surinamensis	*Thunnus albacares*	*Thunnus albacares**
	Macrodon ancylodon	*Thunnus atlanticus*	Not reported
	Miscellaneous demersal fishes	*Thunnus obesus*	*Thunnus obesus*
	Pomacanthus sp.	*Trachinotus*	*Trachinotus* spp.
	Priacanthus arenatus	*Trichiurus lepturus*	*Trichiurus lepturus*
	Rachycentron canadum	Veneridae	Veneridae
	Sciaenidae		*Tivella mactroides*
	Sparisoma spp.	*Xiphias gladius*	*Xiphias gladius**
Perna perna	*Perna perna*		
Pleuronectiformes	Pleuronectiformes		
Pomatomus saltator	*Pomatomus saltatrix*		
Portunus spp.	*Callinectes* spp.		
Rajiformes	*Aetobatus* or *Myliobatis* spp.		
	Various rays		
Sarda sarda	*Sarda sarda*		
Sardinella aurita	*Sardinella aurita*		
	Clupeidae		
Scomber japonicus	*Scomber japonicus*		
Scomberomorus brasiliensis	*Scomberomorus brasiliensis*		
Scomberomorus cavalla	*Scomberomorus cavalla*		
Scombridae	Scombridae*		
Selar crumenophthalmus	*Selar crumenophthalmus*		
Selene setapinnis	*Selene setapinnis*		
Seriola	*Seriola zonata*		
	Seriola rivoliana		
Serranidae	*Mycteroperca rubra*		
	Mycteroperca spp.		
	Serranus dewegeri		
Sphyraena	*Sphyraena* spp.		
Strombus	*Strombus gigas*		
Tetrapturus albidus	*Tetrapturus albidus**		

*These taxa were not compared in this report due to uncertainty of reported values and location of catches.

Table 2: The zones delineated from 13 Venezuelan states used for the spatial allocation of catches.

Zone Number	Zone Name	Venezuelan States pooled in this Zone (remarks)
1	Lake Maracaibo	Merida, Trujillo, Zulia (crab, shrimp and weakfish)
2	Gulf of Venezuela	Merida, Trujillo, Zulia (all other taxa)
3	Western Venezuela	Falcon (landings split between Area 2 & Area 3)
4	West-central Venezuela	Carabobo
5	East-central Venezuela	Aragua, Anzoategui, Vargas (formerly: Districto Federal) , Miranda
6	Eastern Venezuela	Sucre and Nueva Esparta
7	Gulf of Paria	Monagas and Sucre
8	Delta Amacuro	Delta Amacuro

this earlier data is currently unknown. Thus, the updated catch time series reported here contains original FAO data from 1950-1983, while catches from 1984-1999 are based on the national dataset (Figure 2b). Total catches peaked at over 350,000 t year^{-1} in the late 1990s. Quantitative differences between the two data sources were minimal, reflecting good data transfer mechanisms between Venezuela and FAO. The same did not apply to the taxonomic breakdown of reported catches.

Taxonomic differences in reporting

One of the greatest challenges that emerged was the 'taxonomy' of the catch, as all national data are recorded using non-standardized local names, which varied through time. This use of highly localized names may also explain some of the allocation uncertainties and irregularities found in the FAO data for Venezuela. It appears that national catch statistics are reported to FAO by their local names, likely resulting in taxonomic uncertainties and the observed pooling of numerous taxa, such as several distinct species to their family level or 'Miscellaneous Marine Fishes' in the FAO data. The National Dataset obtained here, with 120 taxonomic entities has enabled us to improve the species breakdown of the existing FAO database records which contains 62 taxa for Venezuela (Table 1).

The most obvious change in the updated catch time series from the original FAO dataset was the re-allocation of considerable tonnage from round sardinella (Figure 2a) to the group 'other clupeids' (Figure 2b). This reflects more correctly the diverse species composition of catches in the small pelagic fisheries.

Spatial catch allocation

With respect to spatial allocation, the national dataset is broken down by the 13 coastal states of Venezuela that report marine landings (Table 2). However, given the sometimes small coastal extent of some states, several were amalgamated for the purpose of spatial catch allocations, resulting in eight spatial zones (Table 2, Figure 3). Based on total landings, the Eastern Venezuelan zone dominates due to its large shelf area, accounting for approximately 75% of the total Venezuelan catches in the late 1990s (Figure 4, Table 2). This spatial

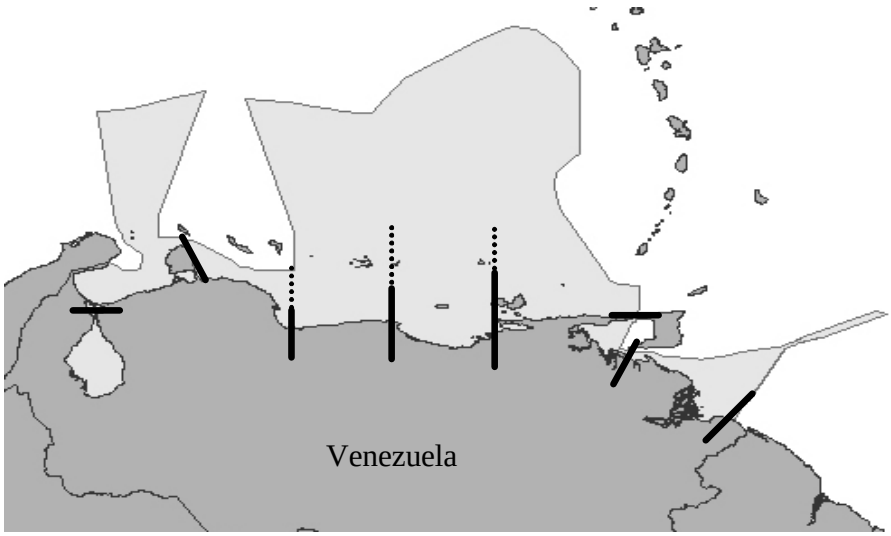


Figure 3: Map of eight reporting zones used for spatial allocation of reported landings, derived through partial amalgamation of the 13 reporting states for national statistics. Venezuelan EEZ is shown also.

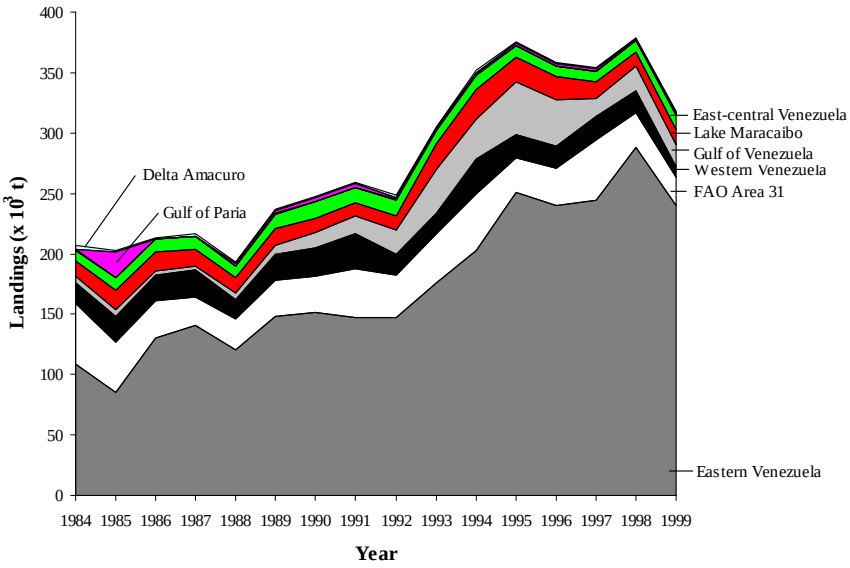


Figure 4: Total national catches allocated to the eight reporting zones indicated in Figure 3 and Table 2, depicting the predominance of the large eastern shelf area (Eastern Venezuela) in total catches.

catch allocation has significantly improved the spatial breakdown of landings over the three zone approach (east, central and west) utilized in previous data descriptions (Novoa *et al.*, 1998), and the broad assignment to FAO area 31 (Western Central Atlantic) in FAO FISHSTAT. To what extent this breakdown of landing locations reflects true spatial location of catches is uncertain, but likely to be high for most species (due to the large, localized artisanal sector). An exception is the snapper/grouper fishery, which has a considerable component outside of Venezuelan waters, our next topic.

Snapper and Grouper fishery

The major taxonomic target for this handline and bottom longline fishery are the Lutjanidae, especially the Southern Red Snapper (*Lutjanus purpureus*), while the Serranidae, (e.g., *Epinephelus* spp.), form a minor component of the reported landings (Mendoza and Lárez, 1996; Figure 5a). Although a significant portion of fish are caught in foreign waters (data only available since 1988), the major part of the landings are still taken in national waters (Figure 5b). The major part of foreign landings appear to be made in French Guiana, followed by Suriname and Trinidad & Tobago (Figure 5c). This historic geographic range of the fishery is in part maintained through existing agreements, mainly with Suriname and French Guiana. Under existing license agreements, 75% of catches made in the waters of French Guiana have to be landed there, while the rest may be landed in Venezuelan home ports (Charuau and Die, 2000). Similarly, 50% of catches taken in Suriname are to be landed in that country. The national dataset reports these catches as landings in 'foreign ports' ('Puerto Extranjeros'), which are assigned spatially according to local expert advice.

Invertebrate fishery

Fisheries for invertebrates are dominated by ark shell (*Arca zebra*), which accounts for over 50% of the total reported invertebrate landings of just under 60,000 t year^{-1} in the late 1990s (Figure 6a). The remaining invertebrate catches are dominated by shrimp, crab and other bivalve catches (Figure 6b). The white shrimp (*Litopenaeus schmitti*) is one of the economically most significant fisheries resources of Venezuela, and accounts for ~90% of the total shrimp catch in Lake Maracaibo (Andrade de Pasquir, 1998). Interestingly, the white shrimp stock in Lake Maracaibo is the largest known population within the range of this species. Overall, the Venezuelan commercial shrimp trawl fisheries began in the 1950s, and the fleet reached a peak of 450 vessels in the 1980s, before dropping to approximately 370 vessels in the mid 1990s (Anon., 1996b; Marcano and Alio, 1996). The traditional fishing grounds are thought to be intensively exploited, although the overall effort seemed to have declined in the mid 1990s (Marcano *et al.*, 1996). However, effort in most places is still considered well beyond levels leading to MSY (Marcano *et al.*, 1996). Approximately 40% of the catch is exported, mainly to North American and European markets, while small shrimp are sold nationally. Bycatch is significant in this fishery, accounting for 93% of the total catch in the nets in 1998, of which 33% is kept for sale in local markets (utilized bycatch), while 60% is discarded at sea (Anon., 2000b).

Underreporting

It is generally thought that parts of the artisanal fisheries sectors are not well covered with regards to catch data collection.

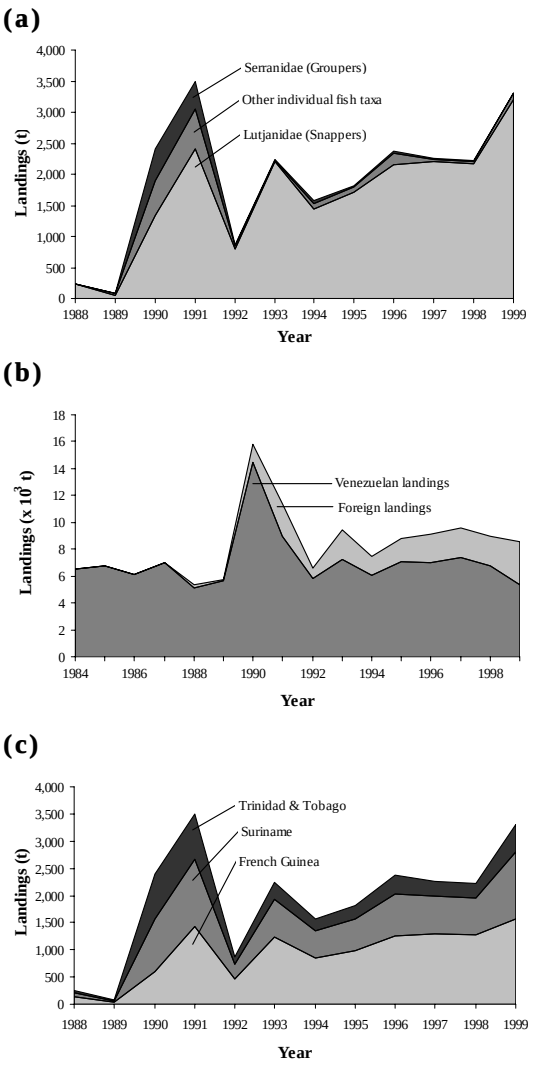


Figure 5: Reported landings for the snapper and grouper fisheries operating in waters of Venezuela and neighboring countries: a) Taxonomic breakdown of reported landings, illustrating dominance by Lutjanidae; b) Separation of catches in those taken in national waters and those taken in neighboring countries; and c) Breakdown of catches taken and landed in the three respective countries.

Official catches for some species might, in some areas or for some time-periods under-represent true catches by as much as 200-500% (Salaya *et al.*, 1985a, 1985c, 1985d, 1985b; Mendoza and Freón, 1991). While the general problem is known, currently there seems to be no reliable way to correct for this, due to massive spatial and temporal variation and uncertainty. However, this problem does not apply to the substantial sardine fishery, nor the catches for ark shell, both of which are thought to be recorded reliably.

International agreements

Information was also obtained on international agreements to which Venezuela is party (Anon., 1996a). Venezuela is member of FAO, the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Inter-American Tropical Tuna Commission (IATTC). A bilateral agreement exists since 1985 with Trinidad & Tobago, designed to permit a limited number of Venezuelan vessels to fish for snappers and groupers in their waters. In return, vessels from Trinidad & Tobago are allowed to continue their traditional fishing for shrimp off the Orinoco delta in Venezuelan waters. There is also an agreement with Suriname which allows around 100 Venezuelan snapper-grouper vessels, through a license system, to fish in Surinamese waters as long as 50% of the catch is landed in that country. There is no written agreement between the French and Venezuelan governments, but administrative permits are given to snapper-grouper vessels to fish in French Guiana, as long as 75% of the catch is landed in this overseas French department.

DISCUSSION

Overall, the temporal trend in total catches as reported by Venezuela indicated a dramatic increase in reported landings throughout the 1980s and 1990s from levels around 150,000 $t \cdot year^{-1}$ to over 350,000 $t \cdot year^{-1}$. The latest year of the dataset examined here (1999) indicated a distinct decline in reported landings. Whether this is a true representation of trends in landings or a reflection of data anomalies for the last year of the dataset utilized here is uncertain, and has to await future work to verify. Thus, this decline has to be treated with caution until 2000 and 2001 data are incorporated.

Concurrence with the global landings database maintained by FAO was good in terms of tonnage, but taxonomic information was transferred less reliably from national sources to FAO, with a ~50% loss of taxonomic diversity. The work reported here corrects for some taxonomic over-aggregating, and improves the spatial allocations through use of eight landings zones.

It is hoped that investigations such as the present will encourage FAO to refine their excellent global dataset on fisheries landings both in-house, as well as through feedback

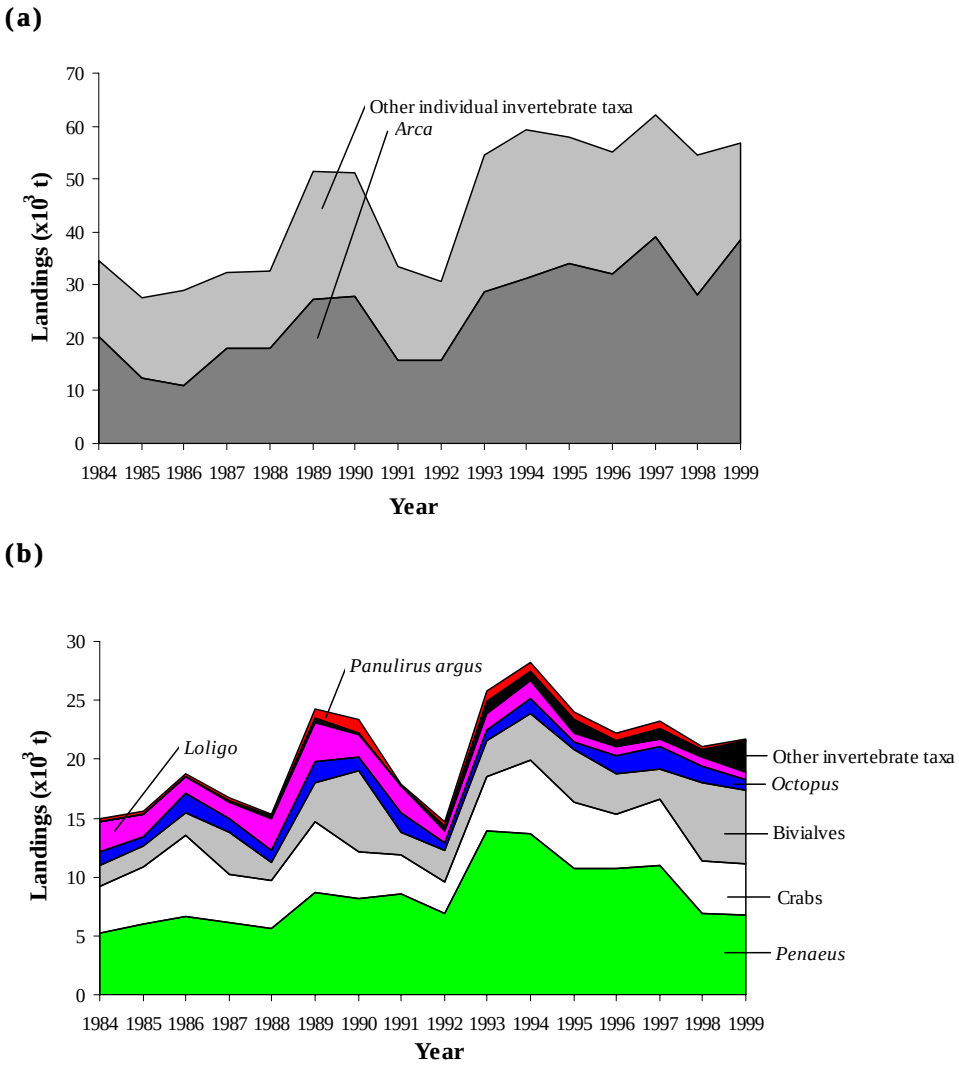


Figure 6: Venezuelan national reported landings for invertebrates: a) Illustrating the predominance of ark shell (*Arca zebra*); and b) Breakdown of the 'other individual invertebrate taxa' pooled in (a) and illustrating the importance of shrimp, crab and bivalve components.

requests to their member countries, i.e., to encourage better taxonomic and spatial allocation of landings. Such efforts will improve the utility of FAO's global database for investigations and evaluations of effects of fishing at the ecosystem levels (Pauly *et al.*, 2002; Christensen, *et al.*, 2003) as mandated by the precautionary and sustainability principles.

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