

The Socio-economic Framework of the Spiny Lobster (*Panulirus argus*) Fishery in St. Vincent and the Grenadines and Associated Socio-economic Fishery Performance Indicators

MAREN HEADLEY and SUSAN SINGH-RENTON

CRFM Secretariat, 3rd Floor Core's Building, Halifax Street, Kingstown, St. Vincent and the Grenadines

ABSTRACT

The spiny lobster fishery is very important to St. Vincent and the Grenadines, and approximately 25 tonnes are exported annually. Habitat degradation and heavy fishing pressure in the near shore areas are believed to have impacted the local spiny lobster population negatively. At present, social and economic considerations, from the level of harvest to the level of supplying external markets, are not incorporated into management decisions for this fishery. Using both formal and informal interviews, this study identified and characterized the component operations of the lobster fishing industry, from harvest to export operations, examined types of social and economic data possible to gather and options for their use in evaluating fishery performance relative to social and economic management objectives. Fishers were the most co-operative interviewees providing information on: material lifestyle; number of dependents; education level; fishing patterns; weekly incomes and expenditures; supply levels to different purchasers. Fishers' most common weekly income range was \$500-1000 XCD and most fished full-time (92.5 %), with fishing as the main income for the family. The ex-vessel price range most often quoted was \$22.05 - 55.13 XCD/kg. Stakeholders who benefitted socially and economically at the post harvest level were identified and some preliminary characteristics of their activities determined. Export markets for spiny lobster included: Anguilla, Barbados, Grenada, Martinique, St. Lucia, Trinidad and Tobago, and the USA with marketing routes by sea and air. Additional research is recommended for developing an adequate socio-economic information base to support the formulation of more integrated and balanced strategies for managing the fishery.

KEY WORDS: Caribbean, spiny lobster, socio-economic data

Pesquería de la Langosta Espinosa (*Panulirus argus*) en San Vicente y las Granadinas e Indicadores Socioeconómicos Asociados

La pesquería de langosta espinosa es muy importante para San Vicente y las Granadinas, y aproximadamente 25 toneladas son exportadas anualmente. Se cree que degradación de hábitat y alta actividad de pesca en áreas costeras ha hecho impacto negativamente con la población de langosta espinosa local. Actualmente, las consideraciones sociales y económicas, del nivel de captura al nivel de suministrar mercados externos, no son incorporadas en decisiones de dirección para esta pesquería. El presente trabajo identificó y caracterizó las operaciones componentes de la industria pesquera de langosta espinosa, de la captura hasta las operaciones para exportar, examinó los datos sociales y económicos posibles de juntarse y opciones para usar estos datos para evaluar la pesquería en cuanto a objetivos sociales y económicos. Las entrevistas formales e informales fueron conducidas. Los pescadores eran la mayor parte de participantes cooperativos. Ellos fácilmente proporcionaron la información en varios aspectos sociales y económicos, que incluyó, inter alia: estilo de vida material; número de dependientes; nivel de educación; modelos de pesca y prácticas; ingresos semanales y gastos; niveles de suministro a compradores diferentes. Basado en los datos se juntó, la variedad de ingresos semanal más común para pescadores era \$500-\$1000 XCD (el 77.5%). 92.5% era pescadores de jornada completa, con la actividad de pesca como los ingresos principales para la familia. La variedad de precios de ex-buque el más común era \$22.05-\$ 55.13 XCD por kilogramo. Aparte de los pescadores, los otros operadores de la industria que beneficiaron socialmente y económicamente fueron identificados y algunas características preliminares de sus actividades fueron determinadas. Los mercados de exportación principales incluyeron: Barbados, Santa Lucia, Trinidad, Martinica y Los Estados Unidos, con marketing rutas por mar y por avión. La investigación adicional es recomendada para desarrollar una base socioeconómica adecuada de información para apoyar la formulación de estrategias más integrada y equilibrada para manejar la pesquería.

PALABRAS CLAVES: Caribe, langosta espinosa, datos socioeconómicos

Une Étude pour Déterminer les Indicateurs Socio-économiques avec la Pêche de Homard (*Panulirus argus*) à St. Vincent et les Grenadines

La pêche de homard est très importante pour le Saint Vincent et les Grenadines, et approximativement 25 tonnes sont exportées annuellement. Cependant, en raison de la dégradation d'habitat et de la forte pression de pêche dans les secteurs proches de rivage, la population de homard est considérée comme être surexploitée. Cette étude visé à rassembler des données qui faciliteraient l'évaluation de l'exécution de la pêche en ce qui concerne des objectifs sociaux et économiques convenus. Des discussions et des entrevues structurées face à face, ont été conduites. Celles-ci ont impliqué l'examinations des marchés et des itinéraires de vente, des pratiques après la moisson, de l'emploi, des méthodes de la pêche et des coûts associés; modèles d'utilisation de ressource, préférences du marché des poissons, recettes, dépenses et style de vie matériel ; et le cadre global de l'industrie. Le revenu hebdomadaire des pêcheurs s'est étendu de \$500-\$1000 XCD (84%). Quatre-vingt-dix pour cent étaient les pêcheurs à plein temps, avec la pêche comme revenu principal pour la famille. Le prix d'ex-navire des homards s'est étendu de \$10-\$25 XCD par livre et tous les pêcheurs ont vendu les homards aux exportateurs locaux. Les marchés d'exportation principaux ont identifié comprennent: Les Barbade, St. Lucie, Trinidad, la Martinique et les Etats-Unis, avec des itinéraires de vente par la mer et avion. Les sorties de cette étude ont : a amélioré notre arrangement du composants socio-économiques qui soutiennent la pêche et ; ont facilité le développement des indicateurs économiques sociaux et nécessaires pour évaluer l'exécution de la pêche afin d'atteindre des buts sociaux et économiques.

MOTS CLÉS: St. Vincent et les Grenadines, la pêche de homard, les indicateurs socio-économiques, les pêcheurs

INTRODUCTION

St. Vincent and the Grenadines is located in the Eastern Caribbean, at the southern end of the Windward Islands chain (Figure 1). The fishing industry in St. Vincent and the Grenadines includes a small scale and artisanal component which utilizes traditional gear, methods and vessels (Jardine and Straker 2003). There are approximately 2500 full and part-time fishers, while fish vendors, traders, and processors make up an additional 500 persons (FAO 2002a). The fishing sector in St. Vincent and the Grenadines contributed an average of \$9.91 million Eastern Caribbean dollars (XCD) to the Gross Domestic Product (GDP) during 2003-2007 (St. Vincent and the Grenadines Statistical Office, Unpublished data). However, this amount does not account for other aspects of industry operations, such as the sale of fish in restaurants, and investments in fisheries.

In the region, the Caribbean spiny lobster (*Panulirus argus*) is believed to be fully or overexploited (FAO 2007). Additional factors that are negatively impacting fish stocks include habitat loss due to coastal development, and the unregulated and illegal fishing from local and foreign vessels (Jardine and Straker 2003, FAO 2007). In terms of export revenue generated, the spiny lobster fishery is one of the most valuable fisheries in St Vincent and the Grenadines. Approximately 25 tonnes are exported annually and an estimated 10 – 20% of the lobster catch is

consumed locally (FAO 2002b).

The majority of spiny lobster is caught and landed in the Grenadine islands of St. Vincent. However, due to the small and dispersed nature of these islands, comprehensive routine monitoring of lobster fishing activities is difficult, and also limited by the current administrative infrastructure. Present regulations specify a closed season for lobster from May 1st to August 31st in each year and prohibit the harvest of berried females, as well as moulting and undersized individuals (Kirby-Straker 2003). Hand loop and fish traps (also called ‘pots’) are the only legal methods by which lobster can be captured (Kirby-Straker 2003). However, there are limited available resources for enforcement of current management regulations. In St. Vincent and the Grenadines, the specific management objectives of the spiny lobster fishery are:

- i) To stabilize the net income per fisher at a level above the national minimum desired income; and
- ii) To maintain stocks at the level of Maximum Sustainable Yield (MSY) (Anon. 2003).

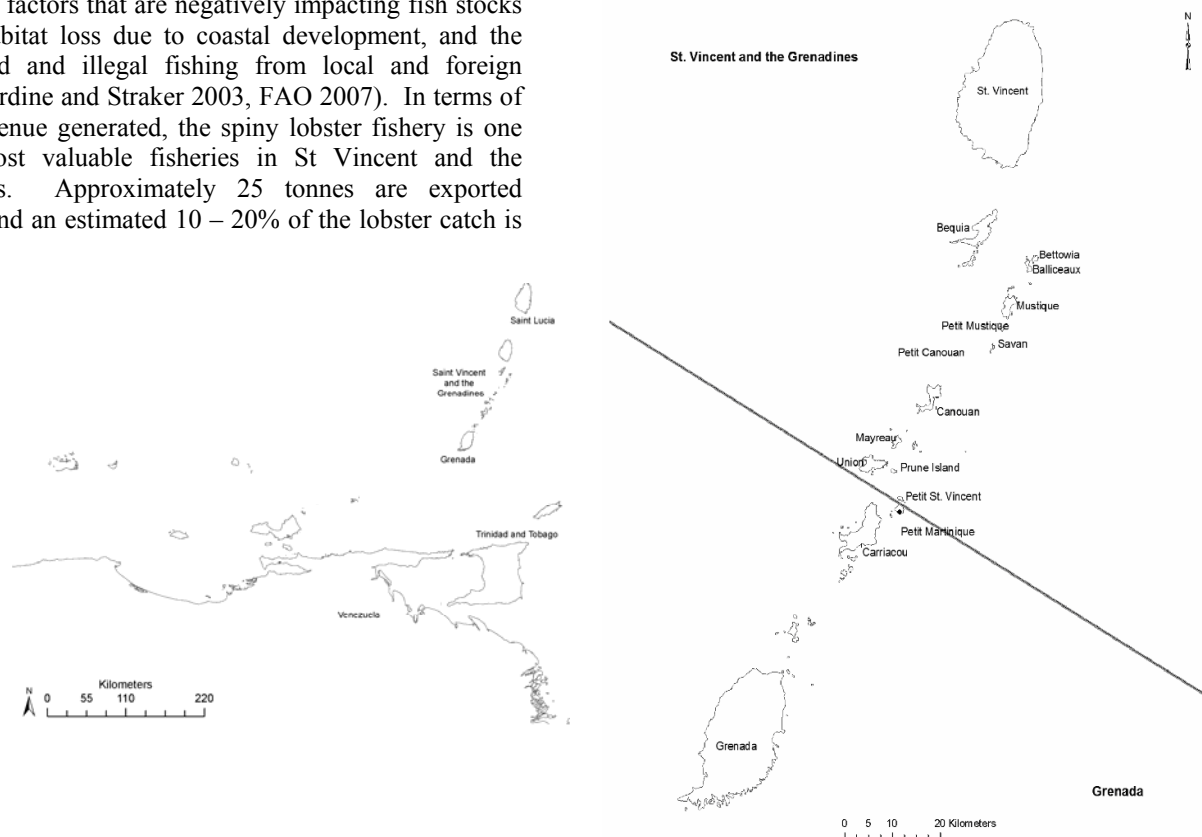


Figure 1. A map of St. Vincent and the Grenadines. The line indicates the boundary between St. Vincent and Grenada.

Despite the obvious need to analyze fishery performance from the standpoint of contributions to the social and economic well-being of the stakeholders, national fishery data collection systems in many of the Eastern Caribbean islands do not routinely collect the types of data necessary to facilitate such an analysis. Though this problem has been recognized for several years, only recently have efforts shifted from qualitative to more quantitative appraisals *e.g.* (Baldwin *et al.* 2006, Gill *et al.* 2007, Staskiewicz and Mahon 2007). Additionally and very importantly, there have been efforts within the sub-region in the past two years to develop data analysis methodology that not only attempts to incorporate social and economic data into fishery assessments, but also seeks to identify and quantify all the social and economic relationships that underpin the fishing industry (CRFM 2007, CRFM 2008).

In an effort to improve the available data and information necessary to apply the methods advocated by CRFM (2007, 2008) to the spiny lobster fishery of St. Vincent and the Grenadines, this study identified and characterized the various component operations comprising the local industry, based on social and economic data gathered during stakeholder interviews, and examined options for utilization of these data on a routine basis to evaluate social and economic performance of the fishery and so inform the development of more integrated management strategies. We also conducted a preliminary evaluation of the fishery's performance with regard to the socio-economic management objective listed above at (i).

METHOD

Interviews were conducted during the period April-September 2008. The fishing communities surveyed included: Paget Farm and Friendship Bay in Bequia; Mustique Fishing Camp in Mustique; Saline Bay in Mayreau; Grand Bay in Canouan, and; Clifton in Union Island (Figure 1). Given the absence of a complete national register of lobster fishers, a list of fishers and other lobster fishery stakeholders was developed based on data and information provided by staff of the national fisheries administration, and other key informants including lobster fishers. The data collection methods included formal interviews using questionnaires and informal interviews with key informants and stakeholders.

Formal Interviews

Formal interviews were conducted using prepared questionnaires, and four stakeholder groups were targeted: lobster fishers (sample size = 40); purchasing company and processing plant operators and the single trading vessel's captain (sample size = 4); employees at landing sites, markets, and processing plants (sample size = 3); the general public, including yacht visitors (sample size = 20). The completion of questionnaires depended on the willingness of individuals to participate and their level of interest. In addition, a fifth questionnaire form was

prepared for restaurateurs and hoteliers, to determine their purchase and sale patterns of lobster. A memorandum was distributed to restaurateurs and hoteliers in St. Vincent and the Grenadines informing them of the study aims and they were also contacted by phone. However, the restaurateurs and hoteliers were unwilling to share this information and the questionnaires were not completed.

A questionnaire was administered to the lobster fishers in order to collect demographic information on the fisher, boat and gear characteristics, spatial and temporal information on fishing practices, markets, and fishing costs. The questionnaire took an estimated 30 - 45 minutes to complete, depending on the detail given by the respondent.

Operators of the purchasing companies and the processing plant, and the trading vessel captain were interviewed to collect demographic information, and to determine lobster purchase patterns, markets and market routes. The questionnaire took an estimated 15 - 20 minutes to complete, depending on the detail given by the respondent.

Interviews were conducted with other individuals involved in the fishing industry *e.g.* processing plant employees and fish vendors using a questionnaire to collect demographic information. The questionnaire took an estimated 10 - 15 minutes to complete, depending on the detail given by the respondent.

A questionnaire was administered to the general public including yacht visitors in order to collect demographic information, and to determine patterns of lobster consumption and purchase. The questionnaire took an estimated 10-12 minutes to complete, depending on the detail given by the respondent.

Informal Interviews

Where formal interviews failed due to the reluctance of interviewees in providing responses to specific questions, informal interviews were conducted as an alternative. Informal discussions were held with restaurateurs in Mayreau (sample size =2), and St. Vincent (sample size =1), and individuals who operated hotels with onsite restaurants in Bequia (sample size =2), St. Vincent (sample size =1), and Union Island (sample size =2). These hotel-restaurants were chosen due to their popularity and high patronage levels as lobster meals were typically expensive. In addition, the importance of the water taxi operators within the sales and distribution chain was only identified after the study had commenced. Consequently, informal discussions were held with selected water taxi operators (sample size = 5) to determine their purchase and sale patterns of lobsters.

Other Sources of Information

The GDP of the fishery sector was supplied by the St. Vincent and the Grenadines Statistical Office (St. Vincent and the Grenadines Statistical Office, Unpublished data), while the data on lobster landings and values were obtained

from the Fisheries Division of St. Vincent and the Grenadines (St. Vincent and the Grenadines Fisheries Division, unpublished data). The Labour Department in St. Vincent and the Grenadines provided the minimum wage for unsheltered agricultural workers as there was no specific minimum wage quoted for fishers (St. Vincent and the Grenadines Statutory Rules and Orders No. 30 2008). Data on yacht and tourist arrivals were obtained from The Ministry of Tourism, Youth and Sports (Ministry of Tourism, Youth and Sports 2007)

On completion of the individual interviews, key informants were again consulted to facilitate validation of the information for general accuracy and consistency.

RESULTS

The key component operations of the lobster fishery were made up of: a harvest component, which involved the fishers and their fishing operations; a sales and distribution component which involved fishers, vendors, traders and processors engaged in local and/or external sales and distribution of spiny lobster and its products; and a consumption component which was made up of consumers from the local population, on-site tourists and consumers in importing countries (Table 1).

Table 1. A summary of the lobster fishing industry operations in St. Vincent and the Grenadines.

Harvest	Sales and Distribution		Consumption
Fishers	Local distribution	Fishers, local vendors and food retail businesses Processor and purchasing company	Local markets Consumers
	External distribution	Fishers, Processor and purchasing company	Export markets

Harvest Component

General technical and technological characteristics — In addition to lobster, the most frequently targeted resources included conch and reef and slope fish (Figure 2a). Large pelagic and small coastal pelagic fish were captured less frequently. Large pelagic fish were only captured by the Bequia fishers whereas small coastal pelagic fish were captured by both Bequia and Mustique fishers. The most frequent average weight range of lobsters captured by fish pots was 18 - 27 kg (Figure 2b) while the most frequent average weight range captured by SCUBA was 27 - 36 kg (Figure 2c). Battowia, Pillores, Savan, Mustique and Balliceaux were identified as the five areas most frequently fished for spiny lobster (Figure 2 d). Bequia fishers fished in all the islands and hence all fishing areas, while the Mustique fishers fished in all identified areas except Isle de

Quatre, Canouan, Petit Canouan, Petit Nevis and Union Island. The Canouan fishers only fished in the Canouan, Petit Canouan and Mayreau fishing areas. The Union Island fishers fished in the areas identified as Canouan, Petit Canouan, Mayreau and Union Island (Figure 2d).

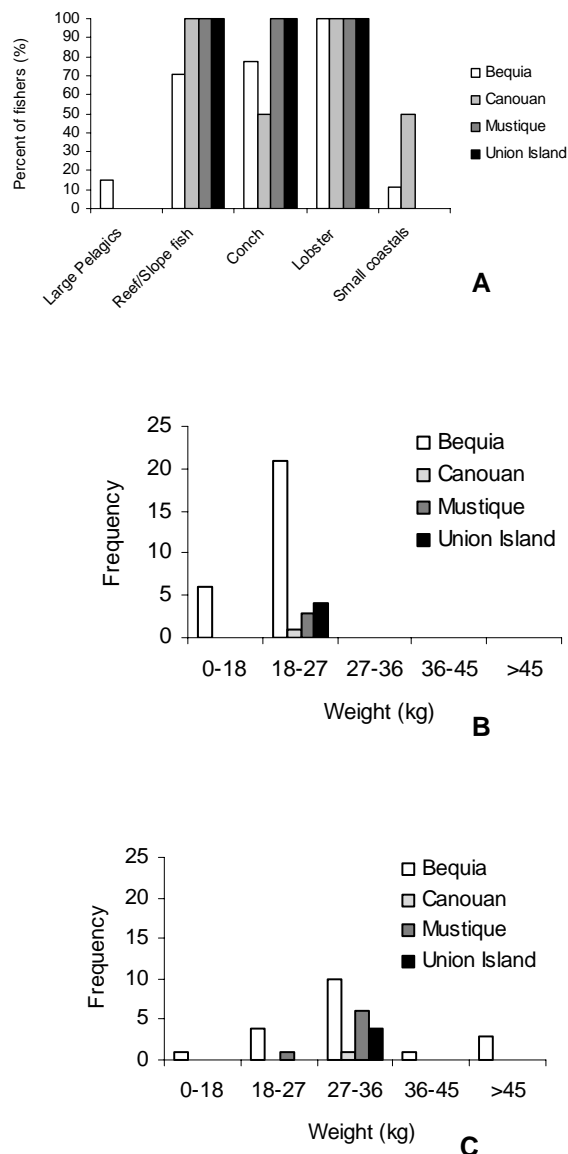


Figure 2. General technical and technological characteristics of lobster fishing operations in St. Vincent and the Grenadines: (a) The percentage of lobster fishers by island targeting various fishery resources; (b) Frequency of the average lobster catch weight per fish pot trip indicated by fishers from each Grenadine island; (c) Frequency of the average lobster catch weight per SCUBA trip indicated by fishers from each Grenadine island; (d) Fishing areas of each Grenadine island frequented by lobster fishers.

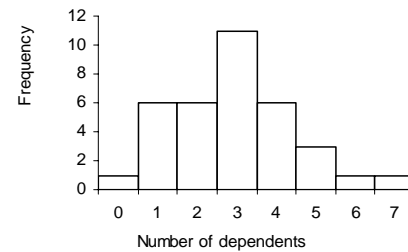
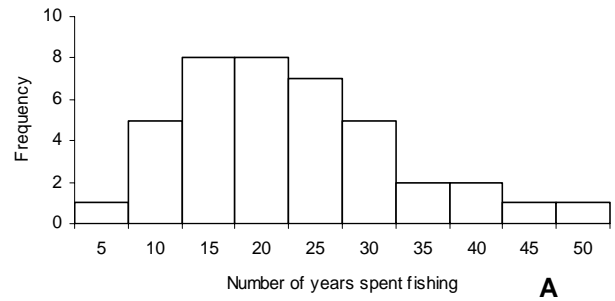
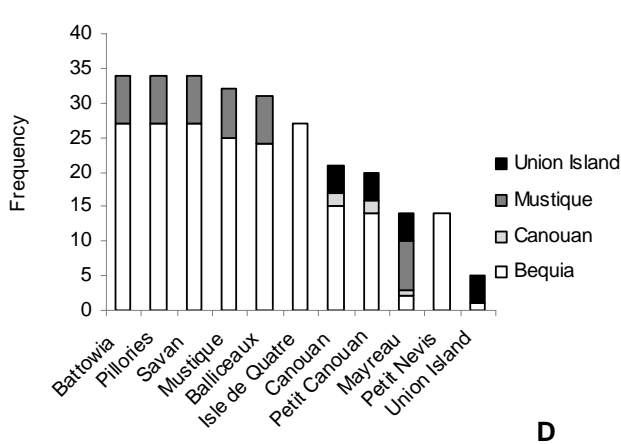


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Social and social-related characteristics of lobster fishing operations — The majority of fishers spent between 10 to 30 years in the fishing industry (Figure 3a). Fishers had 0-7 dependents within their households, with the most common number quoted being three (Figure 3b). Identified dependents were categorised as, children under the age of 16 (40%), employed adults (36%) and unemployed adults (24%) (Figure 3c). There was a high dependence of households on the lobster fishery, with 87.5% of the fishers being the main provider at home and 12.5% being the second/third provider. The majority of fishers (97.5%) depended on the lobster fishery for 75 - 100% of their income, while only 2.5% depended on it for 50-75% of their income. Most fishers were educated up to primary level (95%), with only 5% having completed a secondary level of education. A little over half of the fishers were married (52.5%), 42.5% were single, and 5% lived as common law spouses. In terms of capital, 70% of the fishers owned land, while 30% did not. Fishers most frequently lived in houses made of a combination of concrete and wood (52.5%), while 45% lived in houses constructed completely of concrete and only 2.5% lived in wooden houses. All fishers lived in houses which had running water and electricity. These percentages are illustrated in Figure 3c.

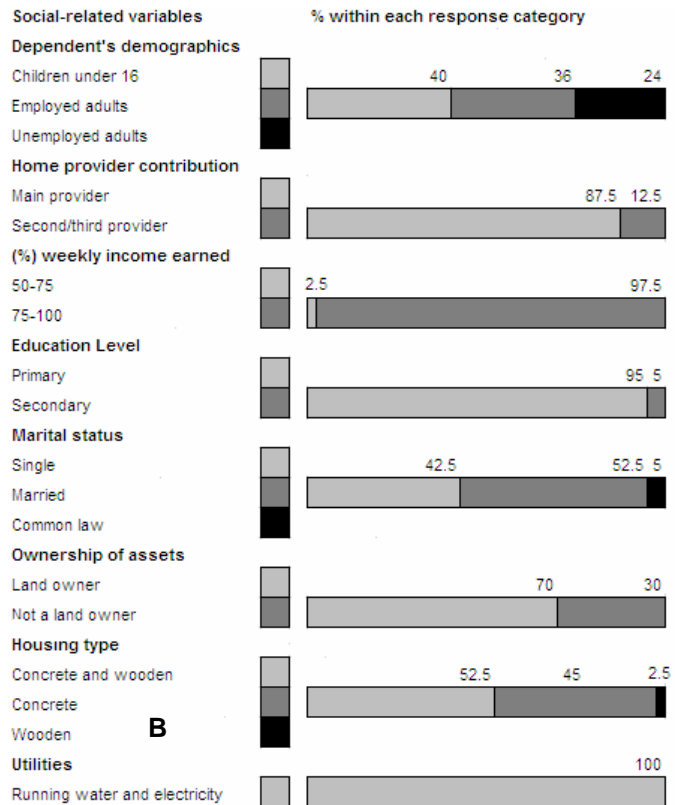


Figure 3. Social and social-related characteristics of lobster fishing operations in St. Vincent and the Grenadines: (a) Frequency of fishers with various years of experience in lobster fishing; (b) Frequency of number of dependents per fisher and hence household size; (c) Frequencies, indicated by percentage responses, of other conditions related to human and social well being.

Economic and economic-related characteristics of the lobster fishing operations — The most frequent average income range for the fishers in all islands was \$500-1000 XCD per week (Figure 4a). Other economic-related characteristics are illustrated in Figure 4b. For instance, crew sizes were most frequently made up of 1 - 3 individuals (72.5%). The other crew sizes given were 4 - 6 individuals (7.5%) and > 6 individuals (20%). The duration of all fishing trips was 4 - 6 hours. This time included search time and represented the length of time between fishers leaving the shore and returning. The majority of fishers (95%) made 4 - 6 fishing trips per week, while 2.5 % made 1 - 3 trips per week and 2.5% made 7 - 9 trips per week. With regard to the number of days fished, most fishers fished 4 - 6 days per week (92.5%), 5% fished 7 days and only 2.5% fished 1 - 3 days per week (Figure 4 b).

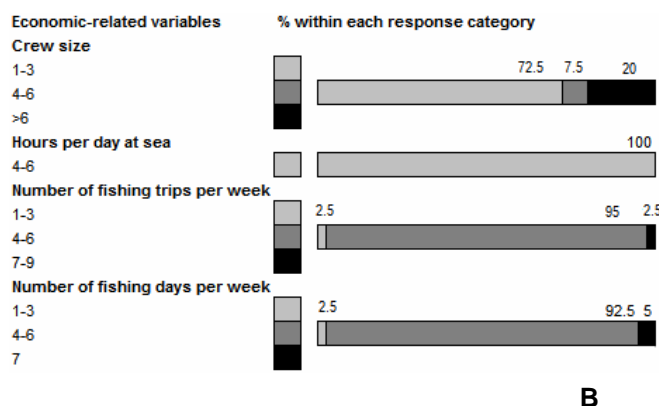
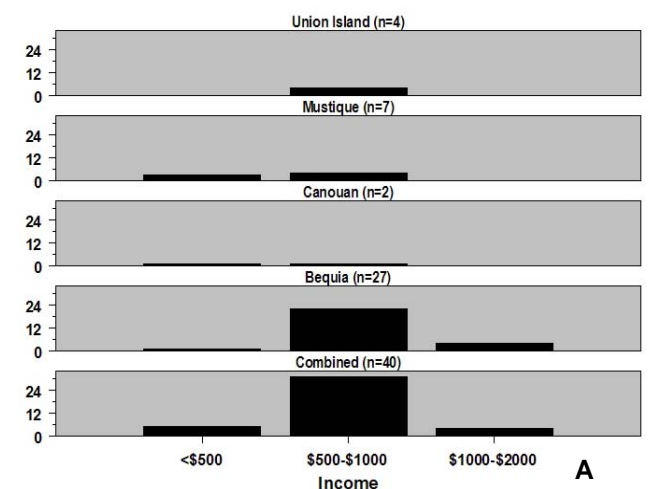


Figure 4. (a) Frequency of average ranges of earned weekly income indicated by fishers interviewed in each island, and all islands combined (n indicates sample size in each case); (b) Frequencies, indicated by percentage responses, of other conditions that impact the economic aspects of fishing operations.

Fishing costs associated with the lobster fishery — Flat transom boats, also known as bow and stern boats or dories, were the most commonly used vessels. The boats were powered by one or two outboard gasoline engines with 40-85 horsepower. Of the 40 fishers interviewed, 25 were vessel owners. In terms of fixed costs, the average costs of a vessel and engine given were \$20,600 XCD and \$10,340 XCD, respectively (Table 2). The average cost given for a fish pot was \$121.79 XCD. Information from key informants suggested that fishers usually owned 1 - 30 pots, with an average of 20 pots per fisher. Fishers were generally unwilling to indicate the number of pots they owned during the interviews. The average cost for a BCD (buoyancy control device) and regulator was \$1390 XCD. In terms of running costs, SCUBA tanks were rented at a cost of \$10 XCD/day and fishers usually used three tanks per fishing trip. The average cost of fuel per fishing trip was \$134 XCD, while the average cost of food was \$14.75 XCD per trip. Overall maintenance costs per year for

Table 2. Fishing costs associated with the lobster fishery given in XCD.

Fixed Costs	Range - (\$ Min- Max)	Mean ± Standard Deviation
Vessel	\$9000-35,000	\$20,600 ± 5748.04
Engine	\$5000-15,000	\$10,340 ± 2105.80
Gear Cost (Fish pot)	\$100-300	\$ 121.79 ± 47.61
BCD (Buoyancy Control Device) and Regulator	\$1000-2500	\$1390 ± 160.17
Running Costs/Day (Fuel + SCUBA gear + Food Costs)	Average XCD Value	
	\$ 178.75	
Maintenance Costs/Year	Percentage of responses	
Vessel		
\$ 0- 500	12	
\$ 500 - 1000	32	
\$ 1000 - 2000	28	
> \$ 2000	28	
Engine		
\$ 0- 500	4	
\$ 500 - 1000	36	
\$ 1000 - 2000	48	
> \$ 2000	12	
Gear (Fish pot)		
\$ 0- 500	85	
\$ 500 - 1000	15	
Operational Costs/Year	Range - (\$ Min- Max)	
Running costs/yr + Maintenance costs/yr of vessel + engine + gear based on 4 fishing days per week	\$24,380 – 26,380	
Running costs/yr + Maintenance costs/yr of vessel + engine + gear based on 6 fishing days per week	\$35,820 – 37,820	

vessels, engines and gear are also shown in Table 2.

The operational cost was estimated by adding the running costs per year to the value range most frequently given by fishers for the maintenance costs for vessel, engine and gear (see Table 2), and based on a range of 4-6 fishing days per week. The most common operational cost range was \$24,380-26,380 XCD per year assuming 4 fishing days per week while it was \$35,820-37,820 assuming 6 fishing days per week.

Economic Value of the Harvest — The average landed weight and value of spiny lobster for the fishing year 2005-2006 were 29,042 kg and \$346,866.50 XCD, respectively (St. Vincent and the Grenadines Fisheries Division, unpublished data). The ex-vessel price of lobster given by the fishers ranged from \$22.05 - 55.13 XCD per kg. A preliminary estimate of a spiny lobster fisher's weekly earnings using values provided by the fishers was calculated based on a crew size of three persons and a mean lobster price of \$36.11 XCD per kg. Assuming a minimum number of four fishing days and a minimum average catch weight per fishing day of 18 kg, the potential minimum weekly earning of a fisher was estimated to be \$575.84 XCD. Assuming a maximum number of six fishing days and a maximum average catch weight per fishing day of 27 kg, the potential maximum weekly earning was estimated to be \$4035.70 XCD

Sales and Distribution Component

The sales and distribution component was divided into two operations: sales and distribution at sea; and sales and distribution after the catch was landed (Figure 5). Fishers sold and distributed their catch to various buyers including yacht visitors, a trading vessel, vendors, water taxi operators, locals, restaurants, hotels with restaurants, purchasing companies and a processing plant. Based on the percentage of fishers who indicated that they sold their catch to these stakeholders, an estimated weight of spiny lobster supplied to each buyer group was calculated using the average landed weight of spiny lobster (29,042 kg) for the fishing year 2005 - 2006.

Sales and Distribution at Sea — Yachts — Visitors on yachts purchased lobsters directly from fishers at sea. Based on interviews with both fishers and visitors, it appeared that the average number of lobsters purchased per yacht was four. Yacht visitors usually bought lobster once or twice per week. There was a preference for lobsters which weighed between 0.7 to 0.9 kg since these could be consumed during one meal. The price range paid by yacht visitors ranged from \$22.05 XCD/kg to as high as \$117.75 XCD/kg. The average annual number of yacht visitors to St. Vincent and the Grenadines during the period of 1998-2006 was 128,364, with the average number of yachts being 32,091 based on four people onboard (ECLAC 2002, Ministry of Tourism, Youth and Sports 2007). Key

informants and fishers estimated that approximately one out of every twenty yachts purchased lobsters. Therefore, based on an estimate of 21,287 yachts potentially being present during any given lobster open season (34.5 weeks), and 1064 yachts purchasing lobster once or twice a week, it can be estimated that fishers supplied these yachts with 4256 - 8512 lobsters. Therefore the estimated weight of lobster supplied to these yachts in a year would range from 2979 - 7661 kg. Assuming a mean price of \$69.90 XCD/kg, fishers could earn between \$208,232 - 535,504 XCD per year. The estimated weight of lobster, which fishers indicated that they supplied to the yachts annually, i.e. based on an estimated percentage, fell within this range as it was 5082 kg (Figure 5).

Trading Vessel — At the time of the study, one trading vessel operated out of Friendship Bay, Bequia. The vessel was licenced in Grenada and operated according to HACCP standards. Reef and slope fish species were purchased by the trading vessel which supplied markets in Grenada and Martinique. It appeared that lobster was not routinely bought and its purchase depended on special orders. The captain of the vessel indicated that it was not profitable to sell lobster in Grenada and Martinique unless there was an order since the selling price was usually too high for customers to purchase on a regular basis. The estimated amount of lobster supplied to the trading vessel by fishers on an annual basis was 2904 kg (Figure 5).

Sales and Distribution on Land — Vendors — It was rare to find lobster in the local markets due to its high export demand. Vendors indicated that they did not typically purchase lobsters unless they received a special order. The estimated annual amount of lobster supplied to vendors by fishers, as indicated by fishers, was 726 kg (Figure 5).

Water Taxi Operators — Water taxi operators based in Union Island and Mayreau purchased lobsters to host weekly barbecues in the Tobago Cays. Five water taxi operators had an informal business arrangement with the captains of charter yachts which visited the Cays. The charge for a lobster meal ranged from \$126.16 - 162.20 XCD per person and the number of guests at the barbecues typically ranged from 5 to 25 people per week. Based on a mean price of \$144.17 XCD, it was estimated that water taxi operators could earn from \$720.85 - 3604.25 XCD per week from these lobster barbecues. The estimated annual weight of lobster supplied to the water taxi operators by fishers, as indicated by fishers, was 2904 kg (Figure 5).

Locals — It appeared that lobster was not considered a traditional meal and therefore was not purchased by Vincentians on a regular basis. In addition to this, the price of lobster was considered to be restrictive to the interviewees who had a mean income of \$2400 XCD per month. The estimated annual weight of lobster supplied to the

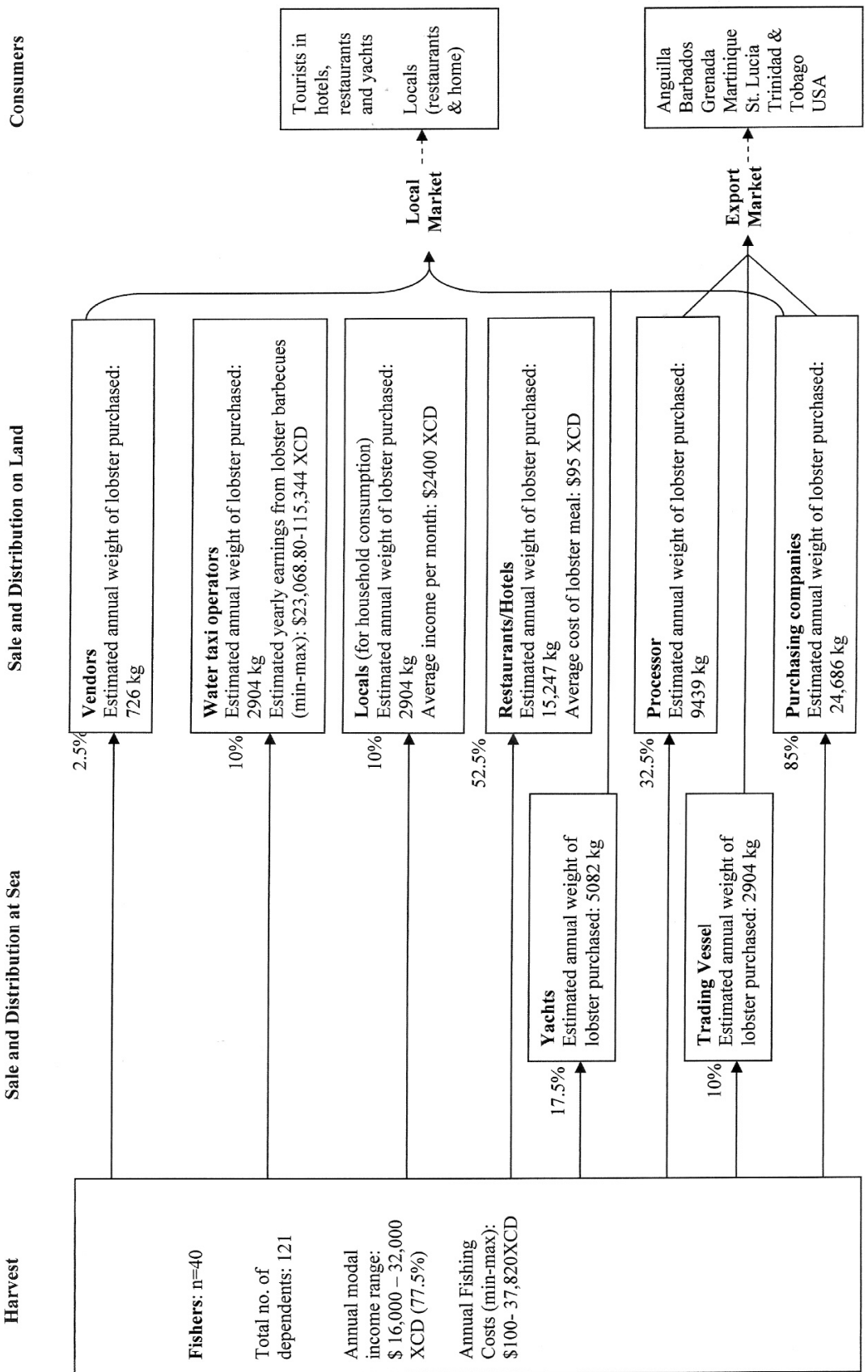


Figure 5. The spiny lobster fishing industry framework for St. Vincent and the Grenadines: where data were provided, quantities and estimated percentages are indicated. Dashed arrow for the export markets indicates that the weights and values concerned remain unknown.

Restaurants and Hotels — The prices at which lobsters were purchased by restaurants and hotels ranged from \$26-55 XCD/kg, and the average lobster meal started at \$95 XCD. Restaurateurs indicated that due to the high demand of the lobster export market, very little lobster was available for local purchase. The restaurateurs/hoteliere also expressed concern about the declining amount of lobster and the competitive prices at which it was being sold. The estimated annual supply of lobster to the restaurants and hotels by fishers, as indicated by fishers, was 15,247 kg (Figure 5).

Processing plant—There was only one processing plant in Bequia, for which the operator leased the Fisheries Complex located in Paget Farm at a cost of approximately \$10,000 XCD per month including utilities. Processing of the lobsters involved the removal of the tail from the head, packaging and freezing of the tails. However, the majority of lobsters were kept live rather than processed. In addition to processing the lobster, the processing plant also supplied lobster to both the local and export markets. No data on the weights and values of lobster processed and sold were available as the operator was unwilling to share this information. The price range at which lobsters were purchased from the fishers was \$22.05-33.08 XCD/kg. The estimated annual supply of lobster by fishers to the processing plant, as indicated by fishers, was 9439 kg (Figure 5).

Purchasing companies — There were two purchasing companies: one located in Bequia and the other in Mustique. The company in Bequia supplied lobster mainly to the export market and all the lobsters were sold live. No data were available on the weights and values of lobster sold as the operator in Bequia was unwilling to share this information. The permanent fishing camp and Fish Market located in Britannia Bay, Mustique, was operated by The Mustique Company. The fishing camp was made up of individual sleeping quarters, gear storage lockers, a common kitchen, and bathroom facilities. The majority of fishers within the camp sold their lobster catches to the Fish Market which then supplied the hotels, restaurants and guests on Mustique. The operator of the Fish Market indicated that the weights of lobster purchased weekly ranged from 23 - 91 kg, and it was noted that this was influenced by supply and demand. A purchase price range of \$22.05-33.08 XCD/kg was given by both purchasing company operators. It was estimated that fishers supplied the purchasing companies with approximately 24,686 kg of lobster on an annual basis (Figure 5).

The total weight of lobster sold to the various buyers based on estimates provided by the fishers was 63,892 kg. This figure is significantly larger than the average landed weight of 29,042 kg which the national fisheries administration had recorded for the 2005-2006 fishing season.

Consumption Component

The initial markets identified were the local and export markets. Within the local market, buyers consisted of yacht visitors, vendors, water taxi operators, locals, restaurants, a processing plant and purchasing companies. The consumers within the local markets consisted of on-site tourists and locals. The export markets included: Anguilla, Barbados, Grenada, St. Lucia, Trinidad and Tobago, Martinique and the USA, with marketing routes by sea and air. Exporters and local suppliers were unwilling to share their export and sale records, therefore there were some data gaps with regard to the weights and values of lobster which were sold and distributed both locally and externally.

DISCUSSION

This study identified and characterised the components of the spiny lobster fishing industry in St. Vincent and the Grenadines along the production chain from harvest, to sales and distribution, and finally to consumption by using an integrated framework in which the interactions among economic and social systems are considered together (CRFM 2007, CRFM 2008). The main stakeholders within the spiny lobster fishery were the fishers, who made up the harvest component; the fishers, yacht visitors, the trading vessel captain, vendors, water taxi operators, locals, restaurateurs, operators of purchasing companies, and a processing plant operator, who were active within the sales and distribution component; and consumers within the local and export markets, who comprised the consumption component.

Examination of the technological characteristics of fishing industry operations allows an increased appreciation of the nature, extent, and purpose of various strategies adopted by the operators concerned, especially as these relate to choices and opportunities for economic development. Within the harvest component, we were able to gain an overall understanding of several technological aspects of the harvest operations. The top five fishing areas identified were all in close proximity to Bequia and Mustique. This may be due to the fact that the largest sample sizes of fishers were from these two islands. However, although the sample size of fishers was small throughout the islands, it is believed that the present study sample was representative of those who depend mainly on spiny lobster as a source of income.

The spiny lobster generates a considerably high return as a result of its ex-vessel price when compared to other fisheries species utilizing the same gears and methods. Although spiny lobster was targeted most frequently because of its high value, other species such as reef and slope fish and conch were also regularly harvested in this fishery. The reef and slope fish were also caught in the fish pots and the average ex-vessel price of these species was given as \$14.82 XCD/kg. Fishers using SCUBA gear to capture lobster also harvested conch when encountered,

probably because conch also has a relatively high average ex-vessel price of \$19.85 XCD/kg. Large pelagic species such as tuna and wahoo were caught using a tow/troll line, which the fishers set en route to and from the fishing grounds. Tuna and wahoo attract a relatively high value with an ex-vessel price of \$19.85 XCD/kg. However, fishers usually had to troll for long distances to catch these species and this method would require a lot of fuel. The average ex-vessel price of small coastal pelagic fish such as carangids and clupeids caught using seine nets, was noted to be approximately \$8.82 XCD/kg. The notable differences in fishing strategies required to target large and small pelagic fish species, and the low ex-vessel price of small coastal pelagic fish probably made it less convenient and less desirable for the lobster fishers to target these species.

Due to the small sample size of fishers, no statistical tests were conducted to compare the weights of lobsters caught by fish pot and SCUBA gear. However, the results indicated that SCUBA divers caught more lobster per trip than fishers using fish pots. This may be due to the fact that divers are able to select their lobsters by sight, and therefore may be expected to select the largest ones, whenever sufficient lobsters are available. Fish pots are non-selective, and restrictions prohibit the landing of berried and undersized lobsters, therefore, when these individuals are encountered in fish pots, presumably they are returned.

The spiny lobster fishery is a social and economic activity which provides employment and income for the fishers involved in addition to a range of other benefits to their standards of living. The fishing sector is rapidly evolving as a result of changes in ecosystems, fishing technologies and market environments. It is therefore important to assess the social and economic well-being of fishers who are dependent on fishing activities for their livelihoods. This information could then be used to guide decision making and strategic planning at both the national and regional levels. In this study we were able gather data on some social and economic aspects associated with the spiny lobster fishery at the harvest component level.

The spiny lobster fishers had dedicated a significant amount of years to their occupation, which implies that it has made and continues to make a successful contribution to their livelihood. The number of years spent fishing is also an indicator of vulnerability with regard to fishers' capacities to pursue alternative livelihoods, because as the fishers age, we argue that it becomes harder for them to learn new skills. The total number of dependents within the fishers' households was three times more than the number of fishers ($n = 40$) interviewed, with the majority being children ($n = 49$) who were under 16. Arguably, this indicator reflects day-to-day financial support dependence on the lobster fishery within the harvest component only. Similar data for the other components could be gathered to provide the total proportion of the local population relying

on the fishery as a direct source of daily financial support.

Education level provides a measure of the level of formal education attained by the fishers and can reflect their capacity for adaptability as well. The majority of the fishers only received up to primary level education and spent a substantial amount of years fishing which suggests that they may find it difficult to easily change occupations. Managers and decision makers would therefore have to take this information into account in establishing training and education programmes and communication strategies that would be suitable for fishers. Some data appear to provide measures of both social and economic well-being. For instance, ownership of assets and marital status reflect states of social well being, but arguably also provide a measure of fishery performance in terms of its contribution to economic well-being and profitability. Most fishers were married and owned land, which indicates that the lobster fishery was economically viable to them as individual operators.

In terms of the lobster fishers' economic well-being, it was found that the majority earned between \$500 - 1000 XCD per week and were dependent on the lobster fishery for most of their income. Considerable investments within this fishery have been made by the fishers with regard to the purchase and maintenance of vessels, engines and gears; and fishing costs. These investments indicate that the lobster fishery is economically viable and provides the fishers with the capital required to make such investments. Other studies have shown that fishers of demersals *e.g.* snappers earn an average of \$500 per week (Gill *et al.* 2007), and given the high ex-vessel price of lobster, it is likely that the lobster fishers earn more than these fishers. In addressing the socio-economic objective of the lobster fishery, the data provided by the fishers and the preliminary estimates suggest that the lobster fishers are earning above the minimum wage of \$30 XCD/day for unsheltered agriculture workers (St. Vincent and the Grenadines Statutory Rules and Orders No. 30 2008). The estimated daily wage for fishers based on a weekly earnings range of \$500-1000 XCD, and the most frequently quoted fishing days per week range of 4 - 6 days, would be \$83-250 XCD/day. Fishers devote a substantial amount of time to lobster fishing, and economic related variables such as hours of day at sea, number of fishing trips per week and number of fishing days per week all provide measures of this. The price of lobster, together with catch and effort data, also provides an indicator of the fishery's economic performance.

The present study focused on understanding the quantities and sales of lobster being transferred through the various components of the spiny lobster fishery. At the post-harvest level, there are many stakeholders who benefit both socially and economically from the lobster fishery; however socio-economic data such as number of family dependents, age, education, and income levels were not collected for these stakeholders. It appears that local fish

vendors do not have a large role in the lobster fishing industry; however, based on the estimated weight of lobster supplied to them by fishers and the high sale price of lobster, they would still obtain some economic benefits. Our data indicated that the estimated annual earnings of the water taxi operators from the sale of the lobster barbecues were quite substantial. The estimated weight of lobster purchased by locals for household consumption was the same amount as that purchased by the water taxi operators; however, based on a population estimate of 119,000 people and a per capita fish consumption of 14.7 kg per year (FAO 2008), it can be concluded that the spiny lobster does not contribute markedly to food security in St. Vincent and the Grenadines. This is due to the fact that Vincentians do not consider lobster as a traditional meal, and the high sale price is also restrictive. The restaurants represent a huge purchasing and sale sector which generates foreign exchange since it is mainly supported by tourists. The processing plant and purchasing companies represent the largest purchasing and sales sector, and it also generates foreign exchange from international trade of the spiny lobster. This highlights the importance of determining the levels of earning and profits made by these businesses and their contributions to the livelihoods of people employed within these sectors.

At present, the majority of landings data for spiny lobster are recorded from the export shipments, since these must be accompanied by corresponding export licences. Landings data for spiny lobster sold on the local market are not fully captured due to direct sales by fishers to: the yacht visitors, trading vessel, vendors, water taxi operators, locals, restaurants, processing plant, and purchasing companies. The potential extent of this problem became clear when we considered that the total weight of lobster supplied to the stakeholders using the fishers' estimates was twice that which the national fisheries administration had recorded.

This study identified the key stages and operators of the spiny lobster fishery of St. Vincent and the Grenadines and provides a preliminary evaluation of social and economic performance, particularly for the harvest component. The average value of fish exports from 2005-2006 for St. Vincent and the Grenadines was \$907,720 XCD (St. Vincent and the Grenadines Statistical Office, Unpublished data), while for lobster the average landed value for 2005 - 2006 was \$346,866.50 XCD (St. Vincent and the Grenadines Fisheries Division, Unpublished data). This shows that the export of spiny lobster accounts for approximately two fifths of the total value of fish export products. It may be possible that the value is higher, based on data gathered during this study.

All components of the fishing industry should be monitored for social and economic performance, as well as technological performance. Hence, in addition to the improvement of catch and effort, and biological data collection, implementation of a routine data collection

programme for social and economic data may not prove to be too onerous and should therefore also be considered by the national fisheries administration in order to facilitate the evaluation of the spiny lobster fishery's social and economic performance. Routine collection of data on the number of dependents within all stakeholder households, their ages and employment status would allow dependency trends to be developed over time and would also enable analysis of the contribution of the lobster fishery to the fishing communities and the country as a whole. Routine data collection of social-related variables such as the total number of people employed in the fishery, and the number of livelihoods associated with the fishery would indicate the levels of social and financial dependence. Routine data collection of income and investment indicators would provide a measure of social and economic security and viability of the fishery. This information, together with data and information on technological aspects of operations, could also be useful in determining the adaptability of the fishery in response to natural and anthropogenic disturbances *e.g.* hurricanes, a bad fishing season, increase in oil prices or a decrease in demand. Routine monitoring and data collection is also necessary to confirm the estimates of lobster weights, values and earnings, which have been made in this study.

In order to ensure that all the landings of the spiny lobster are captured, the national fisheries administration will have to:

- i) Increase monitoring, control and surveillance of all landings and sales at sea;
- ii) Increase monitoring, control and surveillance of export activities; and
- iii) Develop closer linkages with other government departments *e.g.* the Ministry of Trade which collect these types of data and information.

The results of the present study can be used to guide improvements in statistical monitoring that would guarantee adequate coverage of the key players and operations concerned.

The export markets were only generally identified in the consumption component. Within these markets, additional research to improve understanding of the specific players and the nature and extent of their potential operations would provide valuable insight into the strengths and weaknesses of these markets, and the linkage of this to the sustainability of the local industry. Such additional research could be done through collaboration among the relevant government departments in St. Vincent and the Grenadines and the lobster importing countries.

At present, the current biological status of the spiny lobster stock of St. Vincent and the Grenadines is unknown. Knowledge of this is necessary, together with consideration of social and economic indicators of fishery performance, in order to facilitate the development of integrated, sustainable management strategies.

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