RECONSTRUCTING CATCHES OF MARINE COMMERCIAL FISHERIES FOR BRAZIL[1]

Kátia M. F. Freire and Thiago L. S. Oliveira

Universidade Estadual de Santa Cruz, Departamento de Ciências Exatas e Tecnológicas,
Rod. Ilhéus-Itabuna km 16, Ilhéus, Bahia, Brasil, CEP: 45654-000
Email: kfreire2006@yahoo.com.br

ABSTRACT

A database of catches originating from marine commercial fisheries in Brazil was compiled at the state level based on data from national bulletins and previous work for the years 1950-2004. The degree of detail reported in the bulletins differed substantially among years. Three categories were identified: total catch per state (1950-1955), catch of large groups (fishes, crustaceans, molluscs, cetaceans, and chelonians) per state (1956-1961), catch of main taxa per state (1962-1975) and catch of all taxa per state (1976-2004). A simple estimation process was used to estimate missing values using data from the two closest years for which complete data were available. We assessed the estimation process using the 1969 data and found that estimated and observed values were very similar, with the exception of sardine in the State of Rio de Janeiro. National catches increased from 1950 to 1986, and declined thereafter to the current level of approximately 500,000 t. These catches were associated with 446 common names, which may include synonyms used in different states, as the correspondence between common and scientific names is still not well understood. Catches were almost equally distributed among regions (with lower values for northern Brazil) in the 1950s. With the development of industrial fisheries, the southern and southeastern regions started to dominate. After the collapse of sardine stocks, the distribution among regions seemed to be reverting towards homogeneity, but at levels 3.5 times higher than in the 1950s.

INTRODUCTION

The analysis of the 'health' of fisheries resources requires at least basic data such as catch and effort. Some countries do not keep an electronic historical record of such data either because they do not exist or because there is not enough interest in recovering historical data. In Brazil, only catch data are regularly collected, and effort information is available only for major resources such as sardine, lobster, and southern snapper. The low quality of catch statistics in Brazil has been long recognized (e.g., Paiva, 1997; Freire, 2005; Lucato, 2006). Nevertheless, this cannot serve as an excuse for not making official catch data from scattered documents more readily available.

The United Nations Food and Agriculture Organization (FAO) provides online access to catch data as supplied by its member countries (www.fao.org). However, these data are presented at a country level, and do not allow analyses at a more spatially detailed, e.g., state level. Considering the great length of the Brazilian coast (covering approximately 38 degrees of latitude, Figure 1), spatially detailed information is required, as the features of the marine environment and target species vary along the coast (Matsuura, 1995). Freire (2003) compiled catch data for the period from 1980 to 2000. Here, we extend the temporal

Figure 1. Brazil and its coastal states: Amapá (AP), Pará (PA), Maranhão (MA), Piauí (PI), Ceará (CE), Rio Grande do Norte (RN), Paraíba (PB), Pernambuco (PE), Alagoas (AL), Sergipe (SE), Bahia (BA), Espírito Santo (ES), Rio de Janeiro (RJ), São Paulo (SP), Paraná (PR), Santa Catarina (SC), Rio Grande do Sul (RS).

[1] Cite as: Freire, K.M.F. and Oliveira, T.L.S. 2007. Reconstructing catches of marine commercial fisheries for Brazil, p. 61-68 *In*: Zeller, D. and Pauly, D. (eds.) Reconstruction of marine fisheries catches for key countries and regions (1950-2005). Fisheries Centre Research Reports 15(2). Fisheries Centre, University of British Columbia, Vancouver [ISSN 1198-6727].

coverage of the electronic database backwards and forwards, covering the period from 1950 to 2004 in its entirety. Some important characteristics of local fisheries are also discussed.

MATERIALS AND METHODS

A database of marine catches for Brazil was compiled for the period 1950-2004. Previously, catch data for 1980-2000 had been compiled by Freire (2003). For the remaining periods, a variety of source documents were used (see Table 1). The analysis was performed backwards in time. The values presented here refer only to landings[2], and originate from both artisanal and industrial fleets.

Table 1. Sources used to compile marine catch data from commercial fisheries (artisanal and industrial) in Brazil from 1950 to 2004.

YEAR	SOURCE	FORMAT	TYPE OF DATA[a]
1950-1955	IBGE (1957)	Paper	Total (M + F)
1956-1957	IBGE (1959)	Paper	Group (M+ F)
1958-1960	IBGE (1961)	Paper	Group (M + F)
1961	IBGE (1962)	Paper	Group (M + F)
1962	MA/SEP (1964)	Paper	Main taxa (M +F)
1963	MA/SEP (1965a)	Paper	Main taxa (M + F)
1964	Estimated	—	All taxa (M)
1965	Estimated	—	All taxa (M)
1966	MA/SEP (1967)	Paper	Main taxa (M + F)
1967	MA/ETEA (1968)	Paper	Main taxa (M + F)
1968	MA/ETEA (1969)	Paper	Main taxa (M + F)
1969	MA/ETEA (1969)	Paper	Main taxa (M + F)
1970	MA/EE (1971)	Paper	Main taxa (M + F)
1971	SUDEPE/IBGE (1973)	Paper	Main taxa (M + F)
1972	SUDEPE/IBGE (1975)	Paper	Main taxa (M + F)
1973	SUDEPE/IBGE (1976a)	Paper	Main taxa (M + F)
1974	SUDEPE/IBGE (1976b)	Paper	Main taxa (M + F)
1975	SUDEPE/IBGE (1976c)	Paper	Main taxa (M + F)
1976	SUDEPE/IBGE (1979a)	Paper	All taxa (M + F)
1977	SUDEPE/IBGE (1979b)	Paper	All taxa (M + F)
1978	SUDEPE (1980a)	Paper	All taxa (M + F)
1979	SUDEPE (1980b)	Paper	All taxa (M)
1980-2003	Freire (2003)	MS Access	All taxa (M)
2001	IBAMA (2003)	PDF	All taxa (M)
2002	IBAMA (2004)	PDF	All taxa (M)
2003	IBAMA (2004)	PDF	All taxa (M)
2004	IBAMA (2005)	PDF	All taxa (M)

[a] M = marine waters; F = Freshwater

2001-2004

Data were obtained from online PDF format bulletins made available by the Brazilian Institute for the Environment and Renewable Resources (IBAMA)[3] .

1980-2000

An existing electronic database was used for this period (Freire, 2003).

1979

From 1979 backwards, all data were entered manually, as no electronic versions were available. In 1979, values were presented by habitat, thus catches from marine waters were easily identifiable.

1976-1978

Catches from both marine and freshwater habitats were presented in the same source table, and were split between habitats for all taxa recorded in each state.

1962-1975

Catches from both habitats were presented in the same table but only for taxa that accounted for about 80% of total catch for each state. For this period, catches for the main taxa available in the bulletin were encoded manually (both for marine and freshwater habitats) and subtracted from the total catch for each group (fishes, crustaceans, molluscs, chelonians and cetaceans). The remaining catches were distributed among the non-mentioned taxa using the list available for 1976-1977. The distribution was based on the proportion observed of each taxon in 1976-1977 regardless of its habitat, which was adjusted every year as different taxa had catch values in each state each year. Thus, the procedure used was as follows:

The proportion of non-mentioned taxon j (taxon specific catches reported separately only for major taxa) of group g in year y:

[2] For simplicity's sake, they are still referred to as 'catches' in this document.
[3] Brazilian Institute for the Environment and Renewable Resources (IBAMA), accessible at www.ibama.gov.br.

$$P_{jgy} = \frac{(C_{jg76} + C_{jg77})}{\sum_{j=1}^{n}(C_{jg76} + C_{jg77})} \quad ...1)$$

where g represents the taxonomic group (fishes, crustaceans, molluscs, cetaceans, chelonians); C_{jgy} is the catch for non-mentioned taxon j of group g in year y, and is defined as:

$$C_{jgy} = (T_{gy} - S_{gy}) \times P_{jgy} \quad ...2)$$

where T_{gy} is the total reported catch for group g in year y; and S_{gy} is the sum of catches for all reported taxa i within group g in year y.

1956-1961

The procedure above was also used to estimate catches for 1956-1961, considering the total catch available per group for each state. However, proportions P_{jgy} were calculated based on the average catch data for the years 1962 and 1963.

1950-1955

For this period, total catch (one single number per year) was the only information available in the bulletins for each state and the proportion among groups was defined based on 1956 and 1957 values. The proportion among taxa was defined as presented for the period 1962-1975. This procedure was performed separately for each state.

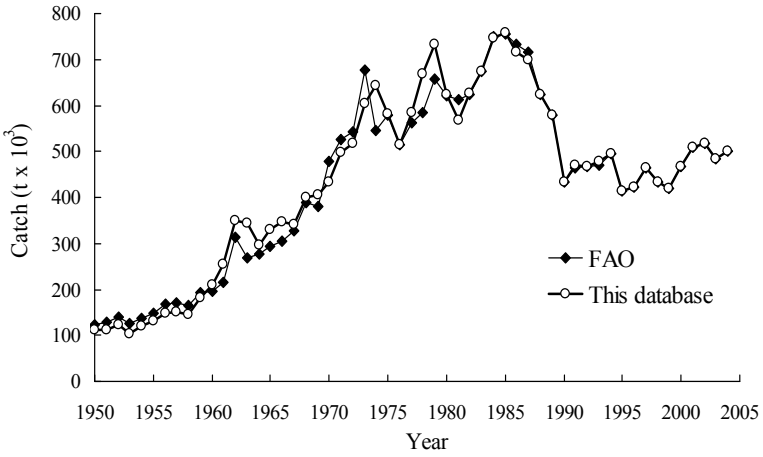

Figure 2. Catches originating from reported marine commercial fisheries in Brazil for the period 1950-2004, comparing FAO and present, reconstructed data.

RESULTS AND DISCUSSION

National and regional catches

The database compiled here indicates that marine catches from Brazil increased from 113,000 tonnes in 1950 to a maximum of 759,000 tonnes in 1985 (Figure 2). Subsequently, catches declined, but then have stabilized at approximately 500,000 tonnes. Data presented by FAO for Brazil indicate very similar trends (Figure 2). A previous analysis indicated that FAO data were higher than data from the national bulletins by about 100,000 tonnes for the period between 1988 and 2000 (Freire, 2003). Further analysis indicated that this discrepancy was due to the inclusion of 100,000 tonnes of 'marine fishes n.e.i.' (not elsewhere included; Freire, 2005). These 100,000 t were supposed to account for catches originating from recreational and subsistence fisheries, even though no basis for such an estimate could be found in local documents. The present re-analysis of the catch data for the same period indicated that this estimate was removed from official FAO data, which now matches the national bulletins for most of the years (Figure 2).

The present data strongly suggests that non-reported catches, e.g., subsistence and recreational, should be assessed and estimated for future inclusion in estimates of total marine catch for Brazil.

The trend in total catches is defined by the trend for fin-fishes, which represent 80-90% of total catches throughout the period. The trend for fishes is also similar to the crustaceans, increasing from 1950 to the early 1980s and decreasing thereafter (Figure 3a). The slight increase in the latest years appears mainly due to higher catches in Pará associated with an improving collection system of catch statistics. Note that catches of crustaceans were equivalent to 10-20% of fishes.

Molluscs were collected throughout the period, with an increasing trend (Figure 3b). Chelonians had the lowest catches amongst the groups with the highest volume caught between 1958 and 1983. After 1988, there was no record of chelonians, due to a complete catch ban imposed in 1986 (Marcovaldi and Marcovaldi, 1999). Nevertheless, it is known that they are caught incidentally by longliners and in gillnet lobster fisheries (e.g., Weidner and Arocha, 1999; Sales and Lima, 2002; Pinedo and Polacheck, 2004). For a discussion on catches of cetaceans, see below.

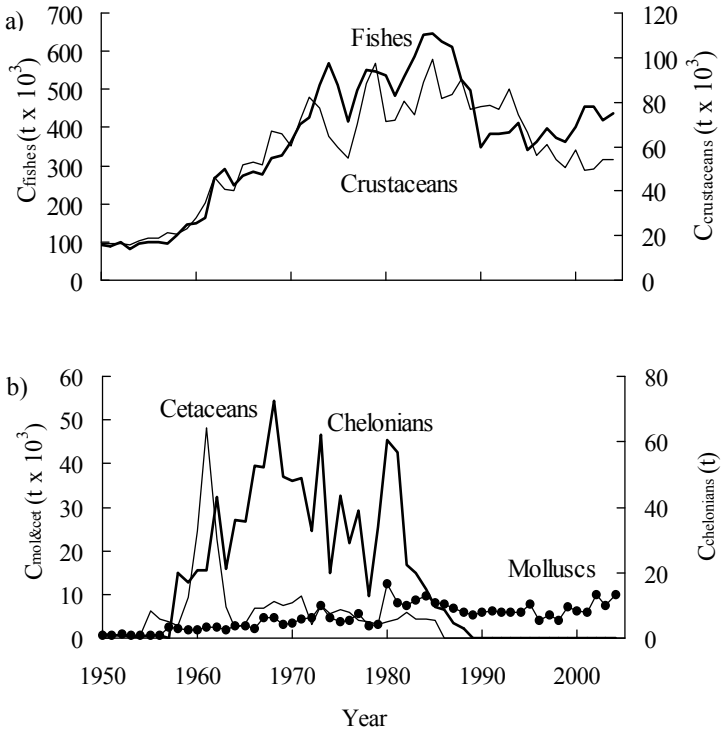

Figure 3:. Commercial marine fisheries catches in Brazil for the period 1950-2004: a) Fishes and crustaceans; b) Molluscs, cetaceans and chelonians.

From 1950 to the early 1960s, three out of four coastal geographic regions of Brazil contributed equally in terms of marine commercial catches (a fifth region is western Brazil and it pertains only to fresh waters, Figure 4). From the early 1960s onwards, when the first industrial fleets started to operate, the southern and southeastern regions alternated in dominating the catches of the country. This continued until 1980 when the southeast had the highest catches, dominated by sardine. After the collapse of sardine stocks in the early 1990s, the south dominated again. The northern and northeastern regions had a smooth increase in catches throughout the period analyzed. Currently, we notice that there is a trend back to the beginning of the period analyzed, with all regions contributing equally to total national catches (though at a level 3.5 times higher than in the early 1950s).

Assessing the estimation procedure

The estimation process was validated using 1969 data. Data were estimated for all taxa recorded in all years for all states. The estimated values were compared with observed data for the selected taxa for which observed data were available. The process was able to estimate well catch values for all taxa, except for 'sardinha' (sardine) in the state of Rio de Janeiro (Figure 5). When the sardine was eliminated from the analysis, the estimated values correlated very well with the observed data (r^2 = 0.96, Figure 5), with the intercept not being significantly different from zero, and the slope not being significantly different from unity. Thus, the estimation procedure used here appears adequate for all taxa, except for sardine, which represented 12% of total catch from Brazil in 1969. We estimated the 1969 catches for sardine using a regression for the period 1962-1971, but the estimated value increased only from 36,611 t to 36,893 t, a value far below the observed 48,664 t. Sardine is a small pelagic, and is closely affected by environmental oscillations. Thus, simple procedures such as those presented here fail to consider the effects of environmental fluctuations on catches. All estimated catches for sardine presented here as preliminary estimates can be replaced by better estimates for this taxon after

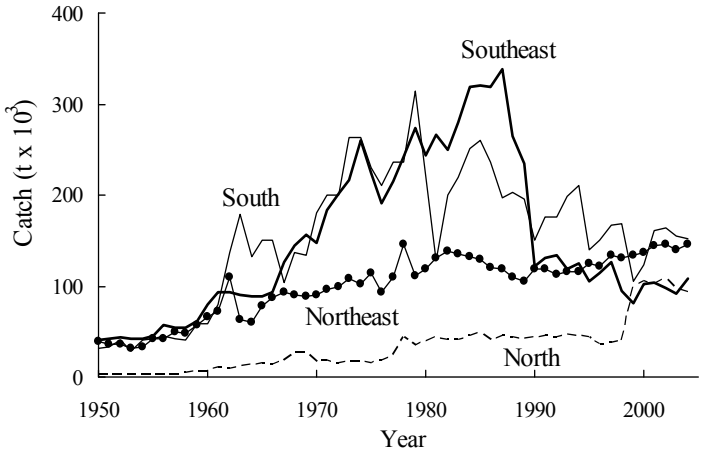

Figure 4. Commercial marine catches from the four coastal geographic regions of Brazil (1950-2004).

consulting local experts. One should point out that for the period between 1962 and 1977, sardine catches are referred to 'sardinha' (i.e., sardine) and 'sardinha verdadeira' (i.e., true sardine), with higher catches associated with 'sardinha' in some years and with 'sardinha verdadeira' in others. All analyses presented here were conducted with the combined catches for the two taxa, but excluding other sardine taxa.

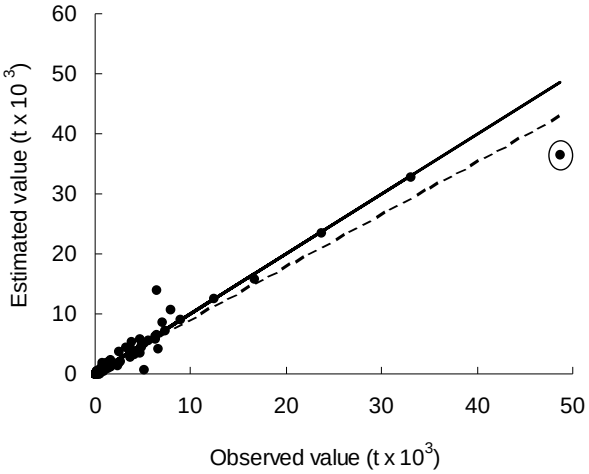

Figure 5. Estimated and observed marine commercial catches for the major taxa caught in 1969: dashed line includes sardine for the state of Rio de Janeiro, solid line excludes sardine for Rio de Janeiro.

Details for other taxa

The 'ghost crab' (*Ucides cordatus*), is distributed from the state of Amapá to Santa Catarina (Figure 1; Melo, 1996). It is an important resource for artisanal fishers and dealers in northern and northeastern Brazil, even though detailed information on catch, effort, and stock size are missing. Indeed, we noticed that the 'ghost crab' was not recorded as an individual entity in the 1980s and in the 1990s. The list of marine species available in the bulletins for these years indicated that records attributed to 'caranguejo' (i.e., 'crabs') were in fact 'ghost crab'. After 2000, 'ghost crab' appears in the bulletins only in the states of Rio de Janeiro, São Paulo, and Rio Grande do Norte. In the 1970s, the reporting situation is more confusing: in the 1979 and 1978 bulletins, 'ghost crab' was not present; in 1974-1977, 'ghost crab' appears together with another category called 'caranguejo (de mar)' (marine crab) but was reported as a freshwater species. In the early 1970s and in the 1960s, 'ghost crab' was not reported. In the 1950s, catches were not recorded at the taxon level. Any attempt to understand the dynamics of this fishery in Brazil is undermined by the way catch statistics are presented in national bulletins. Thus, the analysis presented for this species in GeoBrasil (2002) was restricted to 1998-1999, and thus missed important baselines. The analysis of catch data for northeastern Brazil presented in IBAMA (1994) was heterogeneous amongst all the states due to this data heterogeneity. Considering that *Ucides cordatus* is probably a keystone species in mangrove areas (e.g., Glaser and Diele, 2004), and its sale constitutes the main income for many households in northern Brazil (Glaser, 2003), more attention should be paid to correct data collection of catch statistics to allow for assessment of Brazilian stocks.

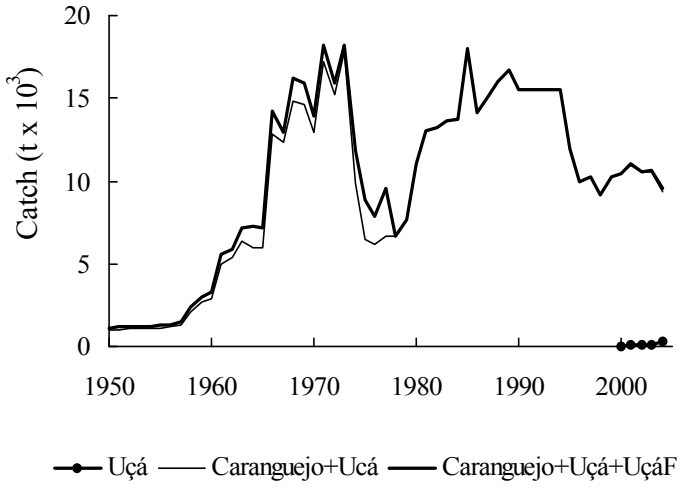

Figure 6. Catches of 'caranguejo-uçá' (*Ucides cordatus*) reported in national statistics, compiled here for all states combined; 'Caranguejo + uçá' indicates 'caranguejo' catches added to 'caranguejo-uçá' (both marine); and 'Caranguejo + uçá + uçáF' includes 'caranguejo-uçá' freshwater catches also.

Catches for 'ghost crab' as compiled here were low (Figure 6). When added to other marine 'caranguejo' data, catches were much higher, and indicated that there was an increase from 1,000 t in 1950 to about 18,000 t by 1973, followed by an apparent decrease from 1973 to 1978 before returning to the levels of the early 1970s. Another decline in apparent catches occurred from 1986 to 2004 (9,300 t in 2004). This apparent 23% decline in crab catches in the last few years is worrisome; however, we are not able to determine, based on the national bulletins, if all the catches presented in Figure 6 are associated only with *U. cordatus*.

Whale hunting is a very old activity in Brazil, going back to the 1660s. National statistics indicate that catches were very low in the early 1950s (Figure 7), when only humpback whales (*Megaptera novaeangliae*) were caught off the state of Paraíba in northeastern Brazil (Singarajah, 1985). In the early 1960s, catches increased as whalers s tarted to operate off the state of Rio de Janeiro in southeastern Brazil. This operation was very costly as whales were caught further offshore compared to the northeastern region. Whaling soon came to an end in southeastern Brazil and national catches dropped significantly. Mean individual weight of whales increased in the beginning of the period analyzed and decreased after the mid 1960s (Figure 7), when the comparatively smaller minke whale (*Balaenoptera acutorostrata*) was the main species targeted. Catches were zero from 1986 onwards. In 1987, the Brazilian government declared a complete ban on cetacean fisheries (Federal law no. 7643, December 18th, 1987).

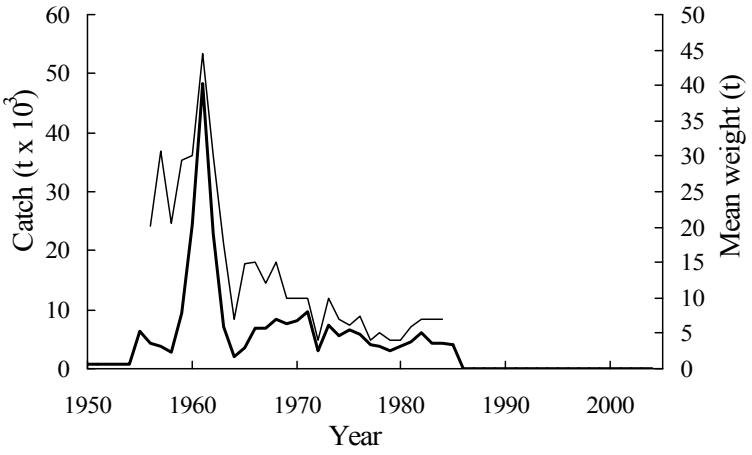

Figure 7. Whale catches in Brazilian waters from 1950 to 2004. The thin line indicates the mean individual weight of the whales caught.

Reported marine catches of molluscs were low compared to other groups, and encompassed 16 taxa. Catches for the main taxa are presented in Figure 8a. 'Marisco' (*Perna perna*) dominated the catches in the early years, and 'lula' (squid; Loliginidae and Ommastrephidae) in the end of the period. Catches of 'ostra' (oyster; *Crassostrea* spp.) and 'polvo' (octopus; *Octopus* spp. and *Eledone* spp.) increased slowly over the period analysed, while catches of 'sururu' (*Mytella* spp.) decreased. Important to note is that from 1970 to 1978, most of the catches were recorded as 'other molluscs'. Trends may be masked by changes and inconsistencies in reported taxon names as was observed for fishes.

Changes in taxon names

Catches are recorded using local common names. After correcting for different spelling of the same names, 446 taxa were recorded in this database. The correspondence between common name and scientific taxon remains to be resolved, although Freire (2005) has demonstrated a richness of common names for each taxon, with different names used in different states. Thus, a detailed comparison and standardization between common names and scientific taxon should be undertaken at state level.

We noticed that some taxon names were used interchangeably over time. This was observed for sardine and crabs as discussed above, but also for other marine taxa. In the state of Rio Grande do Sul, 'pescada real' was called 'pescada verdadeira' between 1968-1973. In northeastern Brazil, 'sarda' was used instead of 'serra' in 1974. In 1962-1963, 'atum' was called 'albacora'. These differences were not restricted to

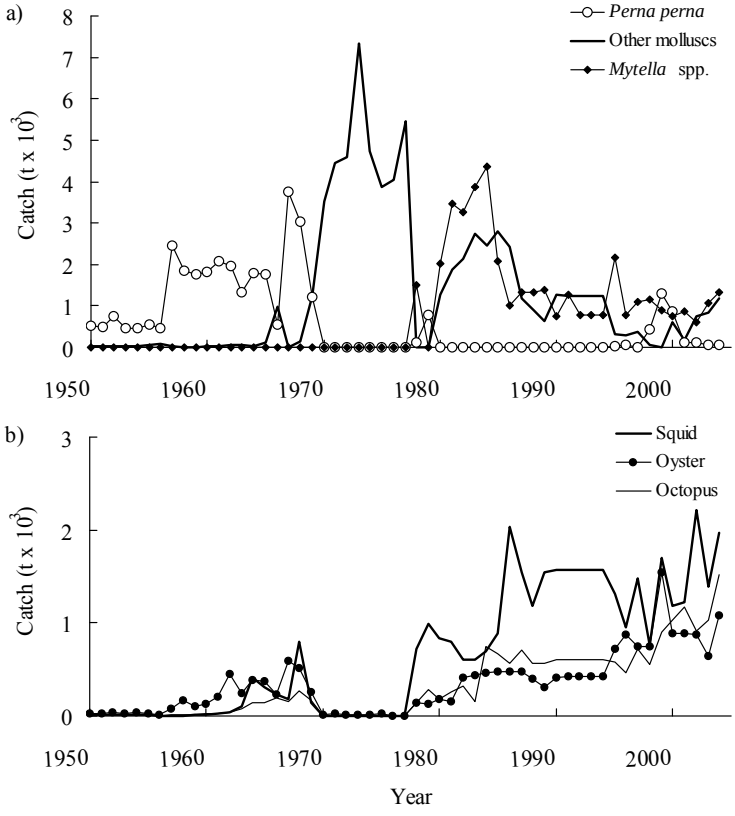

Figure 8. Commercial catches of molluscs in Brazilian marine waters (1950-2004): a) major taxa; b) minor taxa.

marine taxa. For example, 'piaba' was replaced by 'piau' from 1973 backwards. Reconstructions of historical catch time series as undertaken here help detect these and other changes.

FUTURE WORK

Each catch amount compiled in this database is associated with a common name of fish, crustacean, mollusc, cetacean or chelonian. For the first group, the correspondence between common and scientific name is not completely understood. We will establish this correspondence per state for each common name, based on the database compiled by Freire and Pauly (2005) and available from FishBase (www.fishbase.org).

Some states of Brazil have an independent system of collection of catch data, and these data have been encoded over the last few years. There are also bulletins produced by local institutions that report catch data for some states. Data from both sources will be compared with the data compiled here and values will be corrected if necessary.

In the process, we had to compile catch data from freshwater in order to be able to properly split catches from marine and fresh waters for the period 1950-1977. We intend to compile catch data originating from fresh waters from 1978 onwards to better understand how important fisheries are in each environment at a state level. We hope to convince national institutions to better account for historical catch series, using the database presented here as a foundation. This is particularly important now that we have seen some changes in the contribution of different regions to the catch in recent years.

ACKNOWLEDGEMENTS

We would like to thank J. Rodrigues, D. Rodrigues, and C. Primitivo for helping encode part of the data compiled here. The SINAGRI Library (Ministry of Agriculture) sent some of the bulletins used. S. Lucato reviewed an earlier version of this manuscript.

REFERENCES

Freire, K.M.F., 2003. A database of landing data on Brazilian marine fisheries from 1980 to 2000, pp. 181-189. *In*: Zeller, D., Booth, S., Mohammed, E. and Pauly, D. (eds.) From Mexico to Brazil: Central Atlantic fisheries catch trends and ecosystem models. Fisheries Centre Research Reports 11(6), Fisheries Centre, University of British Columbia, Vancouver.

Freire, K. M. F. (2005). Fishing impacts on marine ecosystems off Brazil, with emphasis on the northeastern region. Resource Management and Environmental Studies. PhD thesis, University of British Columbia, Vancouver-Canada**:** 254p.

Freire, K. M. F. and D. Pauly (2005). Richness of common names of Brazilian marine fishes and its effect on catch statistics. Journal of Ethnobiology 25(2): 279-296.

GeoBrasil (2002). Perspectivas do meio ambiente no Brasil. Brasília, Edições IBAMA. 440 p.

Glaser, M. (2003). Interrelations between mangrove ecosystem, local economy and social sustainability in Caeté Estuary, North Brazil. Wetlands Ecology and Management 11: 265-272.

Glaser, M. and K. Diele (2004). Asymmetric outcomes: assessing central aspects of the biological, economic and social sustainability of a mangrove crab fishery, *Ucides cordatus* (Ocypodidae), in North Brazil. Ecological Economics 49: 361-373.

IBAMA (1994). Lagosta, caranguejo-uçá e camarão do nordeste. Brasília, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 190 p.

IBAMA (2003). Estatística da Pesca. 2001. Grandes regiões e unidades da federação. Tamandaré - PE, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 97 p.

IBAMA (2004a). Estatística da Pesca. 2002. Grandes regiões e unidades da federação. Tamandaré - PE, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 97 p.

IBAMA (2004b). Estatística da Pesca. 2003. Grandes regiões e unidades da federação. Brasília - DF, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 98 p.

IBAMA (2005). Estatística da Pesca. 2004. Grandes regiões e unidades da federação. Brasília - DF, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 98 p.

IBGE (1957). Anuário Estatístico do Brasil - 1957. Anuário Estatístico do Brasil XVIII. p. 69.

IBGE (1959). Anuário Estatístico do Brasil - 1959. Anuário Estatístico do Brasil XX. p. 53-54.

IBGE (1961). Anuário Estatístico do Brasil - 1961. Anuário Estatístico do Brasil XXII. p. 70-71.

IBGE (1962). Anuário Estatístico do Brasil - 1962. Anuário Estatístico do Brasil XXIII. p. 52.

Lucato, S. H. B. (2006). An improved mixed-error non-equilibrium stock-production model and its application to some Brazilian fish stocks. Southampton, University of Southampton: 161p.

MA/SEP (1964). Pesca - 1962. Estrutura e produção. Rio de Janeiro, Ministério da Agricultura, Serviço de Estatística da Produção. 45 p.

MA/SEP (1965). Pesca - 1963. Estrutura e produção. Rio de Janeiro, Ministério da Agricultura, Serviço de Estatística da Produção. 37 p. MA/SEP (1965b). Pesca - 1964. Estrutura e produção. Rio de Janeiro, Ministério da Agricultura, Serviço de Estatística da Produção. 46 p.

MA/SEP (1967). Pesca - 1966. Estrutura e produção. Rio de Janeiro, Ministério da Agricultura, Serviço de Estatística da Produção. 34 p.

MA/ETEA (1968). Pesca - 1967. Produção extrativa. Publicação no. 5. Rio de Janeiro, Ministério da Agricultura, Equipe Técnica de Estatística Agropecuária. 34 p.

MA/ETEA (1969). Pesca - 1968. Produção extrativa. Publicação no. 19. Rio de Janeiro, Ministério da Agricultura, Equipe Técnica de Estatística Agropecuária. 34 p.

MA/ETEA (1971). Pesca - 1969. Rio de Janeiro, Ministério da Agricultura, Equipe Técnica de Estatística Agropecuária. 20 p.

MA/EE (1971). Pesca - 1970. Rio de Janeiro, Ministério da Agricultura, Escritório de Estatística. 19 p.

Marcovaldi, M. A. and G. G. Marcovaldi (1999). Marine turtles of Brazil: the history and structure of Projeto TAMAR-IBAMA. Biological Conservation 91: 35-41.

Matsuura, Y. (1995). Os ecossistemas brasileiros e os principais macrovetores de desenvolvimento. Subsídios ao planejamento da gestão ambiental. Projeto Cenários para o Planejamento da Gestão Ambiental (MMA/PNMA). Brasília, DF, MMA: 39-104.

Melo, G. A. S. (1996). Manual de identificação dos Brachyura (caranguejos e siris) do litoral brasileiro. São Paulo, Museu de Zoologia da Universidade de São Paulo. 603 p.

Paiva, M. P., 1997. Recursos pesqueiros estuarinos e marinhos do Brasil. Fortaleza, Brazil, UFC. 278 p.

Pinedo, M. C. and T. Polacheck (2004). Sea turtle by-catch in pelagic longline sets off southern Brazil. Biological Conservation 119(3): 335-339.

Sales, G. and E. H. M. S. Lima (2002). A pesca da lagosta no litoral do nordeste: interação pesca x conservação das tartarugas marinhas. Praia do Forte, Brazil, IBAMA. 11 p.

Singarajah, K. V. (1985). A review of Brazilian whaling: aspects of biology, exploitation and utilization. Symposium Endangered Marine Animals and Marine Parks 1: 131-148.

SUDEPE/IBGE (1973). Estatística da pesca. Produção - 1971. Rio de Janeiro, Ministério da Agricultura/SUDEPE/IBGE. 21 p.

SUDEPE/IBGE (1975). Estatística da pesca. Produção - 1972. Brasília, Ministério da Agricultura/SUDEPE/IBGE. 19 p.

SUDEPE/IBGE (1976a). Estatística da pesca. Produção - 1973. Rio de Janeiro, Ministério da Agricultura/SUDEPE/IBGE. 22 p.

SUDEPE/IBGE (1976b). Estatística da pesca. Produção - 1974. Rio de Janeiro, Ministério da Agricultura/SUDEPE/IBGE. 22 p.

SUDEPE/IBGE (1976c). Estatística da pesca. Produção - 1975. Brasília, Ministério da Agricultura/SUDEPE/IBGE. 22 p.

SUDEPE/IBGE (1979a). Estatística da pesca. Produção - 1976. Brasília, Ministério da Agricultura. 105 p.

SUDEPE/IBGE (1979b). Estatística da pesca. Produção - 1977. Brasília, Ministério da Agricultura/SUDEPE/IBGE. 121 p.

SUDEPE (1980a). Estatística da pesca. Produção - 1978. Brasília, Ministério da Agricultura/SUDEPE. 84 p.

SUDEPE (1980b). Estatística da pesca. Produção - 1979. Brasília, Ministério da Agricultura/SUDEPE. 141 p.

Weidner, D. and F. Arocha (1999). South America: Atlantic, Part A., Section 2 (Segment B). Brazil. Latin America, World swordfish fisheries: an analysis of swordfish fisheries, market trends, and trade patterns. Vol. IV. Silver Spring, Maryland, NMFS. Vol. IV: 237-628.