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Author(s): J.S. Silva-Cavalcanti and M.F. Costa

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Fisheries in Protected and Non-Protected Areas: Is it Different? The Case of *Anomalocardia Brasiliana* at Tropical Estuaries of Northeast Brazil

J.S. Silva-Cavalcanti† and M.F. Costa‡†

‡ Oceanography Dept.

Federal University of Pernambuco, Recife

Brazil, CEP 50740-550

†mfc@ufpe.br



ABSTRACT

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This work aimed at comparing ethnoecological information about the fisheries of *Anomalocardia brasiliana* (Gmelin, 1791) (Mollusca: Bivalvia) in protected and non-protected areas. Semi-structured questionnaires (326) inquired about families, household economy, fishing and perceived environmental changes. The largest part of mussel pickers in protected areas are women (82.4%) who learned the trade from their mothers (48.5%) and has over twenty years of occupation (58.8%). At non-protected areas the activity is practiced by men (51.0%), unemployed (50.9%) from agriculture (8.3%) and building (12.5%). There were significant differences ($P \leq 0.05$) between declared kg of meat produced per season, family income and harvest frequency. Reduction of shell length (mm) were reported for both areas. Meat production increases in high summer (December to January) when compared to the rest of the year (February to November). Values per kg of meat varied according to season in both areas. In summer US\$1.9 and 1.8, and in winter US\$1.4 and 1.2, for protected and non-protected areas, respectively. The production is sold to middle-men in both protected (30%) and non-protected areas (20.5%). The declared catch per unit of effort (CPUE) for male was smaller in the summer (2.2 kg meat/h) than in winter (1.8kg meat/h). For female the same pattern is also observed (1.4 and 1.15kg meat/h, respectively). Tools as spoons ($\bar{x}=14.1 \pm 11$), nets ($\bar{x}=13.9 \pm 18.0$) and forks ($\bar{x}=10.3 \pm 8.8$) increase harvest performance. Deforestation, decrease of quality and quantity of fisheries resources, aggradation and water pollution were the most frequently cited environmental changes observed in the last five years.

KEYWORDS: *ethnoecology, estuarine resources, traditional populations, Goiana River Estuary, Santa Cruz Channel.*

INTRODUCTION

Traditional coastal communities in the tropics are usually in relative geographic isolation, chronic poverty and significant dependence on the harvest of marine and coastal resources for their survival. The majority of people living near mangrove areas derive their principal income from fishing and related activities (WALTERS *et al.*, 2008). The Brazilian coast has widely spread and intense fisheries of *A. brasiliana*, important for large groups of economic and socially disfavored families. The meat is sold, and represents the main (often the only and irreplaceable) source of monetary income for entire small traditional communities.

This work approached mussel pickers communities at two estuaries of the Brazilian Northeast: Acaú / Carne de Vaca (protected area) on the Goiana River Estuary and Mangue Seco (non-protected area) on the Canal de Santa Cruz Estuary, at 150 and 30km from Recife, respectively (Figure 1). Acaú / Carne de Vaca are inserted in a legally established Marine Conservation Unit dedicated to the preservation of traditional livelihoods, since September 2007. It is a territorial space destined to the exclusive exploitation by traditional populations, in a sustainable way, and renewal of natural resources (SNUC, 2000). It does not yet have a

management plan. This work is the first assessment of its mollusk fisheries, and will from now represent the T_0 situation for this activity in this area. Mangue Seco has no protection status except for those normally granted to estuarine and mangrove forest areas in Brazil.

The objective was to investigate if there are significant differences between the two areas, regarding resource exploitation, by comparing ethnoecological information about the fisheries of *A. brasiliana*.

METHODS

A minimum n (455) was estimated through an infinite equation (RICHARDSON, 2007), based on the total population of Goiana (465.549 hab.) and Igarassu Municipalities (75.739 hab.). Interview subjects were randomly chosen at the mollusk banks. Data were collected through semi-structured questionnaires approaching social profile, level of dependence upon the resource, tools, habits, income, environmental perception, and use of mangrove wood. A non-structured interview section was used to probe attitudes towards the recently acquired status of conservation unit of Acaú / Carne de Vaca at both areas. Only 326 could be considered valid, 165 and 161 in the protected and non-

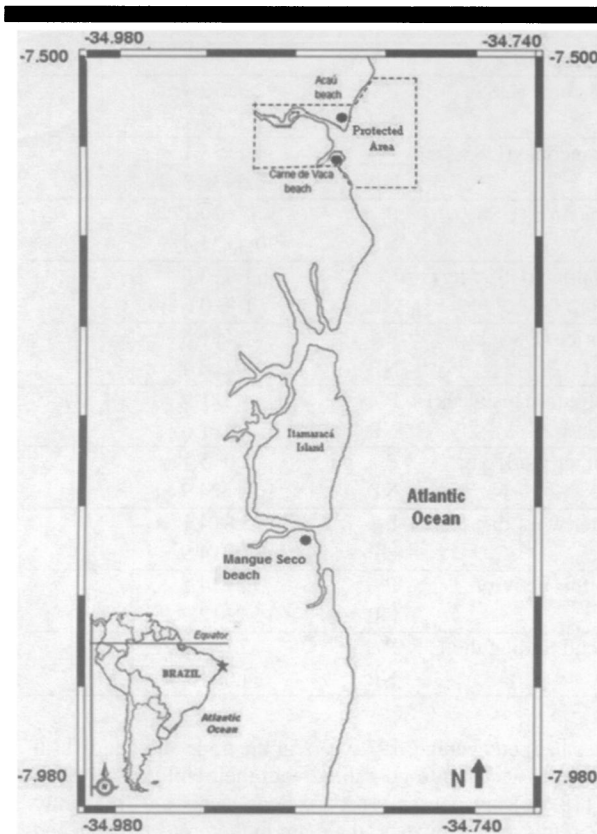


Figure 1. Study sites

protected areas respectively. T-test was used to evaluate the difference between studied areas. Levene's test was used to check the equality of variances.

The catch per unit effort (CPUE) in kg meat/h was calculated based on the quantities declared by the subjects for each area, gender and tool. Analysis of variance (ANOVA) was used to test for differences in CPUE among tools. Where the ANOVA showed significant differences, an *a posteriori* Tukey's HSD was used to determine which means were significantly different ($P \leq 0.05$).

RESULTS

Protected Area

In the 165 valid interviews, 69.7% reported mussel picking as their main activity for income generation (Table 1). Eight mollusk banks were cited in the protected area. However, three of those supported 91.5% of gatherers (54.5%; 21.2%; 15.8% and less than 2.0% all others). Gatherers arrive at more distant mollusk banks using small boats (61.2%).

Mollusks are regarded as a subsistence resource (unique source of animal protein) by only 4.2% of the families. Women learned this trade from their mothers (48.5%), but few men (9.7%)

declared to have learned it in the family. Immigrant people from nearby cities represented 7.3% of interviewed subjects in this area, and learned the trade from friends. Most mussel pickers go to the banks with their children or spouses, thus increasing the household income. Around twenty-two percent of male are also fishers. When fish or lobster is not available, they turn towards mussel picking (as their main activity). Females spend more time harvesting than males. The main tools used are net, fork and spoon.

Forty-four percent used a sieve to increase their performance of meat production. However, sieved meat is cheaper than the hand cleaned product.

Daily harvesting is perceived as responsible by decreasing mollusk size by 68.5% of subjects. When asked what is the ideal shell size, answers range between 13 to 33 mm. However, they assume that the upper limit of this interval is rare. Around 32% of subjects interviewed in this area sell their meat production to middle-men for a low price, and 9.1% sell their production to middle-men and consumes part of it themselves.

Monthly mean family income ranged from US\$ 18.3 to 548.8. There were significant differences between values during the season ($P \leq 0.05$) and buyer ($P \leq 0.05$). The value per kg/meat ranged from US\$ 0.9 to 0.65 in the summer and US\$ 0.4 to 1.5 in winter. Usually, the middle-man pays half the price fishers usually charge holiday makers directly. Meat is sold at better prices by males than females (Figure 2a). Females go fishing more frequently (4.2 days/week) than males (4.0 days/week). During summer there is a higher yield. Males catch 8.0 ± 4.9 kg/day in the summer and 7.3 ± 4.2 in winter. Females catch 6.7 ± 5.0 kg/day in the summer, and 5.5 ± 4.0 in winter. Almost 1/2 have other activities to increase family income. The majority is in the informal economy (23.1%), selling sweets, lollipop and drinks, in front of their own houses. In addition, some (1.2%) have small subsistence cultures (manioc, corn, beans, bananas etc).

Around 60% of subjects know about the protected area status, and think it will be good for them. The main positive aspects cited were resource conservation (67.0%), possibility of income during the lobster out-of season period (10.0%), exclusivity of fishing areas (9.8%), increase of meat quality (5.7%) and decrease of water pollution (2.5%).

Non-Protected Area

Mussel pickers originate from trades as building (12.8%), agriculture (8.3%) and fisheries of other resources (20.8%). This is now the main activity for 88.2% of interviewed subjects (161). The average family income ranged from US\$ 17.1 to 487.8. In summer, weekly income was twice that from winter (Table 2). The majority of respondents (40.3%) go to the mollusk banks three times a week.

Females go more often than males. Females extract on average 15.0 kg/day in the summer and 10.0 kg/day in winter; and males 17.5 kg/day in the summer and 13.0 kg/day in winter. Complementary activities, for family income improvement, involve informal commerce (14.5%) or family and/or children government assistance (4.1%).

Table 1. Social profile and opinions about environmental issues form mussel pickers in the two studied traditional communities.

	Protected (%; n=165)	Non-protected (%; n=161)
Gender		
male	17.6	51.0
female	82.4	49.0
Age average		
male	37.7±14.6	32.8±14.4
female	38.7±12.7	37.8±12.9
Formal education		
illiterate/none	24.8	36.6
primary	41.1	60.9
secondary	9.0	2.5
People in the family	4.5	4.5
People in the family that go fishing together	1.6	2.0
Tide		
spring tide	17.6	35.8
neap tide	58.2	42.4
both	24.2	21.8
Registered at the fishing colony	47.9	31.0
Use to fish		
hands	46.1	22.0
tools	63.9	78.0
Consider the ideal average shell size (mm)	24.1	24.5
Use mangrove wood for cooking the meat	35.8	37.3
Knows that mangrove wood extraction is an environmentally damaging / illegal practice	53.3	43.0
Consider as a consequence of wood extraction		
deforestation	83.3	65.7
fauna decline	9.0	10.5
both	6	-
water pollution	1.5	13.1
aggradation	-	55.5
erosion	-	-
Perceive as an environmental change in the last five years		
deforestation	13.9	3.6
fauna decline	27.3	24.2
both	-	-
water pollution	-	5.5
aggradation	-	4.2
erosion	-	3.6

Destination of meat production varies: family consumption and sale to middle-men (32.9%); sell to middle-men (20.5%); direct sale (13.0%); direct and middle-men sale (11.8%) and; family consumption (6.2%). The majority of interviewed subjects in this area learned the trade from friends (49.1%) and their own mothers (29.1%). When asked why they started in this trade, unemployment was the main answer (50.9%).

Table 2: T-test results of measurable variables.

$H_0: \bar{x}_P = \bar{x}_{NP}$	Area	Mean± Std	*= P<0.05
Family income (US\$ / month)	P	92.3±72.4	*
	NP	129.7±87.1	
Summer income (US\$ / week)	P	36.1±38.1	*
	NP	52.5±35.3	
Winter income (US\$ / week)	P	17.7±20.1	*
	NP	30.4±23.4	
Summer price (US\$ / kg)	P	1.9±0.6	*
	NP	1.8±0.6	
Winter price (US\$ / kg)	P	1.4±1.6	
	NP	1.2±0.4	
Harvest freq. (days/week)	P	4.2±1.9	*
	NP	3.6±1.6	
kg / summer work day	P	7.0±5.1	*
	NP	16.4±24.9	
kg / winter work day	P	5.8±4.1	*
	NP	11.9±14.9	
Years in this activity	P	23.5±14.5	
	NP	15.2±12.7	
Time spend trading the meat (h)	P	5.1±2.3	*
	NP	4.0±1.2	

Females had, on average, 19.2 years in the trade and males 11.0 years. Subjects declared to go fishing with their children (20.5%), siblings (18.6%) or spouses (16.1%). Four banks are frequently explored in this area. However, three are in the protected area and support 14.6% of the “non-protected” meat production. Tools used are nets (52.8%), spoons (17.4%) and forks (5.6%) to increase harvest performance. The majority (51.6%) of respondents use little boats to arrive at the mollusk banks. A public bus is also used (20.5%) for distant banks. The sieve is used to clean the meat by 95.5% of subjects.

Females spend more hours at the bank than males. Daily harvesting was clearly pointed (63.4%) as responsible for shell length decrease. Traditionally, shells between 10 and 31mm are collected. This control is based on sight perception (43.6%) and sieves (32.7%). Ideal shell length for respondents in this area is 24.5mm. Almost 88% of respondents never heard about a mollusk fisheries protected area. Those who did could not cite neither benefits or rules that apply in the protected area territory.

Observed Differences Between Areas

There were significant differences ($P<0.05$) between mean declared kg of meat produced in the summer and winter, family income, weekly income in the summer, summer price, time expend in the trade and harvest frequency (Table 2). The mean family income, summer and winter weekly incomes, meat production in the summer and winter were higher in the non-protected area. However, meat prices independently of season, were higher in the protected area. Harvest frequency and time spend in the trade were also higher in the protected area.

The use of tools differs between areas and genders. In the non-protected area the yield is higher when comparing the use of the same tool (Figure 2a). Tools are used to increase performance and more frequently employed by males, except for the basket which was as a female tool. Tools are more frequent among males from the non-protected area (88%) than of the protected area (57.7%). Spoons ($\bar{x}=14.1 \pm 11.0$ kg/h), nets ($\bar{x}=13.9 \pm 18.0$ kg/h) and forks ($\bar{x}=10.3 \pm 8.8$ kg/h) increase harvest performance and

consequently meat production. Prices were higher in protected than non-protected area (summer $\bar{x} = 1.8 \pm 0.5$ US\$/kg; winter $\bar{x} = 1.4 \pm 1.2$ US\$/kg). Generally, in the protected area, males charge higher prices in the summer than females. At the non-protected area both genders have the same income (Figure 2b).

CPUE was higher for both genders at the non-protected area. For males, CPUE was 2.2kg meat/h in the summer and 1.8kg meat/h in winter. For females the same pattern was observed (1.4 and 1.2kg meat/h, respectively). Males had, independent of area, higher CPUEs than females. However, females at the non-protected area had higher CPUE than males from the protected area. There was no significant differences ($P > 0.05$) between CPUEs for the different tool.

DISCUSSION

It was observed, at both areas, that families living near mangrove forests derive their income from mussel fishing and other activities related to estuarine resources exploitation. The establishment of a socio-cultural profile for these communities is the first step to understand their contribution to environmental changes and resource conservation along coastal environments. The profiles established here show that mussel fishing differs between the two areas. These differences are partially responsible for better product quality and resource conservation within the protected area. But they are not derived from the protected status.

In the protected area females were the majority of mussel pickers, a well known characteristic of this sort of traditional community (SILVA *et al.*, 2000; COSTA NETO and MARQUES, 2001). Traditional livelihoods have as main characteristics the empirical management of natural resources and their exploitation is made according to its resilience (DIEGUES, 1993). In the protected area native women learned the trade, and its empirical management, from their mothers. However, at the non-protected area, both men and women have diverse socio-cultural origins and declared to have started fishing for non-traditional reasons, as observed elsewhere (MORSAN, 2007). The increase in the number of people without ability for empirical environmental management acting in the territory may surpass the carrying capacity of the resource. The social stress caused by newcomers (unemployed from sugar-cane plantations or urban occupations as building) on the environment results in further impoverishment of the local traditional families.

Intertidal fisheries of mollusks has clearly defined subsistence, artisanal (commercial) and recreational components. Subsistence and recreational fisheries consist of occasional visits to the banks, with marked seasonality. The catch is typically lower (0.5 to 1.5 kg meat/person/day) and carried out by several groups of two people, harvesting during low tide only. Artisanal fisheries has two modalities (at both areas) – hand picking along the beach (intertidal zone), and with tools at inter and subtidal environments. Usually, catches in the intertidal zone are for commercial purposes. At the non-protected area only the artisanal and subsistence components were present. The recreational component is typical of summer months, especially at Carne de Vaca (protected area) when the number of people increase, and with it the dispute for space and resource on the mollusk bank. At this time of the year, traditional fishers and tourists compete for the resource. This can lead to a hyperdepletion of the resource (MORSAN, 2007). Some people link the increase of people to decrease of mollusk population on the bank during this time. In the protected area, some families rent their home for holiday makers to increase their income and try to save for the out of season period (March to November).

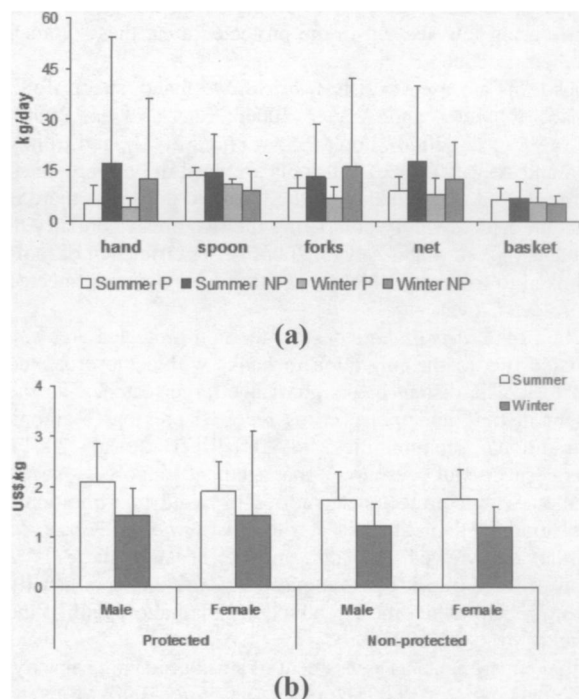


Figure 2. (a) Tools performance in each area and (b) price of meat per season (P = protected and NP = non-protected).

In both areas, some family groups built sheds on the margins to unload and pre-process the meat. There, or at home, they boil and clean the meat. Approximately 37% of interviewed subjects use mangrove forests wood as fuel. The harvest of mangrove wood for fuel is widespread in Brazil (SAINT-PAUL, 2006) and other coastal areas (OCAMPO-THOMASON, 2006; WALTERS *et al.*, 2008). Although respondents cite potential environmental impacts related to mangrove cutting, they do not feel responsible by it. Mangrove wood is widely used by both communities, but especially in the protected area, for housing, cooking and to make fish traps/weirs. In the non-protected area, mangrove wood is used for huts and to cook mollusk meat. This cognitive dissonance is common and occurs at various degrees. It is often caused by conflicting interest or incentives (WALTERS *et al.*, 2008).

In tropical countries it is believed that protected areas may be linked with sustainable exploitation of natural resources, arguing that it is possible that the protected status will potentially generate satisfactory outcomes for all stakeholders. However, Pirajubaé Marine Protected Area has shown characteristics of over fishing (mollusks size and biomass decline) after the area received the protected status (SCHIO *et al.*, 2007). The protected status is not always guaranteeing environmental and traditional livelihoods conservation, but attending to market demands.

Fisheries activity profiles and market demands are, together, responsible for resource conservation, or depletion. Over fishing can occur when the catch of a target species has decreased due to changes in market demands (DOWLING *et al.*, 2008). The demand in the non-protected area is higher, since it attends local and foreigner markets. In the protected area foreigner demand is not yet so intense. Middle-men are responsible for keeping a meat stock for foreigner customers. They buy all the meat production from the non-protected area for a fixed price independent of season. On the other hand, males from the protected area sell their

production at the market place, guaranteeing higher prices during summer than women who sell to middle-men all year round. Although during low season, in the protected area, these women still sell their production.

Various tools are used to fish *A. brasiliana*: hand, spoon, fork, rake, spade (NISHIDA and ALVES, 2006c; SILVA *et al.*, 2000), basket (SILVA *et al.*, 2000), hook (SILVA *et al.*, 2000), and trolley (NISHIDA and ALVES, 2006c). All tools are used in both protected and non-protected areas. Although the tools are the same, there is difference in catch quantity comparing the two areas, similarly to other studies (NISHIDA and ALVES, 2006c). The efficiency of tools can be linked to resource depletion whether a practice in protected or non-protected areas.

Depletion of *A. brasiliana* stocks at the non-protected area can be predicted due to the migration to banks within the protected area territory. The distant banks guarantee larger catches, so the investment in time and transport, as reported previously among other traditional communities in Brazil (BEGOSI, 2001). However, successful resource management involves social organization within protected territories to avoid non-traditional groups degrading their stocks. Territorialism was not observed among the interviewed subjects, maybe because there is a migration of the mollusk banks along the years. Pioneers usually move from a bank when meat production falls below half of the initial yield (MORSAN, 2007).

Essential experiments as assessment of stocks carrying capacity, CPUE (DOWLING *et al.*, 2008; FRANGOUEDES *et al.*, 2008; MORSAN, 2007), areas of no-take-zone (DOWLING *et al.*, 2008; MORSAN, 2007), and resource valuation would determine the maximum quantity to be collected/day/per person. Within protected areas these experiments will also provide the foundations, and shape the frame, of precautionary management intervention.

CONCLUSION

Mussel picking is an important fisheries for both traditional and non-traditional communities living near tropical estuaries since it provides them with a way of life and a source of financial income. The profile of this activity and market demands are different in the protected and non-protected areas studied here. The main differences were harvest frequency, kg of meat produced seasonally, time spend trading, summer price, weekly income in the summer, and family income. The use of tools was more frequent among males at non-protected area for performance increase. The price per kg presented seasonal changes, which influenced family income. Males in the protected area had a higher market value per kg (summer) than those who sell to middle-men. However, family income was higher at the non-protected area. In winter, price per kg is lower than in summer for independent seller and equal for seller which depends of middle-men. Mangrove wood is used as building materials and fuel in both areas. There was knowledge among between interviewed subjects of the potential impacts of using mangrove wood, however they do not feel responsible for that. The depletion of mollusk banks at the protected and non-protected area was cited and the increase in the number of people harvesting was identified as the root cause for this. Traditional and subsistence characteristic and low market demand were found only at the protected area and still guarantee a sustainable exploitation of *A. brasiliana*.

LITERATURE CITED

- BEGOSI, A., 2001. Mapping spots: fishing areas or territories among islanders of the Atlantic Forest (Brazil). *Regional Environmental Change*, 2: 1-12.
- COSTA NETO, E.M. and MARQUES, J.G.W., 2001. Atividade de pesca desenvolvida por pescadores da comunidade de Sibeirinha, Município de Conde, Bahia: uma abordagem etnoecológica. *Stientibus* 1(1): 71-78.
- DIEGUES, C.A.S., 1993. *Realidades e falácias sobre pescadores artesanais*. CEMAR-USP. São Paulo, Série documentos e relatórios de pesquisa, nº 7. 15p.
- DOWLING, N.A.; SMITH, D.C.; KNUCKEY, I.; SMITH, A.D.M.; DOMASHENZ, P.; PATTERSON, H.M. and WHITELAW, W., 2008. Developing harvest strategies for low-value and data-poor fisheries: case studies from three Australian Fisheries. *Fisheries Research*, 94:380-390.
- FRANGOUEDES, K.; MARUGÁN-PINTOS, B. and PASCUAL-FERNÁNDEZ, J.J., 2008. The case of women access to co-governance and conservation: The case of women shellfish collectors in Galicia (Spain). *Marine Policy* 32(2): 223-232.
- MORSAN, E., 2007. Spatial pattern, harvesting and management of artisanal fishery for purple clam (*Amiantis purpurata*) in Patagonia (Argentina). *Ocean and Coastal Management*, 50: 481-497.
- NISHIDA, A.K.; NORDI, N. and NOBREGA ALVES, R.R., 2006. Mollusc gathering in Northeast Brazil; An ethnoecological approach. *Human Ecology*, 34(1): 133-145.
- OCAMPO-THOMASON, P., 2006. Mangroves, people and cockles: impacts of the shrimp-farming industry on mangrove communities in Esmeraldas Province, Ecuador. In: CAB International, 2006. *Environment and Livelihoods in Tropical Coastal Zones: Managing agriculture-fishery*, pp. 140-153.
- RICHARDSON, R.J. *Pesquisa Social, Métodos e Técnicas*. 3 ed. Revista e Ampliada, São Paulo: Atlas, 2007, 334p.
- SAINT-PAUL, U., 2006. Interrelations among mangroves, the local economy and social sustainability: a review from a case study in north Brazil. 154-162 In: CAB International, 2006. *Environment and Livelihoods in Tropical Coastal Zones: Managing agriculture-fishery-aquaculture conflicts* (eds. C.T. Hoanh, T.P. Tuong, J.W. Gowing and B. Hardy), pp. 154-162.
- SCHIO, C. SOUZA, D.S. and PEZZUTO, P.R., 2007. Dinâmica populacional do berbigão *A. brasiliana* (Gmelin, 1791) (Mollusca: Pelecypoda) na Reserva Extrativista Marinha de Pirajubaé-SC, Brasil. XII Congresso Latino Americano de Ciências do Mar (COLACMAR) 15 a 19 de abril de 2007. CD-ROM.
- SILVA, G.S.; MELLO, R.L.S.; NASCIMENTO, A.E.; MESSIAS, A.S.; and ARAÚJO, S.F.S., 2000. As atividades pesqueiras artesanais e a relação com a malacofauna no manguezal do rio Formoso, PE-Brasil. *Trabalhos Oceanográficos da UFPE*, 2(28): 195-207.
- SNUC – Sistema Nacional de Unidades de Conservação, 2000. Law 9985 (18th July 2000). Establishes the Brazilian National System of Conservation Areas. (Available at: <http://www.mma.gov.br>).
- WALTERS; B. B.; RÖNNBÄCK, P.; KOVACS, J M.; CRONA, B.; HUSSAIN, S. A.; BADOLA, R.; PRIMAVERA, J. H.; BARBIER, E. and DAHDOUN-GUEBAS; F., 2008. Ethnobiology, socio-economic and management of mangrove forests: A review. *Aquatic Botany*, 89(2), 220-236.