Maria Elanny Damasceno Silva
(Organizadora)

Interfaces entre **Desenvolvimento**, **Meio Ambiente** e **Sustentabilidade**

2

Atena Editora
Ano 2021

Maria Elanny Damasceno Silva
(Organizadora)

Interfaces entre **Desenvolvimento**, **Meio Ambiente** e **Sustentabilidade**

2

Atena Editora
Ano 2021

Editora Chefe
Profª Drª Antonella Carvalho de Oliveira
Assistentes Editoriais
Natalia Oliveira
Bruno Oliveira
Flávia Roberta Barão
Bibliotecária
Janaina Ramos
Projeto Gráfico e Diagramação
Natália Sandrini de Azevedo
Camila Alves de Cremo
Luiza Alves Batista
Maria Alice Pinheiro
Imagens da Capa
Shutterstock
Edição de Arte
Luiza Alves Batista
Revisão
Os Autores

Atena Editora
Ano 2021

Atena Editora
Ano 2021

Atena Editora
Ano 2021

Atena Editora
Ano 2021

Atena Editora
Ano 2021

Interfaces entre desenvolvimento, meio ambiente e sustentabilidade 2

Editora Chefe: Profª Drª Antonella Carvalho de Oliveira
Bibliotecária: Janaina Ramos
Diagramação: Luiza Alves Batista
Correção: David Emanoel Freitas
Edição de Arte: Luiza Alves Batista
Revisão: Os Autores
Organizadora: Maria Elanny Damasceno Silva

Dados Internacionais de Catalogação na Publicação (CIP)

I61 Interfaces entre desenvolvimento, meio ambiente e sustentabilidade 2 / Organizadora Maria Elanny Damasceno Silva. – Ponta Grossa - PR: Atena, 2021.

Formato: PDF
Requisitos de sistema: Adobe Acrobat Reader
Modo de acesso: World Wide Web
Inclui bibliografia
ISBN 978-65-5706-857-1
DOI 10.22533/at.ed.571211503

1. Meio Ambiente. I. Silva, Maria Elanny Damasceno (Organizadora). II. Título.

CDD 577

Elaborado por Bibliotecária Janaina Ramos – CRB-8/9166

Atena Editora
Ponta Grossa – Paraná – Brasil
Telefone: +55 (42) 3323-5493
www.atenaeditora.com.br
contato@atenaeditora.com.br

Ano 2021

Multidisciplinar

DECLARAÇÃO DOS AUTORES

Os autores desta obra: 1. Atestam não possuir qualquer interesse comercial que constitua um conflito de interesses em relação ao artigo científico publicado; 2. Declaram que participaram ativamente da construção dos respectivos manuscritos, preferencialmente na: a) Concepção do estudo, e/ou aquisição de dados, e/ou análise e interpretação de dados; b) Elaboração do artigo ou revisão com vistas a tornar o material intelectualmente relevante; c) Aprovação final do manuscrito para submissão.; 3. Certificam que os artigos científicos publicados estão completamente isentos de dados e/ou resultados fraudulentos; 4. Confirmam a citação e a referência correta de todos os dados e de interpretações de dados de outras pesquisas; 5. Reconhecem terem informado todas as fontes de financiamento recebidas para a consecução da pesquisa.

Atena Editora
Ano 2021

APRESENTAÇÃO

Prezados (as) leitores (as), é com satisfação que apresento-lhes o livro "*Interfaces entre Desenvolvimento, Meio Ambiente e Sustentabilidade*" dividido em dois volumes contendo 21 capítulos, separadamente. Uma gama de abordagens metodológicas científicas permite a investigação e compreensão da dimensão do desenvolvimento urbano, rural, econômico, cultural, social dentre outras com relação ao meio ambiente natural e modificado.

O volume 1 inicia-se com capítulos voltados para temas educacionais e consciência ambiental no trato dos recursos naturais. Destaque para projetos universitários envolvendo a participação de comunidades e a observação panorâmica das percepções ambientais entre regiões do país. Estudantes de cursos técnicos e graduações promovem e atuam em atividades extensionistas de horticultura, paisagismo e artesanato com foco na promoção do empreendedorismo, saúde alimentar e mental em comunidades.

O saneamento básico é pauta de debate para redução de doenças em zonas de periferias. O reaproveitamento de alimentos e resíduos de produção alimentícia são as tônicas de pesquisas relativas à gestão de resíduos no meio ambiente, bem como do tratamento de efluentes industriais e domésticos para geração de biofertilizantes e compostagem.

Produzir alimentos com menor toxicidade química e contaminantes de solos e águas continua sendo um desafio, para tanto são divulgadas informações relevantes de índices de estresse hídrico, assim como estudos fenológicos de vegetação em floresta.

No volume 2 encontrarão pesquisas direcionadas à bacias hidrográficas por meio de técnicas de geoprocessamento para verificação de declividades, fragilidades ambientais e análises morfométricas. Questionamentos acerca da gestão social e políticas públicas são temas debatidos no tocante à reforma agrária, gestão ambiental em Universidades Federais e descarte de resíduos hospitalares. A qualidade da água é verificada em rios, canais e Estações de Tratamento de Águas. A modelagem matemática é aplicada em irrigação e determinação de coeficiente de carga cinética "K".

Os telhados verdes e um protótipo de sistema de potabilização de águas de cisternas são projetos de manejo de águas pluviais para retenção de alagamentos e para ingestão humana, respectivamente. Índices de custeio e distribuição de águas são verificados na intenção de reduzir custos no abastecimento público, que consequentemente reflete no preço final do consumidor. Embora haja controvérsias entre o sistema capitalista e a sustentabilidade dos recursos, são exemplificados a implementação de economias em rede e economia circular em comunidades locais para geração de renda e preservação ambiental. A zona Amazônica e litorais pesqueiros de São Paulo e Ceará são *locus* de análises socioambientais e produtivas de atividades urbanas e rurais.

Por fim, enfatizo o esforço e dedicação empregados em cada projeto científico divulgado neste livro em prol do bem social e ambiental. Em nome da Atena Editora parabenizo a todos os envolvidos e desejo uma excelente leitura dos trabalhos.

Maria Elanny Damasceno Silva

SUMÁRIO

CAPÍTULO 21

SUSTAINABILITY AND FUTURE PERSPECTIVE OF THE LOBSTER FISHERY: THE PERCEPTION OF FISHERMEN OF PONTA GROSSA, ICAPUÍ, CEARÁ, BRAZIL

Data de aceite: 01/03/2021
Data de submissão: 04/12/2020

André Prata Santiago
Federal University of Delta Parnaíba - UFDPar, Department of Fisheries Engineering, Laboratory of Biotechnology and Marine Aquaculture
Parnaíba-Piauí
http://lattes.cnpq.br/4798225763912193

Janaína de Araújo Sousa Santiago
Federal University of Delta Parnaíba - UFDPar, Department of Fisheries Engineering, Laboratory of Biotechnology and Marine Aquaculture
Parnaíba-Piauí
http://lattes.cnpq.br/6077862213827683

Luiz Gonzaga Alves dos Santos Filho
Federal University of Delta Parnaíba - UFDPar, Laboratory of Biotechnology and Marine Aquaculture
Parnaíba-Piauí
http://lattes.cnpq.br/9399215752362083

George Satander Sá Freire
Federal University of Ceará - UFC, Department of Geology, Marine and Applied Geology Laboratory
Fortaleza-Ceará
http://lattes.cnpq.br/6803944360256138

ABSTRACT: This paper analyzes the perception of the fishermen about the problems with which they issue in lobster fishing in a community where most people live off this activity. The data were taken by questionnaires to a part of the population involving around 70% of resident fishermen in the studied community from north coast Brazil, which assessed aspects related to fishery, management applied in resource conservation, and socioeconomic aspects. The fishermen showed knowledge of the legislation related to lobster fishing, but they think which should be better managed. They also believe that increasing their participation in decisions on fisheries would help to improve the activity. Most do not believe in the improvement of fishing in the future, and 100% of them do not want the sons continue working in lobster fishing. The production of lobster tends to stay in control of the fishing companies in the future, thereby removing artisanal fishing from this activity.
KEYWORDS: Artisanal fishing, lobster fishing, management, *Panulirus*, socioeconomic aspects.

SUSTENTABILIDADE E PERSPECTIVA FUTURA DA PESCA DA LAGOSTA: A PERCEPÇÃO DOS PESCADORES DE PONTA GROSSA, ICAPUÍ, CEARÁ, BRASIL

RESUMO: Este artigo analisa a percepção dos pescadores sobre os problemas enfrentados na pesca da lagosta, em uma comunidade onde a maioria dos moradores sobrevive dessa atividade. Foram questionários a uma parcela da população, abrangendo cerca de 70% dos pescadores residentes na comunidade, onde

avaliou-se aspectos relacionados à pesca, gestão aplicada na conservação de recursos e aspectos socioeconômicos. Os pescadores mentais da legislação relacionada à pesca da lagosta, mas eles pensam que deve ser melhor gerenciada. Eles também acreditam que aumentar sua participação nas decisões sobre pescarias ajudaria a melhorar a atividade. A maioria não acredita na melhoria da pesca no futuro e 100% deles não querem que os filhos continuem trabalhando na pesca de lagosta. A produção de lagosta tende a manter o controle das empresas de pesca, removendo assim a pesca artesanal desta atividade.
PALAVRAS-CHAVE: Pesca artesanal, gerenciamento, *Panulirus*, aspectos socioeconômicos.

1 | INTRODUCTION

The Palinuridae family consists of crustaceans living in tropical and temperate seas, comprising more than 47 species, 33 of which are captured commercially. There are three genera of spiny lobsters of greatest economic importance in the world: *Panulirus* (White, 1847), *Palinurus* (Weber, 1795), and *Jasus* (Parker, 1883) (Lipcius and Eggleston, 2000), but only *Panulirus* is present in Brazil (Fonteles-Filho, 2000). The species of lobsters of the *Panulirus* captured along the Brazilian coast, mainly in the North and Northeast regions, are: lobster red - *Panulirus argus* (Latreille, 1804), lobster green – *P. laevicauda* (Latreille, 1817) and lobster painted – *P. echinatus* (Smith, 1869) (Paiva, 1997; Fonteles-Filho, 2000).

Lobster fishery in Brazil began in the mid-1950s, and, in the 1980s, Brazil has become the second largest lobster producer in the world. This activity has faced problems in recent decades and, although there is a regulatory management, many people fail to comply with these regulations (Phillips and Melville-Smith, 2006; Phillips *et al.*, 2013a).

Brazil has always been among the world's largest producers of spiny lobsters. In 1991, Brazil attained its highest production with 11,059 t, what amounted to 14.3% of world production, reaching the second place among top producers. In the data published by FAO in 2014 related to the year 2012, however, the production achieved in Brazil was 7,386 t, showing a decrease of 33.2% from its higher production, representing around 8.8% of world production, which was 84,402 t. Brazil currently ranks fourth, behind Indonesia which produced 13,549 t, Bahamas 12,051 t, and Australia with 9,195 t (FAO, 2014).

Despite being one of the world´s largest producers of lobster, and to have achieved stability of its production in recent years, Brazil is going through management problems in lobster fishing, which results in difficulties, mainly in artisanal fisheries. The cause of the decline and fluctuation in spiny lobster production in producing countries is mainly overexploitation of stocks, due to the management of these be done an unsustainable way. Nowadays, the sustainability of the lobster exploration requires great attention, since it is a commercial high value resource, and lesser supply than demand in many regions/markets (Phillips and Melville-Smith, 2006).

Over the past 10 years, the management of resources is based on the ecosystem in which they are inserted, which is wider than just focusing on a single species. Marine

ecosystems are considered complex with a dynamic interaction of animals, plants, and microorganisms, and the factors abiotic associated, as water, air, and the sediment, interacting as a functional unit (Phillips *et al.*, 2013b).

The exploitation of fishery resources in Brazil took place in a disorderly way, and, currently, it is in stage of overexploitation, with striking socioeconomic and environmental consequences. This fact is more evident in lobster fishing activity in several communities along the Northeastern coast. In Brazil, lobster fishery is difficult to achieve sustainability in long-term because of low inventory replenishment, combined with high rates of exploitation and lack of proper management. There is no future perspective of this activity, if the current situation is maintained (Phillips *et al.*, 2013a).

The municipality of Icapuí (4°42'55.66"S, 37°21'13.46"W), located in Ceará state, 202 km from capital Fortaleza, has a population of 18,392 people (Brasil, 2014a) and a Gross Domestic Product (GDP) of R$ 194,011.00 (about US$ 82.432,60), and almost 40% (R$ 73,998.00; about US$ 31.443,02) is derived from primary sector activities, such as fishing (Brasil, 2014b). The community of Ponta Grossa (4°37'47.12"S, 37°30'16.10"W), located in Icapuí (Figure 1), has as its main source of income the lobster fishing of the species *P. argus* and *P. laevicauda*, and it is being severely hampered by scarcity of this resource. It comprises about 250 residents, around 1.5% of the population of Icapuí, among which 54 were lobster fishermen. Today, with the reduction of production in lobster fishing, the population seeks other activities for complementary the income, such as farming, beekeeping, trade, and tourism.

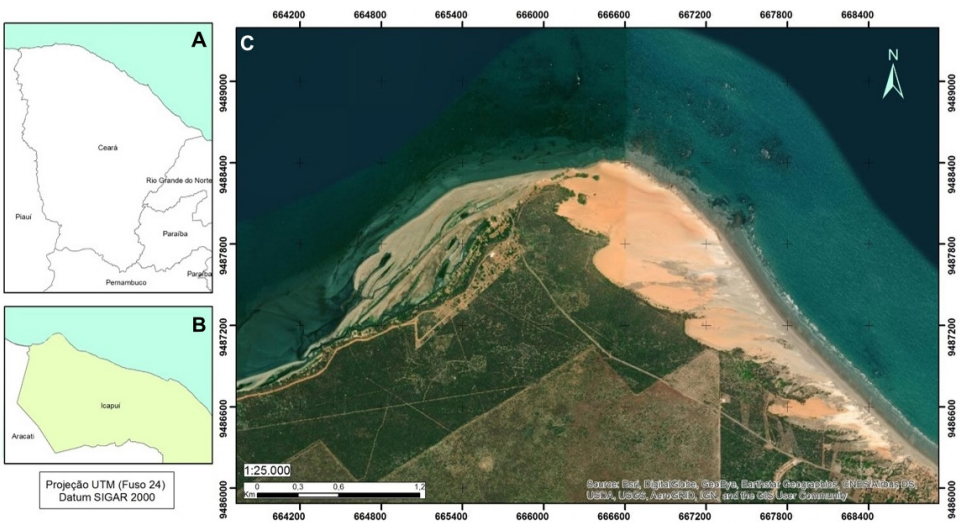

Figure 1. Map of study area. (A) Ceará state. (B) Municipality of Icapuí; (C) Community of Ponta Grossa.

This paper analyzes the perception of fishermen about the problematic faced in lobster fishing in a community that typically lives off this activity, in the coast of Ceará State, in the village of Ponta Grossa. Thus, we will assess the answers of the fishermen participating in the lobster fishing activity in Ponta Grossa, Icapuí, Ceará, to characterize it and search for alternatives for sustainability of this activity. This community was chosen because it historically captured this resource since the beginning of its exploration in Brazil, keeping similar the characteristics in fishing mode and respect to the exploration and preservation of the lobster, over of all these decades of fishing.

2 | METHODOLOGY

Questionnaires involving aspects related to fishery, management applied in the resource conservation, and socioeconomic aspects were administered, *in loco*, in 70% of resident fishermen in Ponta Grossa, Icapuí, Ceará. The research was conducted in the last week of fishery interruption, near the beginning of the fishing season, when the fishermen are on the beach, preparing boats and traps for start of fishing activity. It is emphasized that the research sought to interview the fishermen which survive of fishery activity, i.e., that have lobster fishing and activities related to fishing as the main source of income.

According to Resolution N° 510/2016 of the National Health Council (Brasil, 2016), on section 1, subsection VII, research aimed at the deepening of the theory related to situations arising from professional practice, provided they do not reveal data that can identify the subject, are ethically acceptable, and therefore must not be evaluated by the Research Ethics Committee. However, the consent of the participant is necessary, and thus was obtained as follows.

After identified as fisherman lobster, and invited to participate in the survey, it was reported to them that the data obtained would be treated as strictly confidential. And could refuse to answer any question, or end the interview at any time. If the fisherman agreed to participate and understand the purpose of the study, it would be asked to sign and date the consent form. In addition, one copy of the consent form was signed by the responsible for the research, and given to each interviewee fisherman.

2.1 Fishery

About fishery the fishermen were asked the factors observed and related directly to the capture of the lobster, such as: time in which they fish, whether the fisherman performs another fishery activity beyond lobster fishing; whether the fisherman think the amount of captured lobster is decreasing; how many days the fisherman spends at sea to conduct fishing (lobster); whether the fisherman is the owner of the boat; what kind of boat he uses - number of fishermen it carries, type of propulsion, and storage medium for the lobsters caught (ice); whether the fisherman uses another fishing trap (lobster) beyond the allowed

(eco-friendly); whether the fisherman sees other fishermen fishing illegally; whether he captures lobster illegally; and, finally, whether he is knowledgeable about the closed season.

2.2 Management applied in the resource conservation

Regarding the management, there were questions related to management of fishery, involving aspects that influence directly and indirectly lobster fishing, and the fisherman's opinion with respect to this, such as: what is the purpose of the closed season; whether he respects the closed season; whether the closed season helps to improve fishing; whether the closed season is done and determined at the right time; whether the fisherman knows which institution is responsible for managing (monitoring etc.) lobster fishing in Brazil; whether the fisherman already was inspected; whether the fisherman has witnessed the supervisory activity done with another fisherman; what the perspective of the fisherman for the lobster fishing in the coming years; whether think they should be listen when deciding questions about the lobster fishing; whether the fisherman would suggest some attitude to be taken for this improvement; and when receiving the insurance in the closed season the fisherman must perform some activity to help preserve the lobster.

2.3 Socioeconomic aspects

Regarding the socioeconomic aspects, there were questions related to the income obtained in fishery, feature of family of the fisherman, and perspective of future for your family in the lobster fishing, such as: origin of the main income of the fisherman; what activity the fisherman does to supplement the income during the closed season; whether the fisherman is associated with a trade union; whether the fisherman receives insurance in the closed season; what the income of the fisherman during the closed season and the permission period of the lobster fishing; whether the father of fisherman was or is a fisherman; marital status; and advises their children to work in lobster fishing.

3 I RESULTS

As previously mentioned, Ponta Grossa is a community essentially composed of lobster fishermen, and all people involved in this activity are male. In the identification of the fishermen, early stage of the questionnaire, 86.8% reported having no other profession, i.e., they work exclusively in fishery, the others 13.2% mentioned, claim having other profession, such as craftsman, bricklayer, electrician, maid at a inn, and carpentry.

Most of the fishermen interviewed (78.9%) were born in the village of Ponta Grossa. Analyzing the 21.1% remaining portion, the majority, 75% were born in Aracati, in Ceara State, a city near Icapuí distant of 55.1 km. The remaining 25% were born in Retiro Grande and Redonda, coastal villages neighboring Ponta Grossa, 4.2 km and 4.4 km respectively and also belonging to the municipality of Icapuí, in Ceara State.

3.1 Fishery

The fishermen were initially questioned about how long time they work in the lobster fishing. 36.8% answered that they have been doing lobster catch activity for a period of time ranging from 10 to 19 years, followed by those which have been doing it for a period of time from 20 to 29 years, which represent 21.1%, and 15.8% of the fishermen have been doing it for a period of time between 30 to 39 years. The fraction with lower representation are those that include the fishermen who fishing there more time, 40 years or more, and less time of 0 to 9 years. Around 18.4% of fishermen, fishing for 40 years or more, and consist mostly of fishermen already retired, but remain in activity to supplement income. What becomes curious, and shows the growing discouragement for to work in the activity. Because these represent double the fishermen that are in the activity there less time, in the range of 0 to 9 years, who are the younger ones, representing only 7.9%, the lowest portion of fishermen.

Regarding the performance of other activities, in addition to lobster fishing, 84.2% responded positively. The most of them mentioned the additional activity was the capture of only fish, 93.8%, with Pescada, *Cynoscion* spp. (Sciaenidae, Perciformes) and robalo or snook, *Centropomus* spp. (Centropomidae, Perciformes) being the most commonly caught. While 6.2% said capture both shrimp and fish, in addition the lobster.

Activities like these are undertaken as subsistence fishing, i.e., fishing that is consumed mainly by the family of the fisherman. The fishermen who fish to supplement income are the ones that also capture the shrimp or higher value fish, which occurs sporadically. The price of the fish and shrimp is influenced by the size and appearance (fresh seafood). The most common destinations for trade are restaurants located near the beach in the community or to middlemen.

Regarding the situation of fishing, 92.1% of interviewee said that the amount of lobster captured by them is decreasing. The main reasons cited for this decline are: fishing with scuba diving, use of illegal trap, fishing in closed season, capture of lobster of restricted size, lack or inadequate control by authorities, excessive number fishermen in the activity, among others.

Fishing held in the community of Ponta Grossa is mainly of come and go (output and returns diary), that is, 78.9% of the fishermen spend only one day at sea. This option is mainly due to low production and the type of boat most commonly used in the community, which is boat sailing. When only boats motorized are considered, time spent at sea increases to up to 15 days. Only 68.4% the fishermen fish during the 6 months of permission. The lowest fishing period mentioned by them was one and a half months. This is due to low production of lobsters early in the season.

As regards the characteristics of the boat used, 65.8% are not the owner of the fishing boat. These boats have the capacity between 2 and 5 fishermen when not powered, and between 4 and 5 when motorized, and have sizes ranging from 5 to 8 meters when non-

motorized and 8 to 10 meters when powered. The great majority, 78.9%, fishing in sailing boats, and, this total 83.3% do not lead ice, and nor has otherwise for conserve the fresh lobster. The fishermen who own boat total 34.2%. Of these, only 15.4% have motorized boats, equivalent to 5.3% of all respondents. It is observed that the fishing made in one day is performed not only because of low production.

Relative to fishing tackle used, 100% say they only use allowed traps for lobster fishing. Of these, 81.6% said they saw other fishermen fishing irregularly, as follows: 64.5% observed other fishermen fishing only with scuba diving; 25.8% with scuba diving and also fishing net; 6.5% fishing only with fishing net; and 3.2% they said see other fishermen fishing during the closed season. All fishermen interviewed reported having knowledge of the closed season.

3.2 Management applied in the resource conservation

As for the management in the activity, when they were asked whether or not they knew the purpose of the closed season, 100% of the fishermen said yes, and, for them, the reason for the establishment of the closed season was growth, reproduction and lobster preservation. The same 100% said obey the closed season, and of these only 65.8% said that it is being determined in the right time, but 92.1% believe that the closed season can improve the fishing.

For fishermen that do not agree with the current closed season, many suggest its increase, and even to stop fishing for more than a year.

With regard to fishing management, 97.4% claim to know which government agency is responsible for its management. When it comes to oversight, 71.0% said they already have been inspected. Of those who said they were inspected, 88.9% said that this happened at sea, 7.4% on the beach (on landing), and 3.7% in both environments. When they were asked if observed another fisherman be approached by a fiscalization, 76.3% said yes. Of these, 79.3% said that the inspection was done at sea, 6.9% on the beach, and 13.8% at the beach and sea.

Only 44.7% of the interviewee think that fishing will improve, and that predatory fishing is the main reason for the lack of improvement due to reasons already previously mentioned by the fishermen, and again cited, such as: as lack of inspection, irregular fishing, and increasing the number of fishermen, reasons related to the management of the activity.

Regarding the participation of fishermen in decision-making on fisheries management, 100% think they should participate. However, when asked whether they would like to suggest a way of improving fishing, 92.1% said yes, being suggested by almost all of them increased enforcement.

When they were asked whether they should perform some activity to help preserve the lobster while they are getting insurance because of the closed period, 84.2% said yes. The activities most frequently cited by them were: to help the government supervise the fishing and to respect the closed season.

3.3 Socioeconomic aspects

With respect to the socioeconomic characteristics of the community, 89.5% of fishermen claim that their main income comes from lobster fishing. Most fishermen, 55.3%, said they perform another activity to complete their income during the closed season, being fishery of fish the activity most frequently cited.

The government management agency does not allow that any type of fishing or activity that brings some kind of income to be done during the closed period. This is due to the receipt of insurance, which is exclusively for those people who are exclusively fishermen of lobster. It is a wrong attitude, when it prohibits another fishery kind, even proven to be subsistence. Because even during the lobster fishing season, as stated earlier, 84.2% of fishermen perform another fishery activity because of low production. This fishing activity aims at improving their quality of life through better nutrition in most cases, as well as increasing the income in some families.

Out of the interviewee that are working and are not retired, 100% are unionized, and 94.1% receive insurance in the closed season. The remaining 5.9% have some pending issue related to the syndicate, but currently in legalization process.

Out of the fishermen that are actively employed, 76.5% reported having less income in the fishing season than in the closed season. In the closed season they received R$ 724.00 (US$ 307.64), which is the minimum wage in Brazil. The declared monthly income during the fishing season varied between R$ 100.00 to R$ 1,017.00 (US$ 42.49 to 432,14, respectively), with 41.2% earning less than half of the minimum wage.

Over the years, fishing has always been the main community activity, 89.5% of interviewees, the father was a fisherman. Out of the remaining 10.5%, 7.9% are children of farmer and 2.6% beekeepers.

Regarding family composition, 81.6% are married and 76.3% have children, and the number of children per fisherman varies from 1 to 14. 21.0% of the fishermen that have children, have only one, 26.3% have two, 7.9% have three, and 5.3% have four, five or six children. The remaining 5.2% have from seven to fourteen children, with 2.6% for each.

Although the vast majority of fishermen are son of fisherman, 100% of those who have children said they would not advise their son to be lobster fisherman. According to them, “fishing has no future”, and they prefer that their son goes school and college, so that he can have a better life, since it is difficult to study and participate in lobster fishery simultaneously.

4 I DISCUSSION

Until the 1990s, lobster fishery in Brazil had a large fishing area available, with part of it being poorly explored. The government, then, encouraged the deployment of a fishing fleet to offset the decline of fishing in areas near the shore. So reduced the taxes as a form

of subsidy due to the increase in operating costs due the fishing be performed farther of the shore (Fonteles-Filho, 2000).

However, this increase in the fleet was not accompanied by research studies that aimed at determining environmental carrying capacity, that is, there was no concern about the sustainability of the resource. According to Holland (2011), understanding the relationship between the effort and the catch is important in the exploration of many species. This is due not only to social and economic planning, but, because many fisheries are managed indirectly, controlling of the effort, instead of to control the amount captured. This because the economic performance and fishing sustainability depend on the definition of the level of effort.

After the encouragement given by the Brazilian government for catching lobsters, there was a lack of control that led to an excess of issued of licenses, which had to be controlled afterwards. According to Bodiguel (2002), control the release of licenses should also be seen as a social factor as well as of environmental protection, i.e., that produces sustainable development.

According to Bodiguel (op. cit), during the 1990s in Canada, the purchase of licenses for lobster processing units, fishing companies or individual fishermen, increased significantly. This was causing transferring for companies the fishing control, what worried the fishermen, immediately. So, the government established individual transferable quotas, which led to a major reduction in the concentration of the fleet in the control of companies, doing the lobster fishery the last open lucrative fishing for autonomous fisherman.

When the relationship between granted licenses and the catch is not well understood or influenced by unregulated decisions, the management of nominal fishing effort can be an ineffective way of achieving the objectives established in economic or biological terms. In such cases, individual quotas or for cooperatives may be the better solution (Holland, 2011).

According to Phillips and Melville-Smith (2006), lobster fishery in Brazil was in serious risk of collapse because of overfishing and inadequate management measures to protect the stocks. Among them, it is worth mentioning the suspension of the prohibition of capture of ovigerous females in 1986 and the use of gillnets in 1992. The use of gillnets was permitted and prohibited several times along the years until 2006, when it was determined by IBAMA, through Normative Instruction 138/2006, starting from January 1st 2007, that the species of lobster *P. argus* and *P. laevicauda* could only be captured with the use of eco-friendly traps, prohibiting definitely fishing with gillnets (Brasil, 2006; 2008).

In the 2000s, according to Phillips *et al*. (2013a), with the expected decline of the production, in personal communication from R. Schärer in 2007, the legal fishing effort in Brazil was reduced, taking an attitude contrary to the given incentive in the previous decade. This reduction was to achieve a maximum theoretical effort of 40 million traps per year. However, the lack of oversight led to an increase in fishing with gillnets and scuba

diving. There was also an increase in the closed season introduced in 2009, from four to six months. Seeking help protect ovigerous lobsters that can be caught legally in the period of fishing, because there is no prohibition for their capture in legislation.

Regarding the capture of ovigerous females, countries such as Australia, New Zealand and Cuba, major producers of spiny lobsters, and others with lower production, prohibiting fishing these individuals (Brasil, 2008).

Cavalcante *et al*. (2011) reported that two resolutions performed by fishing managers of the Brazilian government made it difficult to the sustainability of the lobster fishery. The first regarding the protection of the ovigerous females, which in the early of the resolutions was always present, and, in recent years, this measure it was not observed. In the second resolution, the fishing with gillnet was authorized, even though to be harmful for the environment; already in the 1970s was allowed your use several times over the last years, until his last and perhaps definitive prohibition, in 2007. The management of fishing activity of many countries is aimed to protect and support their marine fishing resources, leading to the sustainability of their industry in present and future. The complexity this management may depend on the length of coastline and diversity of the resources. Countries with extensive coastlines tend to have more problems than the countries with shorter ones (Khan, 2006).

Therefore, managing the sustainability of fishing is a dynamic process. While some future questions concerning some species of lobster are more easily identified, it is inevitable that unforeseen issues may arise. The challenge for researchers, managers and the industry will be to identify these issues as potential problems ahead of time and to have the means and ability to deal with these situations to correct them (Phillips *et al*., 2013a).

In addition, fishing industry is not immune to the large variation of the interaction of natural factors and pressure brought about by globalization. Helped by technological advances, globalization has resulted in an increase in exploration and value of exploited products. The emergence of environmental and social standards is necessary to ensure the survival of the species caught, and higher resilience of ecosystems and development of codes to the practice of responsible fishing (Phillips *et al*., 2013b).

According to Ivo *et al*. (2013), the production chain of the lobster depends directly on the biological stability of its stocks and the difficulty to control the exploitation of this resource in Brazil is strongly related to two basic aspects: (1) Large extent of the fishing area; and (2) Diversity of traps and capture methods used, despite the permissions limitations in legislation.

For Muñoz-Nuñez (2009), regarding the sustainability of lobster fishing in Cuba, the local Ministry of Fishery considers the development of aquaculture as the main and the fastest possible solution for increasing fishery production. Jeffs and Davis (2003) corroborate this statement, and comment that aquaculture, in low density, of lobsters caught in the environment in the juvenile stage has great potential until the cultivation techniques in the laboratory, to the larval stage, are effectively developed for species, of the genus *Panulirus*.

Similarly, Kittaka and Booth (2000) and Miller *et al*. (2010) said that a possible solution to the problem of sustainability in the fishing would be aquaculture, with the capture of pueruli and pre-juveniles, for rearing in captivity, which near the commercial size would be returned to the environment in protected areas, so as to reproduce in the natural environment. Butler and Hermkind (2000) states that this solution shows sustainability because studies estimate mortalities in nektonic stage (pueruli) exceed 90% in the environment, which are mainly due to predation.

Over the last 15-20 years, we have seen an increase in named sustainable fishery management. Initially, this expression was primarily directed to the management of fishery resources, and gradually to the ecology of these resources. This management includes economic and social aspects of fishing, but, in most cases, without real objectives. This is gradually changing and the management of lobster fishery is increasingly related to the all these aspects, which are now needed for a successful management in a modern world (Phillips *et al*. 2013a).

In conclusion, one should seek greater participation of fishermen in the decisions taken in the management, so that they also feel responsible for steps crucial to fate of activity, since many fishermen state that there is a failure to comply with the rules during the inspection procedures by government inspectors, which confiscate and destroy their traps, and some agents require which the seized material be launched in the sea, which is completely against any environmental conservation program. A partnership between fishery managers and fishermen should be done, i.e., a shared management with a real interest on all parts, so that there is an improvement in activity, punishing those who do not comply with the law, but everyone, not just some, as stated by fishermen themselves.

A few decades ago, the period of lower income of fisherman was in the closed season. Currently, some people, especially fishermen, desire to extend the closed season aiming at the improvement of fishing, and, consequently, of their income. Since the actions taken in this direction, seeking a balance in production and stabilization of the income of fishermen, had no effect. This is demonstrated in the lack of desire for their sons be lobster fishermen, showing that the production of lobster tends to stay in the control of the fishing companies, and removing the artisanal fisherman of the activity.

In many countries, activities such as aquaculture are included in the sustainability of fishing of various organisms, including lobster. In Brazil, lobsters could be cultivated from the nektonic stage (puerulus), which has low survival in the environment, by fishermen at sea, supervised by government research agencies such as Universities. A percentage of these animals, set by the government, when already near the market size, would be released in permanent preservation areas in the sea, where no fishing activity would be allowed. The remainder would be sold by fishermen in the market size, with certification that originates from sustainable aquaculture.

REFERENCES

Bodiguel C. 2002. Fishermen facing the commercial lobster fishery licensing policy in the Canadian Maritime Provinces: origins of illegal strategies, 1960-2000. **Marine Policy**, 26, p. 271-281.

Brasil. 2006. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis - IBAMA. **Instrução Normativa nº138 de 6 de dezembro de 2006**. Retrieved from: http://www.ibama.gov.br/sophia/cnia/legislacao/IBAMA/IN0138-061206.PDF. Accessed in: 31/05/2016.

Brasil. 2008. **Plano de gestão para o uso sustentável de lagostas no Brasil: *Panulirus argus* (Latreille, 1817) e *Panulirus laevicauda* (Latreille, 1804)**. IBAMA - Centro Nacional de Informação Ambiental - CNIA, Brasília, 121 pp.

Brasil. 2014a. **Instituto Brasileiro de Geografia e Estatística - IBGE**. Retrieved from: http://www.cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=230535&search=cearalicapui. Censo de demográfico de 2010. Accessed in: 31/05/2017.

Brasil. 2014b. **Instituto Brasileiro de Geografia e Estatística - IBGE**. Retrieved from: http://cidades.ibge.gov.br/xtras/temas.php?lang=&codmun=230535&idtema=125&search=cearalicapuilproduto-interno-bruto-dos-municipios-2011. Accessed in: 31/05/2017.

Brasil. 2016. Ministério da Saúde. Conselho Nacional de Saúde. Resolução no 510, de 7 de abril de 2016. Disponível em: http://conselho.saude.gov.br/resolucoes/2016/Reso510.pdf. Acessed in: 09/07/2020.

Butler MJ and Herrnkind WF. 2000. Puerulus and juvenile ecology. In: B.F. Phillips and J. Kittaka (Eds) **Spiny lobsters: fisheries and culture**, Oxford: Blackwell Publishing: Fishing News Books, p. 276-301.

Cavalcante PPL, Furtado-Neto MAA, Costa JM and Neves SS. 2011. Discussão: sucessos e frustrações. In: PPL Cavalcante, MAA Furtado-Neto, JM Costa and SS Neves (Eds). **Ordenamento da pesca da lagosta: uma experiência desordenada**, Ministério da Pesca e Aquicultura, Universidade Federal do Ceará, p. 45-62.

FAO. 2014. **Programa Estatístico FishStatJ**. Retrieved from: http://www.fao.org/fishery/statistics/software/fishstatj/en, Roma: Database 1950-2012, 2014. Access in: 31/05/2017.

Fonteles-Filho AA. 2000. The state of the lobster fishery in north-east Brazil. In: B.F. Phillips and J. Kittaka (Eds). **Spiny lobster: fisheries and culture**, Oxford: Blackwell Science: Fishing News Books, p. 121-134.

Holland DS. 2011. Planning for changing productivity and catchability in the Maine lobster fishery. **Journal of Fisheries Research**, 110, p. 47–58.

Ivo CTC, Fonteles-Filho AA, Silva AC and Vieira RHSF. 2013. Composição dos estoques. In: CTC Ivo, AA Fonteles-Filho, AC Silva, RHSF Vieira (Eds). **Cadeia produtiva da lagosta nas regiões Norte e Nordeste do Brasil**, RDS Editora, p. 121-142.

Jeffs A and Davis M. 2003. An assessment of the aquaculture potential of the Caribbean spiny lobster, *Panulirus argus.* In: **Proceedings of the Gulf and Caribbean Fisheries Institute**. v. 54, 2003, p. 413-426.

Kittaka J and Booth JD. 2000. Prospectus for aquaculture. In: BF Phillips and J Kittaka (Eds). **Spiny lobsters: fisheries and culture**, Oxford: Blackwell Publishing - Fishing News Books, p. 465-473.

Khan SA. 2006. Fishery management objectives and strategies. In: S.A. Khan. **Management of spiny lobster fishery resources**. National Biodiversity Authority.

Lipcius RN and Eggleston DB. 2000. Ecology and fishery biology of spiny lobsters. In: BF Phillips and J Kittaka (Eds). **Spiny lobsters: fisheries and culture**, Oxford: Blackwell Publishing - Fishing News Books, p. 1-41.

Miller CL, Ohs, CL and Creswell RL. 2007. **Candidate Species for Florida Aquaculture: Caribbean Spiny Lobster, *Panulirus argus***. University of Florida: IFAS Extension, 2010. Retrieved from: http://www.thefishsite.com/articles/355/candidate-species-for-aquaculture-caribbean-spiny-lobster-ipanulirus-argus-i/. Acessed in: 31/05/2017.

Muñoz-Nuñez D. 2009. **The Caribbean spiny lobster fishery in Cuba: An approach to sustainable fishery management.** Masters of Environmental Management. Nicholas School of the Environment of Duke University. Durhan, North Carolina, 97pp.

Paiva MP. 1977. **Recursos pesqueiros estuarinos e marinhos do Brasil**. Fortaleza, EUFC.

Phillips BF and Melville-Smith R. 2006. *Panulirus* species. In: BF Phillips (Eds) **Lobsters: biology, management, aquaculture and fisheries**, Oxford: Blackwell Publishing, p. 359-384.

Phillips BF, Melville-Smith R, Kay MC and Vega-Velázquez A. 2013a. *Panulirus* species. In: B.F. Phillips (Eds) **Lobsters: biology, management, aquaculture and fisheries**, Oxford: Blackwell Publishing, p. 289-326.

Phillips BF, Wahle RA and Ward TJ. 2013b. Lobsters as part of Marine Ecosystems - A Review. In: BF Phillips (Eds) **Lobsters: biology, management, aquaculture and fisheries**, Oxford: Blackwell Publishing, p. 1-35.

SOBRE A ORGANIZADORA

MARIA ELANNY DAMASCENO SILVA - Mestra em Sociobiodiversidade e Tecnologias Sustentáveis pela Universidade da Integração Internacional da Lusofonia Afro Brasileira - UNILAB, ex-bolsista de pesquisa CAPES e integrante do grupo GEPEMA/UNILAB. Especialista na área de Gestão Financeira, Controladoria e Auditoria pelo Centro Universitário Católica de Quixadá - UniCatólica (2016). Tecnóloga em Agronegócio pelo Instituto Federal de Educação, Ciência e Tecnologia do Ceará - IFCE (2014). Foi estagiária no escritório Regional do SEBRAE-Quixadá/CE entre os anos de 2012 a 2014. Atuou como bolsista técnica e voluntária de pesquisas durante a graduação em Agronegócios. Tem experiência nas áreas de ciências ambientais, ciências agrárias, ciências sociais e recursos naturais com ênfase em gestão do agronegócio, desenvolvimento rural, contabilidade de custos, políticas públicas hídricas, tecnologias sociais, sociobiodiversidade e educação ambiental. Além disso, faz parte da Comissão Técnica-Científica da Editora Atena. Possui publicações interdisciplinares envolvendo tecnologias sociais para o campo, cultura, ensino-aprendizagem, contabilidade rural, poluição e legislação ambiental.

ÍNDICE REMISSIVO

U

V

Interfaces entre **Desenvolvimento**, **Meio Ambiente** e **Sustentabilidade**

2

www.atenaeditora.com.br
contato@atenaeditora.com.br
@atenaeditora
www.facebook.com/atenaeditora.com.br

Atena Editora

Ano 2021

Interfaces entre **Desenvolvimento**, **Meio Ambiente** e **Sustentabilidade**

2

www.atenaeditora.com.br
contato@atenaeditora.com.br
@atenaeditora
www.facebook.com/atenaeditora.com.br

Atena Editora
Ano 2021