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Fishing and marketing of queen conch (*Strombus gigas*) in Barbados

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ABSTRACT

The queen conch, *Strombus gigas*, is a commercially valuable marine gastropod with a distribution restricted to the Western Central Atlantic. Heavy exploitation of this species and subsequent drastic population declines led to the listing of queen conch on Appendix II of the Convention on International Trade in Endangered Species (CITES) in 1992. In 2004 the CITES Authority implemented a suspension of conch exports from a number of range states, including Barbados, for failure to report on the status of the local conch fishery and resource. This study will help to addresses the lack of information by formally describing the fishing and marketing of queen conch in Barbados for the first time.

Information was gathered from fisher and shell vendor interviews and from observation and informal conversation whilst accompanying fishers on conch fishing trips. Conch fishing in Barbados is an unregulated, unmonitored, small scale and mostly untargeted activity, that is little know by the island's general public. Approximately 49 fishers actively harvest conch from shallow, nearshore areas all around the island. The majority of fishers (84%) are free divers and most take conch, lobsters and octopus whilst spearfishing for reef fish. A few use SCUBA to access deeper areas. The fishing grounds are generally accessed by small open boat with outboard engine, or by swimming from shore. Only 20% of fishers harvest conch year-round, whilst the majority fish conch only during the summer months in the pelagic fishing 'off-season'. Harvested conch range in size from 5.4 – 31 cm shell length and the majority of the catch (71% by number) is immature. Based on a very limited sample size, catch per trip appears to range between 8 and 30 shells and the mean catch rate per fisher per trip is estimated at 9.48 shells. A very crude estimate of the annual harvest indicates that somewhere between 3,000 and 5,000 shells are taken, representing a processed meat weight of around 0.28 – 0.47 mt. Both the meat and shells are generally sold and are of equal commercial importance to fishers. Conch meat is usually extracted from intact shells after freezing, and is sold directly to private customers. As a consequence, conch meat is not available in the public fish markets and is not exported. Conch shells are generally sold to shell vendors, who sell mostly to tourists from temporary, road-side stalls. Tourists are allowed to leave Barbados with up to three shells without a CITES permit. As such there is no record of how many shells leave the island. There are approximately 20 full-time shell vendors in Barbados.

Although the harvesting of conch is small scale, the number of fishers few and the proportion of fishers reporting a decline in abundance of conch is relatively small (36%), the very limited shallow shelf area available in Barbados, the high proportion of immature shells being harvested and the lack of a closed season to protect the breeding stock are issues of concern for the long-term sustainability of this resource.

Keywords: queen conch; *Strombus gigas*; small scale fishery; Barbados; CITES Appendix II species

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1.0 INTRODUCTION

1.1 General biology

The queen conch, *Strombus gigas*, (Mesogastropoda: Strombidae) is restricted to the Wider Caribbean region, from south Florida and Bermuda in the north to northern Brazil in the south (Leal 2002, Valle-Esquivel 2002; Figure 1-1).

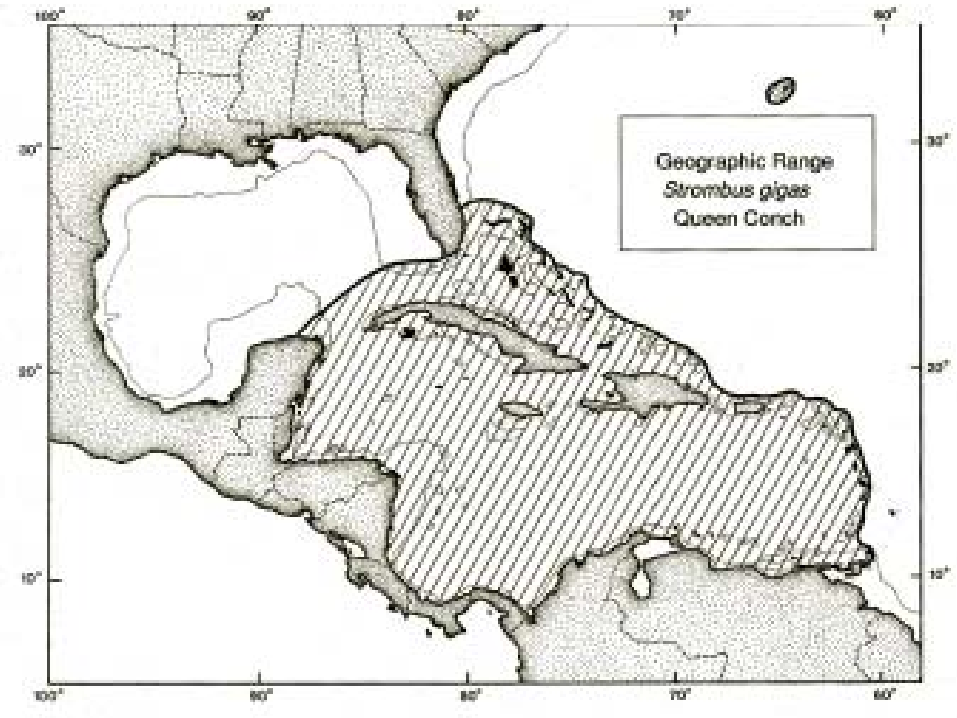

Figure 1.1: Geographic range of queen conch. Source: Bower-Dennis (undated)

It is the largest of six species of true conch found in this region (Abbott and Dance 1982, Theile 2001). The other five species are the Florida fighting conch, *Strombus alatus* Gmelin, the hawk-wing conch *S. raninus* Gmelin, the milk conch *S. costatus* Gmelin, the rooster tail conch *S. gallus* Linnaeus and the West Indian fighting conch *S. pugilis* Linnaeus. Strombids exhibit determinate growth and develop a characteristic flared lip as they mature (Leal 2002).

Strombus gigas is a commercially valuable species with a targeted fishery harvesting thousands of kilograms of conch meat yearly (CITES 2003a). As such this species has been intensively studied (Stoner 1997, Theile 2001).

Juvenile and adult queen conch are benthic, inhabiting meadows of seagrass (primarily *Thalassia testudinum*), adjacent sandy areas, algae-covered hard bottoms and coral rubble (Stoner et al 1992, Stoner and Ray 1993, Stoner and Schwarte 1996, Tewfik, 1996, Stoner 2003). The very small post-settlement juveniles live infaunally in sand flats (Stoner et al 1988), but a change to an epibenthic habit occurs after the first year when juveniles (35-54 mm) move from beneath the sand to seagrass meadows (Stoner et al 1988, Stoner and Sandt 1991, Sandt and Stoner 1993).

Queen conch are generally found in relatively shallow waters between a few centimetres and 30 metres, but they can occur at greater depths (Tewfik 1996, Theile 2001). While juvenile conch are found at the shallower (<10-15 m) depths, adults inhabit a wider depth range and can be found in shallow and deep water (Stoner and Sandt 1992, Stoner and Schwarte 1994, Ray and Stoner 1995, Theile 2001, Stoner 2003). The diet of queen conch includes benthic diatoms, cyanobacteria, sea grass detritus, macroalgae, and particulate organic matter found in sediments (Stoner and Waite 1991, Ray and Stoner 1995).

Reproduction typically occurs between March and November, but in some areas may be year round (Stoner et al 1992). Queen conch larvae spend about 2 to 3 weeks in the plankton after which they begin to settle and metamorphose (Theile 2001, CITES 2003a). The young conch increase in size until the adult shell length is reached and growth in length ceases. Around this time the characteristic flared lip develops and then thickens (Appeldoorn 1988, CFMC/CFRAMP 1999, Theile 2001, Valle-Esquivel 2002). Sexual maturity does not coincide with the onset of lip development, but occurs a few months later, usually within a year, when lip thickness exceeds 4 mm (Appeldoorn 1988, Appeldoorn 1995). Estimates put the age at first reproduction between 3 and 4 years of age (Tewfik 1996) at a shell length of between 18 and 27 cm (Stoner and Lally 1994). Its life span is known to exceed 20-30 years (Appledoorn 1995) for unexploited populations; in Bermuda queen conch have been aged at 40 years (Cascorbi 2004). Queen conch can reach up to 30 cm in shell length and 3.0 kg in weight (CITES 2003a).

1.2 Queen conch fisheries in the wider Caribbean

A comprehensive review of the queen conch fisheries in the Caribbean was prepared by Theile (2001) for TRAFFIC Europe, a joint programme of the World Wide Fund For Nature (WWF) and the World Conservation Union (IUCN) for monitoring trade in wildlife. An updated report was subsequently produced following a second Review of Significant Trade on *Strombus gigas* (CITES 2003a). These reviews provide *inter alia* information on fishing fleets, fishing gear and fishing practices used in the region as well as information on landings, domestic and international trade in conch products. A brief summary of the fishery in the region is provided here and in Table 1-1.

Queen conch has been harvested in the Caribbean since prehistoric times by Amerindian peoples for their meat as well as for their shells, which they fashioned into tools (Wilson, 2001). Subsistence exploitation still continues today, but commercial harvesting of queen conch has increased to the point where *Strombus gigas* is now heavily exploited throughout the Caribbean region due to its status as a luxury item (Tewfik 2002). The increase in conch harvest rates is due to a greater market demand that is driven in part by an increase in human populations in the region, as well as by increased visitor numbers to the Caribbean, as many states in the region have switched from an agriculture-based economy to a tourism-based one (Tewfik 2002). The latter has resulted in an associated rise in queen conch consumption, as a growing number of hotels and restaurants have placed queen conch on the menu to satisfy visitor demands (Theile 2001). The expansion of international markets for conch products due in part to the certification of major conch producers in line with USA and EU food quality standards, as well as to improvements in global transport and communications that has facilitated the easy and safe transport of marine produce over long distances, has also contributed to the increased demand (Theile 2001, Tewfik 2002, Cascorbi 2004).

Table 1.1: Summary of the queen conch fisheries for range states in the Wider Caribbean. (Annual landings and exports are those recorded between 1993- 2001 and 1992-2001 respectively.)

Country	Fishery	Landings (mt)	Exports (mt)	Management Tools include	Comments
Anguilla	Subsistence	N/A	-	-	-
Antigua & Barbuda	Commercial - Small scale. Subsistence only (Barbuda)	35-69	0.5-4	Size (length, lip, weight) restrictions, closed season	-
Aruba	None, harvest prohibited	-	-	-	-
Bahamas	Commercial - Large scale	454-680	89-293	Size (lip) restriction, closed areas, no SCUBA	Illegal harvesting by foreign and recreational fishers
Barbados		N/A		None	
Belize	Commercial – Advanced artisanal	138-263	26-255	Size (length, weight) restrictions, closed season and areas, no SCUBA or hookah	Illegal harvest by fishers from Guatemala, Honduras
Bermuda	None, harvest prohibited	-	<1	-	-
Brazil	No commercial fishery; incidental catch	N/A	<1	-	-
British Virgin Is.	Small scale	4.9-6.2		-	-
Cayman Islands	Small scale	N/A	-	-	-
Columbia	Commercial - Industrial	100-240	64-196	-	-
Costa Rica	None, harvest prohibited	-	-	-	-
Cuba	Commercial - Small scale	20-141	7-40	Quotas, size (lip) restriction, restricted fishing areas (depth limits), closed season	-
Dominica	No formal fishery - Subsistence	N/A	3	Gear restriction, closed season	Restrictions imposed under the precautionary principle
Dominican Republic	Commercial - Artisanal and Industrial	1222-2669	32-552	Closed season	Exports suspended.
Grenada	Commercial - Small scale	26	N/A	Size (length, lip, weight) restrictions, closed season	-
Guadeloupe	Commercial - Moderate	N/A		-	-
Guatemala	Commercial -Small scale	Unknown		None specific to conch	Conch caught in Belizian waters and marketed in Guatemala
Haiti	Commercial – Small scale	55-70	<1-159	Size (lip) restriction, no SCUBA or hookah	Closed since Sept 2003. Export suspension.
Honduras	Commercial – Industrial	450-1328	636-1328	-	?closed. 2003 Export suspension.
Jamaica	Commercial – Artisanal as well as Industrial	1366-3000	19-2000	Quotas, weight restriction, closed season, limited entry	-

Country	Fishery	Landings (mt)	Exports (mt)	Management Tools include	Comments
Martinique	Small scale	27-50	-	-	-
Mexico	Commercial fishery closed in 1985.	42-45	-	Quotas, size and gear restrictions, limited entry	Harvesting continues
Montserrat	Subsistence	0.5-3	-	-	-
Navassa Island, U.S.	Subsistence	N/A	N/A	-	Fishers are Haitian
Netherland Antilles: Bonaire, Curaçao St. Eustatius, St. Maarten, Saba	Subsistence	N/A	61	Quotas, size and gear restrictions, closed areas present in St. Eustatius	-
Nicaragua	Commercial - Small scale	17-65	7-41	Size (length, lip) restrictions	-
Panama	Small scale	5-372	-	No regulations specific to conch, but SCUBA cannot be used to harvest marine resources	-
Puerto Rico, USA	Commercial - Small scale	75-128	0		-
St. Kitts & Nevis	Commercial - Small scale	29-81	2	Size (length, lip, weight) restrictions; provisions for closed season	-
St. Lucia	Commercial - Small scale	20-41	1-15	Size (length, lip, weight) restrictions; provisions for closed season	-
St. Vincent & the Grenadines	Commercial small scale	7-38	<1-13	Size (length, lip, weight) restrictions; provisions for closed season	-
Trinidad & Tobago	Subsistence	Unknown	1-6		-
Turks & Caicos Islands	Commercial Small scale	737-965	9-482	Quotas, size restrictions, gear restrictions, seasonal closures	-
USA (continental)	None, harvest prohibited	-	-	-	-
U.S. Virgin Islands	Small scale	8.9-35		Quotas, size (length, lip) and gear restrictions, closed areas and seasons	-
Venezuela	None, commercial harvest prohibited	-	-	-	Illegal harvesting occurs

Sources: CFMC/CFRAMP 1999, Theile 2001, Tewfik 2002, CITES 2003a, Davis 2003, Miller et al 2003, Rudd 2003, Tewfik & Guzman 2003, Catarci 2004, Huitric 2005, Acosta 2006, Belize Fisheries Department 2006, CFMC 2007, FAO 2007, Smith et al undated

Depending on the size and type of the fishery, a few small boats or large industrial fleets are used, from which fishers harvest conch by free diving or, increasingly, with the use of SCUBA or hookah diving (Chakalall and Cochrane 1997, Theile 2001, CITES 2003a). Processing of the conch may occur at sea, as some fishers extract the conch meat under water or in the boat, but primarily occurs ashore; the degree of processing is dependent on the requirements of the consumers and importers (Theile 2001).

While harvesting of queen conch is prohibited in some range states, e.g., Aruba, Bermuda, Costa Rica, Florida and Venezuela, conch is currently fished commercially in approximately 25 countries and territories throughout the Caribbean (Theile 2001, CITES 2003a). By the 1990s, Chakalall and Cochrane (1997), Theile (2001, 2002) and CITES (2003a) report that the annual harvest of queen conch had reached an estimated 6,000 mt of conch meat, a figure they note, that did not include conch meat obtained through subsistence or illegal fishing. Thus, the queen conch fishery is economically one of the most important fisheries in the Caribbean with an estimated US$ 60 million in revenue being generated during the latter half of the 1990s (Theile 2001, 2002). In some range states the only demersal fishery that exceeds this in economic importance is the spiny lobster fishery (Tewfik 2002). The tonnage of queen conch exported varies among range states. Nations such as Jamaica, Bahamas and the Dominican Republic export large amounts of conch annually to international buyers, others, e.g., Grenada and St. Vincent and the Grenadines, export little, utilizing most of their conch internally (CITES 2003a). In some countries, e.g., Bahamas and the Dominican Republic, domestic use may exceed exports (CITES 2003a). Since the late 1990s total landings of queen conch meat have decreased and most of the queen conch stocks throughout the region are classified as overfished (Stoner and Ray-Culp 2000, Theile 2001, CITES 2003a).

1.3 Management of queen conch in the wider Caribbean

As a result of increased harvesting of queen conch since the 1970s, populations of the species have declined throughout its range (Theile 2001). Concern over the dwindling numbers of queen conch and the continued heavy exploitation of and international trade in this species, led to it being added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1992 (Theile 2001). CITES is an international instrument that seeks to promote sustainable use of wildlife by regulating international trade in animals and plants. As an Appendix II species, monitoring of trade in queen conch is mandatory and Parties to CITES must submit, annually to the CITES Secretariat, data on trade in this commodity. In addition, Range States with a conch fishery, and which are Parties to the Convention, must implement Article IV of the Convention, which includes the requirement that Parties determine that their exploitation of queen conch is sustainable, i.e., make a non-detriment finding. Barbados acceded to CITES in 1992 and enacted CITES legislation (International Trade in Endangered Species of Wild Fauna and Flora Act, 2006-3) in February 2006. Subsequent to its listing in Appendix II, as a result of continued high volumes of trade, the queen conch has been twice the subject of a 'Significant Trade Review' (Theile 2002, CITES 2003a), a process conducted by the Animal Committee of CITES that serves to assess all of the trade that occurs in the queen conch industry.

One outcome of the Appendix II listing has been a push toward sustainable management of conch fisheries in the Caribbean. This has resulted in stock assessment surveys being conducted

in several islands including Jamaica (Tewfik 1992, Appeldoorn 1995), Belize (Appeldoorn & Rolke 1996, Acosta 1996) and Antigua and Barbuda (Tewfik et al 2001).

A regional instrument also aimed at ensuring sustainable use of resources is the Specially Protected Areas and Wildlife (SPAW) protocol of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention). This convention is a legally binding environmental treaty for the Wider Caribbean region (UNEP 2006), and provides the basis for the protection of organisms and the habitat on which they depend for existence. *Strombus gigas* is listed on Annex III of the SPAW Protocol (CEP-UNEP 1997), and as such, signatories (governments) must adopt appropriate measures to ensure its sustainable use (UNEP 2000, UNEP 2006). Barbados acceded to SPAW in 2002.

There are other Caribbean Mechanisms that have relevance to the development of sustainable fishing practices in the region and thus to sustainable exploitation of queen conch. The Organisation of Eastern Caribbean States (OECS) has developed, via its Natural Resource Management Unit, harmonised Fisheries Regulations for the queen conch and other fisheries. These regulations include size restrictions, gear restrictions and closed seasons and areas (Theile 2001). The Caribbean Fisheries Management Council (CFMC) plays an important role in governing queen conch fisheries throughout the region (Theile 2001) as it promotes the acquisition of biological and fishery data from which educated management decisions can be made. To this end, the International Queen Conch Initiative (IQCI) was created by the CFMC to provide a common management strategy for the Caribbean region (Theile 2001). CARICOM, under the CARICOM Fisheries Resource Assessment and Management Programme (CFRAMP) launched the Lobster and Conch Resource Assessment Unit to facilitate the provision of data and information for effective management of queen conch fisheries around the region (Theile 2001). The Caribbean Regional Fisheries Mechanism (CFRM), the successor to CFRAMP, continues to collect data on and monitor the region's conch fisheries (CFRAMP 1996, CFMC/CFRAMP 1999, Haughton 2005, FAO 2007).

Almost all the nations in the Caribbean region have some regulations governing the queen conch fishery, exceptions to this are: Barbados and Trinidad and Tobago, both of which currently have none (Theile 2001, GOB 2004). Regulations include size restrictions, harvest quotas, gear restrictions, closed areas and closed seasons, (Chakalall and Cochrane 1997, Aiken et al 1999, Theile 2001, Luckhurst and Marshalleck 2004, Acosta 2006).

1.4 Queen conch in Barbados

Very little has been reported on the biology of queen conch in Barbados. A study on allelic frequencies in populations of queen conch in the Wider Caribbean (Mitton et al 1989), suggests that by virtue of its position relative to prevailing ocean currents, the population of queen conch in Barbados may be self-sustaining. This lack of information on the queen conch resource in Barbados is acknowledged by the Barbados Fisheries Management Plan 2004 – 2006 (GOB 2004), which notes the need to obtain biological data on the conch fishery for an effective management strategy to be developed.

As with the biology of queen conch, very little is known about the conch fishery in Barbados, although it is perceived to be small-scale and artisanal, with the main market thought to be the tourism industry. Theile (2001), CITES (2003a), GOB (2004) and FAO (2007) report that queen conch are harvested mainly for their shells, which are sold as curios on the local market.

Harvesting is done using small (3-6 m long) open boats known locally as "moses" or larger (6-12 m long) day boats or launches. Fishers predominantly free dive for conch to depths of around 12 m, although SCUBA is also used to harvest deeper conch (GOB 2004). It has also been reported that in Barbados, conch meat is either consumed by the harvesters or sold privately without ever reaching the fish market (Theile 2001, GOB 2004, FAO 2007). The only available estimate of conch landings in Barbados is that made by C. Parker[1] of around 1,300 shells annually (May 2001 TRAFFIC questionnaire), which was subsequently misquoted as 100 shells annually in CITES (2003a).

At present the exploitation of queen conch in Barbadian waters is unregulated, however the Barbados government recognizes the need to properly document and manage its conch fishery. This is evident from the fact that queen conch is included in the Barbados Fisheries Management Plan 2004 – 2006 (GOB 2004). This plan outlines the need to collect information on the distribution and size of existing stocks and on the status and size of the fishery. The plan also calls for the establishment of a co-management arrangement with the conch fishermen.

1.5 Purpose of study

The unregulated harvesting of queen conch in Barbados and the lack of data on the status of the resource means that the relevant authorities do not have the information to manage this resource effectively. Significantly also, this dearth of knowledge made it impossible for Barbados, who acceded to CITES in 1992, to offer a non-detriment finding with regards to the exploitation and export of its queen conch resource. As a result, in 1999 a suspension of imports of queen conch from Barbados was recommended (Theile 2002) and the queen conch in Barbados has been categorised as a "Species of Possible Concern" (CITES 2003b) until the requirements of CITES, regarding the investigation of the exploitation of the Appendix II species *Strombus gigas*, are fulfilled.

The purpose of this study, therefore, is to identify and document the extent and nature of the conch fishery in Barbados. This information should in part fulfil Barbados' commitment to CITES as regards its queen conch resource, and can be used together with a resource assessment, in the development of a sound national management strategy for the queen conch fishery.

[1] Christopher Parker, Fisheries Biologist, Ministry of Agriculture and Rural Development

2.0 METHODOLOGY

Information about conch fishing and marketing in Barbados was collected primarily from fishers and shell vendors between October 2005 and November 2006. Additional biological and catch rate data were collected in July 2007.

2.1 Conch fishing

Conch fishers were located and counted using a snow-ball approach. That is, an initial conch fisher was contacted with assistance from the Fisheries Division, and after that all others were located and/or recorded through referral by other fishers, who often knew them simply by nickname and landing site. Further enquiries at the named landing site were usually successful in determining a fisher's whereabouts or a contact number for him, allowing a subsequent meeting. Details about conch fishing including: the location and description of conch fishing grounds, landing sites, fishing techniques, frequency and length of conch harvesting trips, species of conchs targeted, processing techniques, market prices and observed changes in the abundance of conch over time were sought through formal interview (Appendix 1) and informal exchanges with conch fishers. Formal interviews were conducted at a time and place convenient to the fisher, usually on the beach at the landing site, and took approximately 20-30 minutes to complete. Not all fishers approached were willing to take part in the interview, although the general reaction was very helpful. The former were counted, but no further attempt was made to interview them.

Additional information on conch fishing practices and catch (including harvesting strategy, species composition and catch rate) were collected through observation whilst accompanying fishers on harvesting trips. These trips were conducted using snorkelling gear and/or a boat, depending on the fisher being accompanied.

2.2 Conch marketing

Shell vendors where located simply by visiting all well known tourist areas around the island including beach and craft markets, popular shopping areas, site seeing spots and the road outside the Bridgetown Port. Unlike the conch fishers, they were easy to find since they usually set up their stalls for the entire day. Information on the species sold, the sources of shells, the number and prices of shells on display, and a brief profile of customers was obtained by formal interview (Appendix 2) conducted on site. Interviews were brief, taking approximately 5-8 minutes to complete. If vendors were unwilling to talk or too busy with customers, they were simply recorded and the shells on display were noted.

Information on the sale of meat was obtained largely from fishers as a part of their formal interview (see section 2.1, Appendix 1). Additional information was also sought from Seafood wholesalers/processors. These were contacted via the Barbados phonebook yellow pages and short telephone interviews were conducted with a senior staff member (Appendix 3).

2.3 Biological data

Biological data on harvested queen conch was collected when accompanying fishers on conch fishing trips and from a subsample of shell vendors' stalls. All individuals in the catch or on the vendor's stall were measured for shell length (to the nearest 0.1cm) and lip thickness (to the

nearest 0.1 mm). A measuring tape was used for shell length and callipers for lip thickness, following the method described by Appeldoorn (1988) (Figure 2.1). Whenever possible, the wetweight of whole conch, the weight of conch meat and processed (dressed) meat was also recorded to the nearest 1.0 g using a field balance.

All conchs observed, but not measured, on vendor stalls during interviews, were categorised as either immature (no flared lip), intermediate (thin lip starting to develop a flare) or mature (fully formed flared lip). All measured conchs from fisher catches and vendor stalls were further categorised into one of six size/maturity classes following Appeldoorn (1995). These are defined in Table 2.1 with our own additional criterion of a lip thickness ≥ 2 < 4 mm for subadults.

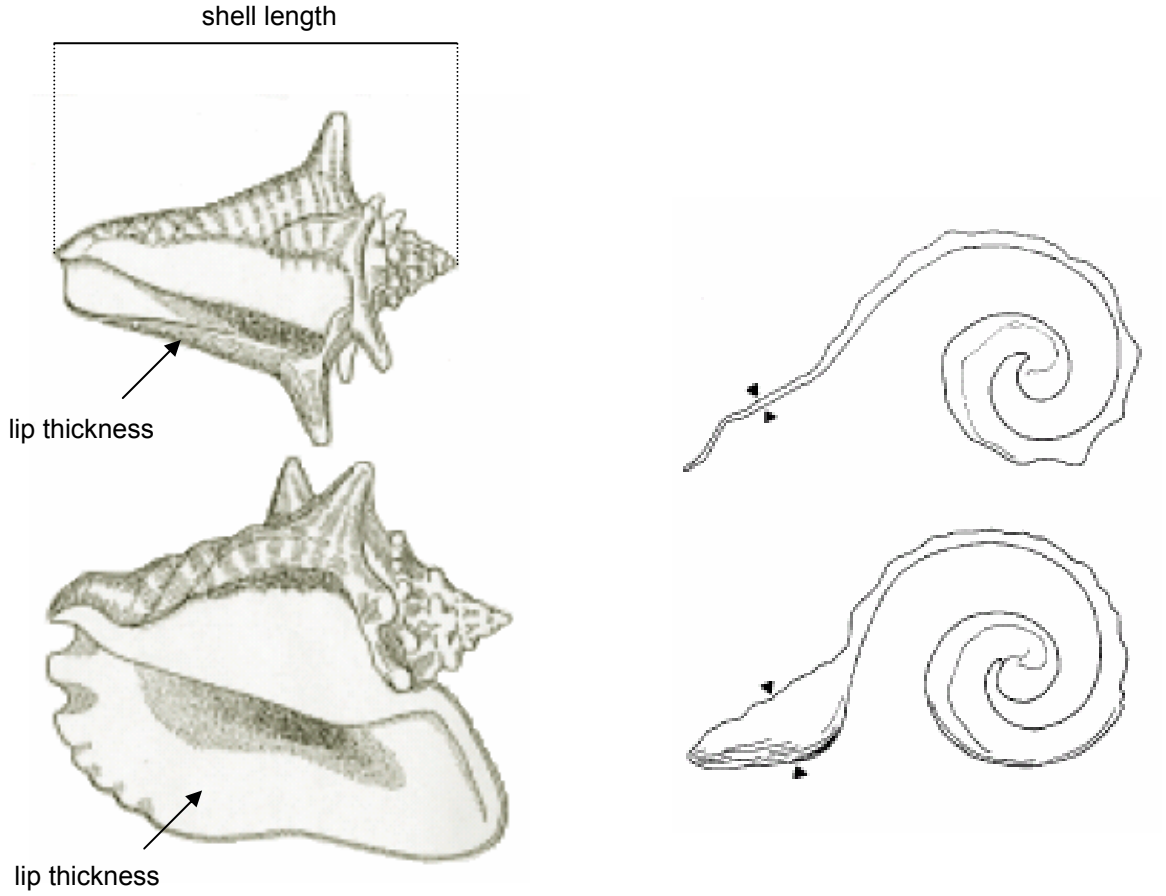

Figure 2.1: Diagrams of queen conch, *Strombus gigas*, showing where size measurements were taken. Diagrams to left are adapted from Berg and Olsen (1989) and show shell length and positions where lip thickness was measured on an immature (top) and a mature (bottom) shell. Diagrams to right are adapted from Appeldoorn (1988) and indicate in cross section where lip thickness was measured (between arrowheads) by calliper on a recently mature (top) and an old adult (bottom) shell.

Table 2.1: Size/maturity categories used for queen conch, *Strombus gigas*, as adapted from Appeldoorn (1995).

Category	Description
Small Juvenile	< 15 cm shell length
Medium Juvenile	15 – 20 cm shell length
Large Juvenile	> 20 cm shell length, but without flared shell lip
Subadult	Flared lip present, but not fully developed (lip thickness ≥ 2 < 4 mm)
Adult	Flared lip is fully formed (lip thickness ≥ 4 mm), minimal to moderate shell erosion
Stoned conch	Shell characterized by significant erosion and heavy fouling, lip thick and worn

2.4 Data handling and analysis

All data were stored in Microsoft Excel 2003 worksheets and subsequently analysed using the cross tabulation and graphic functions. Statistical analysis was handled in SPSS ver. 11.0. Data were categorised according to the source i.e. fisher, vendor or seafood wholesaler. All data were tested for normality and homogeneity of variance before proceeding with parametric analyses. Where data did not fit, non-parametric analysis was performed.

3.0 RESULTS

3.1 Fishery

3.1.1 Fishers

The fisher registration database held at the Barbados Fisheries Division indicates that a total of 186 fishers are involved in conch harvesting. Whilst this may represent the absolute total number of fishers who would harvest a conch if seen, this database is likely to greatly over-estimate fishers who are regularly active, particularly in the minor fisheries, since fishers tend to register themselves for a broad range of fishery types, rather than restrict themselves to their primary fishery (C. Parker, pers. com.[1]). Furthermore, since conch landings are not recorded at any of the fish markets, there is no way of checking the names of fishers actively fishing conch in any given year.

From observation and interviews conducted with fishers, we estimate that there are currently around 49 active conch fishers in Barbados, who frequently take queen conch along with other species on at least some fishing trips (Table 3.1). Twenty five (51%) of these conch fishers were formally interviewed.

Conch fishers are active in 15 fishing communities around the island, with most along the south coast (30 conch fishers), ten from the west coast, five from the north coast and four from the east coast (Table 3.1). The fishing community of Oistins has the largest number of active conch fishers (11 fishers), whilst Sam Lord's and Silver Sands have a further seven and five conch fishers respectively (Table 3.1).

All of the fishers interviewed were male, and all considered themselves to be part-time conch fishers, although they noted that the income they received from conch fishing was an important component of their total annual income. Alternative sources of self-employment included store owner, shell vendor, painter and participation in other fisheries (inshore fisheries and offshore pelagic fisheries), whilst other jobs included employment as a security guard and a clerical officer (Table 3-2). Participating in other fisheries was the most common alternative occupation with 72% of respondents indicating that they spearfished, potfished, harvested seaeggs and 'seacats' (octopus) and/or worked full-time in the flyingfish fishery during the pelagic fishing season (November to June).

3.1.2 Fishing grounds

<u>Location</u>

Conch fishing grounds occur on every coast of the island (Table 3.1, Figure 3.1). Along the semi-windward southwest coast, the majority of conch fishing grounds are in the sand and patch reef areas to landward of the bank reef, whilst a few are distributed in sandy bays. Along the exposed southeast coast there are numerous "shoals" or shallow rubble reef areas inside the bank-barrier reef, around which conch are harvested. In the Sam Lord's / Bottom Bay lagoon area each shoal and adjacent conch ground is known to fishers separately by name (for example

Table 3.1: Estimated number of active conch fishers shown by fishing community. The names, depths and distance from shore of conch fishing grounds, and the landing sites used by conch fishers from each community are also indicated. Data represent summary of information from fisher interviews conducted between November 2005 and October 2006. Locations are shown in Figure 3.1.

Coast	Fishing Community	No. conch fishers	Conch Fishing Ground						Landing Site
			Name	Depth (m)	Shore (m)	Name	Depth (m)	Shore (m)	
North	Crab Hill	3	Animal Flower	11	-	Crab Hill	7-12	-	Crab Hill
	Checker Hall		Jurdines	7-8	900	The Head	7-8	900	
		2	Cluffs	4	-	Harrison Point	18	-	
			Archer's Bay	18-27	900				
West	Half Moon Fort	1	Maycock's	-	-	Bombas	15	-	Half Moon Fort
	Weston	4	Six Men's	3-9	200	Fitts Village	12-15	200	Six Men's
	Paynes Bay	2	Speightstown	7-11	600	Prospect	9-12	200	Weston
	Pile Bay	3	Mullins	9-2	-	Escape Hotel	7-9	-	Paynes Bay
			Gibbs	-	-	Batts Rock	7-9	-	
			Tropicana	12	-	Paradise	5-12	100-200	
			Weston	3	-	Pile Bay	3	600	
			Sandy lane	8-12	200	Brandons	-	-	
			Paynes Bay	7-9	200				
South	St. Lawrence	2	Carlisle Bay	9-12	-	Paragon	-	-	St. Lawrence
	Oistins	11	Kentucky	>30	-	Airport	3	-	Oistins
	Sam Lord's	7	Welcome Inn	>30	-	Penny Hole	7	200-300	Silver Sands
	Silver Sands	5	Welches Gut	9-27	-	The Oven	7-9	-	Foul Bay
	Foul Bay	2	Oistins Caves	7-12	600-700	Foul Bay	7-8	200-600	Sam Lord's Bay
	Crane	3	Heady Ground	18-33	900	Crane	8	200	
			Kendal Point	3-7	100-200	Sam Lord's Bay	7-9	300-1600	
			Silver Sands	3-15	100-200	Bottom Bay	17	900	
			Long Beach	7-12	150-3000	Peat Bay	-	-	
East	Consett Bay	2	Morgan Lewis	12-15	-	Bath	5	-	Consett Bay
	Bath	1	Tent Bay	12	-	Ragged Point	5	-	
	Martin's Bay	1	Martin's Bay	12	-				
All	15	49	47						11

see Table 3-3). Along the sheltered leeward west coast, conch fishing grounds appear to be virtually continuous in the shallow, nearshore areas in the vicinity of the fringing reefs. The exposed north coast has conch fishing grounds that are mostly restricted to small bay areas although there are two deeper offshore areas. Along the windward east coast, conch fishing grounds are restricted to areas inside semi-protected lagoons

Southeast coast conch fishing grounds may be up to 3 km from shore, but most are within 1 km and many within 100-300 m from shore (Table 3.1). On the west coast where the benthic profile is much steeper, the fishing grounds are generally within 200 – 300 m from shore and conch may be taken as close in as 100 m.

Table 3.2: Summary of fisher attributes and harvesting habits as given by interviewed conch fishers.

Fisher group	Coast fished	Other occupation	Harvest season	Harvest frequency	Harvest method			
					Free dive	SCUBA	Boat	Swim
Not year-round (seasonal)	SW,SE	fisher	Jul-Sept	weekly	Y		Y	
	E	fisher	Jun-Oct	weekly	Y		Y	Y
	SE	clerical officer	July-Sept	fortnightly	Y		Y	
	W	Security guard	July-Sept	fortnightly	Y			Y
	SE	shop owner/fisher	Jul-Oct	on request	Y		Y	
	W	fisher	Jul-Sept	on request	Y		Y	
	SW,SE	fisher	Jul-Sept	on request	Y		Y	
	SW	fisher	Jun-Sept	on request	Y		Y	
	SE	fisher	Jul-Sept	by chance	Y		Y	Y
	SE	shop owner/fisher	May-Nov	by chance	Y		Y	
	W	fisher	Jun-Oct	by chance	Y		Y	
	SE	fisher	Jun-Sept	by chance	Y		Y	
	N,SW,SE	fisher	Summer	-		Y	Y	
Not year-round (not seasonal)	N,W,SW	fisher		full moon	Y		Y	
	SW	fisher		full moon		Y	Y	
	SE	fisher		on request	Y		Y	Y
	SE	fisher		on request		Y	Y	
	SW	fisher		on request	Y		Y	
	SE	fisher		by chance	Y			Y
	N	fisher		by chance		Y	Y	
Year-round	SE	painter		weekly	Y		Y	Y
	SE	fisher		weekly	Y		Y	
	W	security guard		weekly	Y	Y	Y	Y
	N	fisher		monthly	Y			Y
	N,W,SE	shell vendor		fortnightly	Y	Y	Y	Y

Table 3.3: Names and depths of shoal areas and adjacent grounds where conch are harvested in Sam Lord's Bay.

Name	Depth (m)	Name	Depth (m)	Name	Depth (m)
Crib Ground	7 - 11	Gate Ground	8 - 11	Long Shoal	6-9
Brother Will	7	Upper Bank	6.5-9	Rockstone Ground	5.5-8.5
Knockdown	6 - 7	Catherine Shoal	unknown	Little Cossey	6-8
Gibb's Ground	10	Black Ground	7	Quarker Shoal	5-7
Hog Style	8 - 12	Broady& Davey	8	Permaiden	7 - 8
John Potter	9	London Edge	8 - 11	The Patches	7

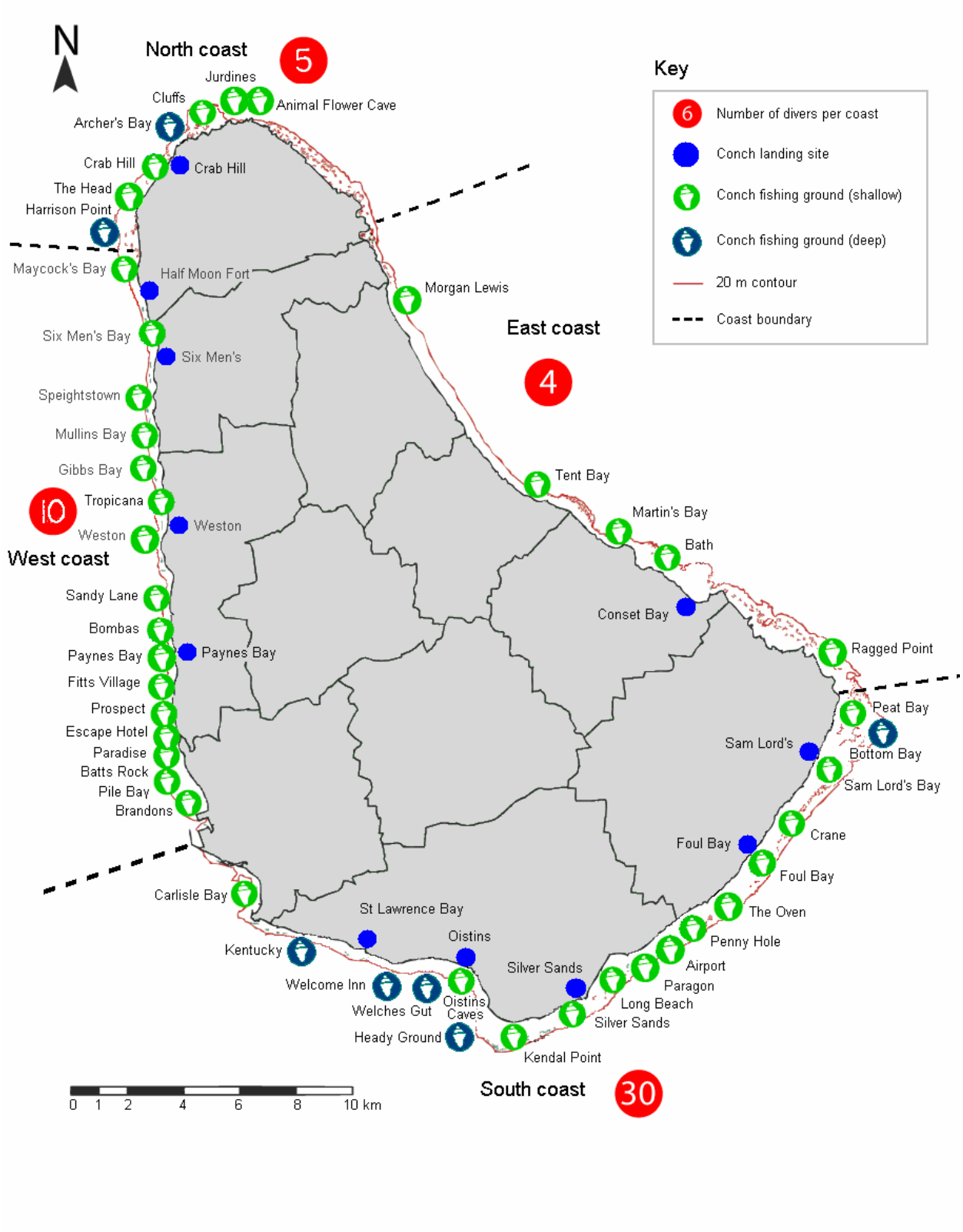

Figure 3.1: Map of Barbados showing conch fishing grounds, landing sites and number of conch divers active on each coast. Deep fishing grounds are > 15 m, requiring SCUBA gear to access them.

In summary, the vast majority of conch fishing grounds around Barbados are shallow (7-12 m), nearshore areas inside (to shoreward of) the outer bank and bank-barrier reefs (Table 3.1, Figure 3-1). These areas are accessible to free divers with small open vessels or by swimming from shore. There are also a few deeper fishing grounds (>15 - 33 m) that require the use of SCUBA. These include: Harrison Point and Archer's Bay in the north, and Kentucky, Welcome Inn, Welches Gut, Heady Ground, and Bottom Bay along the south coast.

Habitat description

Conch fishing grounds appear to cover a variety of habitat types, including sand flats, algal pavement, coral rubble and coral patch reef. South coast fishing grounds include sand flats, patch reef, coral rubble and algal pavement. West coast fishing grounds are typically in areas of sparse patch reef and sand, or coral rubble with macroalgae and sponges in the vicinity of fringing reefs. North coast fishing areas are over algal pavement. East coast fishing grounds include sparse seagrass and coral rubble (e.g. Bath) and coral rubble and brown algal pavement.

The majority of conch harvested during eleven observational fishing trips in Sam Lord's Bay and Pile Bay where from sandy coral rubble areas (41.1 % of conch harvested) and algal pavement (40.6%) with few (18.3 %) coming from bare sand flats. Interviewed fishers unanimously agree that the favoured habitat for conch in Barbados is 'gravel rock and sand', the former term being used to describe coral rubble.

3.1.3 Landing sites

Conch landing sites are found on every coast of the island (Table 3.1., Figure 3.1). Almost all of the fishers interviewed stated that they had a regular landing site, which was generally in their area of origin or the mooring site for their boats. Oistins and Sam Lord's Bay on the south coast are the most active landing sites for conch overall, whilst Weston is the most active landing site for conch on the west coast.

3.1.4 Fishing technique

The majority (84%) of conch fishers interviewed harvest conch by free diving, using mask, snorkel and fins. Some of these (2 of 21 free divers) also use SCUBA gear occasionally to dive conch, but only when going back to harvest a large aggregation of conchs that had been spotted earlier. Four fishers stated that they always use SCUBA and often fish the deeper grounds from 17 – 33 m whilst simultaneously spearfishing (Figure 3.2, Table 3.2).

Most (88%) conch fishers interviewed use a boat at least some of the time to access their conch fishing grounds (Figure 3-2). Three fishers stated that they always swim from shore, whilst a further six sometimes swim and sometimes use a boat (Figure 3.2). A typical conch fishing boat is a small (3.6 – 6 m), open, wood or fibreglass 'moses' or pirogue powered by a single outboard engine (Figure 3.3).

When using a boat, wide areas are generally searched for the presence of conch. For example, in Sam Lord's Bay a typical conch fishing trip will involve searching around several isolated shoals. At each shoal, fishers will leave the boat and search (from the surface) in the vicinity of the boat for any signs of conch (e.g. tracks or exposed shells). If any are located, the fisher will free dive for the conch, bringing them up four at a time and placing them in the nearby boat. The search will continue until the fishers are satisfied that there are no more conchs in that area. The fishers will then return to the boat and move to another shoal. To improve searching efficiency a

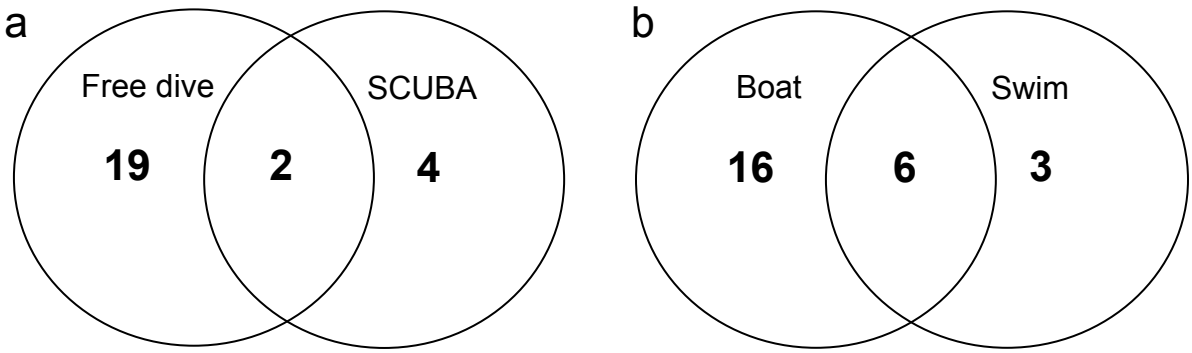

Figure 3.2: Distribution of (a) fishing technique and (b) transportation method among conch fishers in Barbados.

surface diver is often towed behind the boat until he observes conch, or at least an area where conditions appear to be suitable for finding conch. The choice of shoal to be searched on any given fishing trip depends on the sea conditions and vertical visibility. At shoals where there is evidence of recent wave action covering the bottom with fresh sand, or when visibility is poor, the search will be aborted or the shoal left unvisited during that trip. Visibility is a particular constraint for the deeper (10 – 12 m) free diving grounds.

When swimming from shore, fishers carry a mesh bag and tow a surface float. The float serves a double purpose since it alerts boat traffic to the presence of a diver in the water and is also used to suspend the mesh bag so that a fisher can carry a large number of shells and still have his hands free to continue harvesting or using a speargun to catch fish and octopus

Figure 3.3: Typical 'moses' boat used by conch fishers at Sam Lord's Bay

3.1.5 Harvest season and fishing effort

The majority of conch fishers interviewed (20 fishers, 80%) stated that they do not harvest conch year-round. Of these, most (13 fishers) stated that they only harvest conch seasonally, specifically during the summer period (July-October) (Table 3.2). The other seven did not indicate a specific season although several acknowledged that the summer months were the best.

The stated reason for summer seasonal harvesting was that the conch migrate shoreward during the warm water months forming breeding aggregations, and are therefore much easier to find. Several of the interviewed fishers also stated the best time to harvest conch during the 'season' is within one week before and after a full moon, since conch will partially or fully uncover themselves during this period and move about, leaving obvious tracks in the substrate, thus making them easier to spot and harvest.

The frequency of conch fishing trips for summer season fishers varied from once a week (2 fishers), once a fortnight (2 fishers) to *ad hoc* (11 fishers) depending on chance sightings or specific requests from customers (Table 3.2). Likewise, fishers stating that they do not fish for conch year-round but also do not restrict themselves to only harvesting conch during the summer also have an unpredictable frequency. Two fishers only harvest conch around full moon, but not every full moon whilst the others take conch at the request of a customer (3 fishers) or opportunistically during other fishing trips (2 fishers) (Table 3.2).

Five (20%) of the interviewed fishers harvest conch year-round. All had a regular schedule of conch fishing with fishing trips from once a week (3 fishers), once a fortnight (1 fisher), to once a month (1 fisher).

The typical time spent per conch fishing trip (as given in interviews and observed during fishing trips) was 4 - 5 hours, although the time may range from one to more than six hours (Figure 3-4). The number of dive partners used by the conch fishers varied from zero to six, with divers who swam out from shore often harvesting alone or with 1 partner, while those using a boat almost always carried multiple partners with them on harvesting trips.

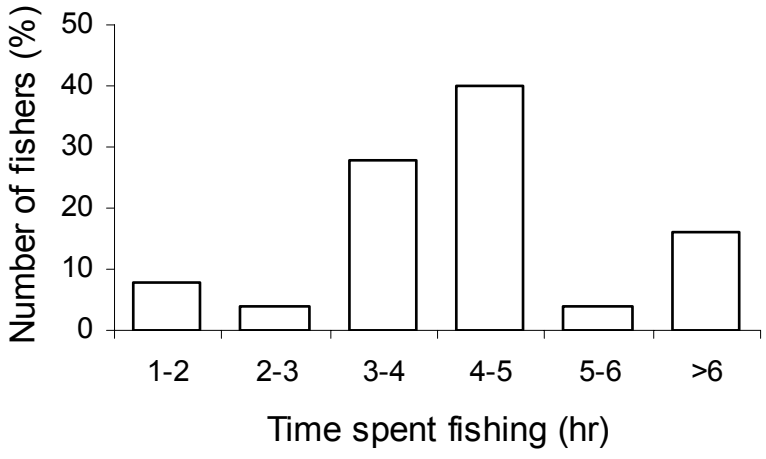

Figure 3.4: Typical length of a conch fishing trip as given by 25 interviewed conch fishers.

3.1.6 Catch

Species composition

The conch fishery in Barbados is not a targeted fishery but an opportunistic, and generally a multi-species fishery. All of the conch fishers interviewed harvested species other than queen conch and confirmed that no fishers in Barbados fish only for conchs. Conch is often not the main reason for the trip unless a large aggregation of conchs was observed earlier and the fishers set out specifically for those conchs. The majority of fishers interviewed stated that they carry their spearguns with them when going on conch harvesting trips, or will take any conch seen while on a spear fishing trip (Figure 3.5). Four of the fishers (three in Sam Lord's Bay and one in Weston) operate fish pots in the same area that they harvest conchs and will actively search for conch while on trips to haul up their fish pots.

Conch fisher catches (comprising 295 conchs in total) were sampled opportunistically at landing sites around the island. Five different species, all of the family Strombidae, were identified in the catches (Figures 3.6, 3.7). Queen conch (*Strombus gigas*) was by far the most common species taken, comprising 88.8% of the sampled gastropod landings, while the West Indian fighting conch (*Strombus pugilis*) accounted for 6.4% of the total and the other three species (milk conch, *S. costatus*; hawkwing conch, *S. raninus*; and roostertail conch, *S. gallus*) together accounted for the remaining 4.7%.

Figure 3.5: Typical free diving conch fishers in action. a - shows conch fisher with speargun picking up two conch from coral rubble ground on the west coast, b – shows conch fisher with speargun displaying his mixed conch, crustacean and reef fish catch on the southeast coast.

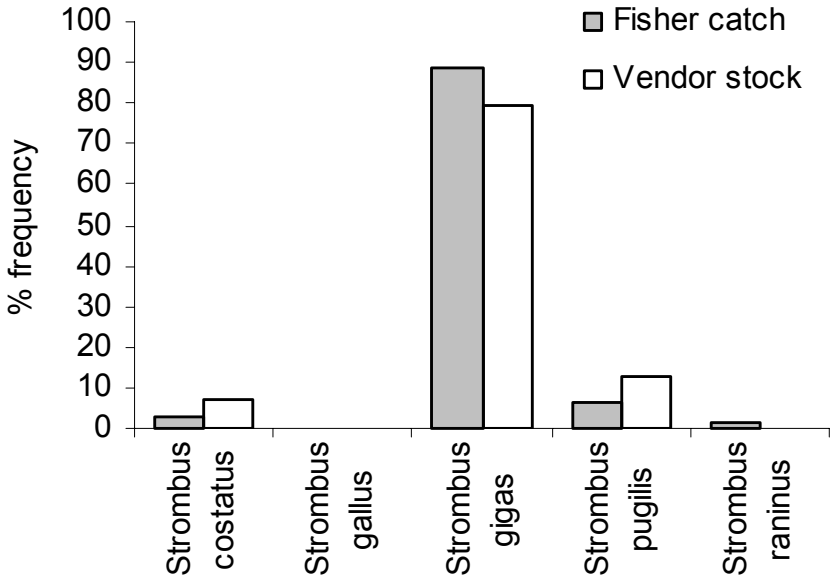

Figure 3-6: Species composition of conch landings and shell vendors' stock around Barbados.

A further 94 strombid specimens, all reported to be from the Barbados fishery, were also sampled opportunistically from shell vendors' stalls. As with the landed catch, queen conch was the dominant species, representing 79.8 % of the conch specimens displayed for sale, and West Indian fighting conch was the second most abundant species (12.8 %). Milk conch accounted for 7.4 % of the vendors' conch stock, whilst the hawkwing and roostertail conchs were not found for sale. However, vendors reported that these species were generally kept by the fishers who landed them, for personal use as curios.

Size structure and maturity status

A total of 337 queen conch sampled opportunistically (262 from fishers, 75 from vendors) were measured for shell length and lip thickness. A further 182 queen conchs were observed on vendor stalls and categorised as mature, intermediate and juvenile. Since the mean size of conch from fishers did not differ significantly from those of vendors (Mann-Whitney U test, for shell length: U = 9150, n =262, 75, P = 0.364; for lip thickness: U = 9592, n = 262, 75, P = 0.754), the samples were pooled to give a representative size-frequency distribution for queen conch harvested in Barbados (Figure 3.8). Harvested queen conch range in size from 5.4 – 31.0 cm shell length and from 0.5 – 23.9 mm in lip thickness (mean shell length: 23.0 cm, mean lip thickness: 4.4 mm). There is a large overlap in shell size between harvested immature and mature conch (the latter being determined by a shell lip thickness ≥ 4 mm). For example, immature conch range in size from 5.4 – 29.5 cm shell length (mean: 22.0 cm) whilst mature conch range from 19.0 – 31.0 cm shell length (mean: 25.6 cm) (Figure 3.8). The majority (70.9%) of queen conch harvested in Barbados appear to be immature. Mature conch, referred to by fishers as 'broad-lips', make up only 28.6% of the sampled fishers' catch (n = 262) and 37.7% of the vendors' stock (n = 257). Considering the size/maturity structure in more detail, the most

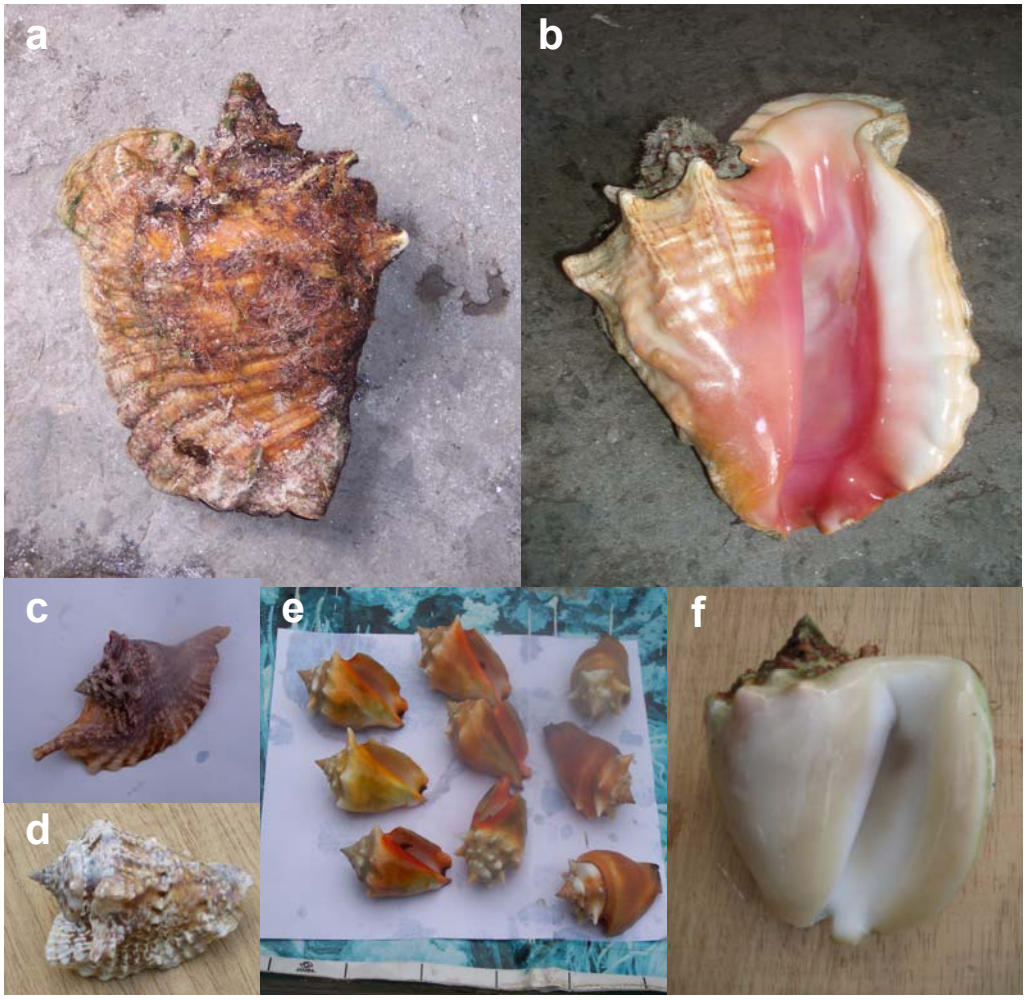

Figure 3.7: Examples of conch harvested in Barbados, showing adult queen conch, *Strombus gigas*, (a) dorsal and (b) ventral surfaces; (c) roostertail conch, *S. gallus*; (d) hawkwing conch, *S. raninus;* (e) West Indian fighting conch, *S. pugilis*; and (f) milk conch, *S. costatus*

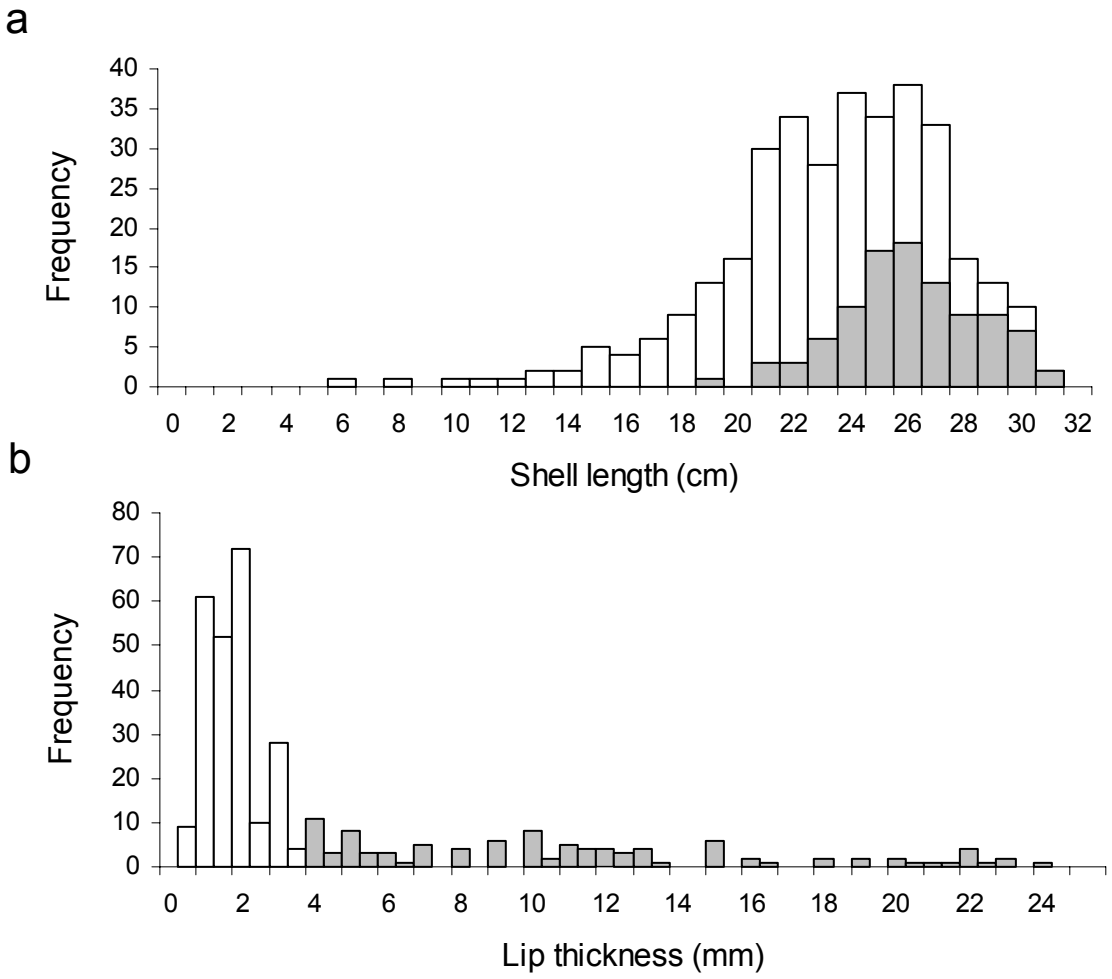

Figure 3.8: Size frequency distribution of queen conch harvested in Barbados (sampled from divers and vendors), shown as (a) shell length and (b) lip thickness. Shaded bars indicate sexually mature conch as determined by a flared lip of ≥ 4 mm thick.

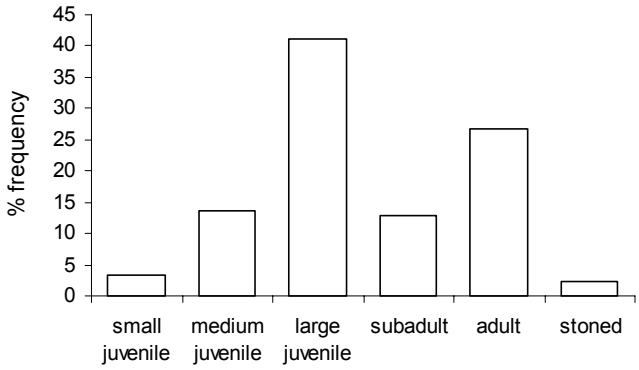

Figure 3.9: Size/maturity class distribution for queen conch harvested in Barbados (sampled from fishers and vendors). Adults > 4 mm lip thickness.

commonly harvested group is that of the large juveniles comprising 41% of all the conchs measured (n = 337) (Figure 3.9). Small and medium juveniles, generally referred to by fishers as 'rollers' or 'round conch' are taken less frequently (comprising 3 and 14 % of the sampled conch respectively). Likewise, subadults recognised by the presence of a newly forming flared lip, also comprise a small portion of the total sample (13%). Some (8.2%) of the sexually mature adults have heavy, eroded shells and are known by fishers as 'old poles'. These are generally referred to in the literature as 'stoned' or 'samba' conch.

A comparison of the size of queen conch landed by fishers on the west and south coasts indicated that there was no significant difference between them (Mann Whitney test: for shell length, U = 4934, n = 216, 46, P = 0.942; for lip thickness, U = 4360, n = 216, 46, P = 0.191) (Figure 3.10). However, there appeared to be a higher proportion of mature conch harvested on the west coast (43.5% of the catch) than the south coast (25.5%).

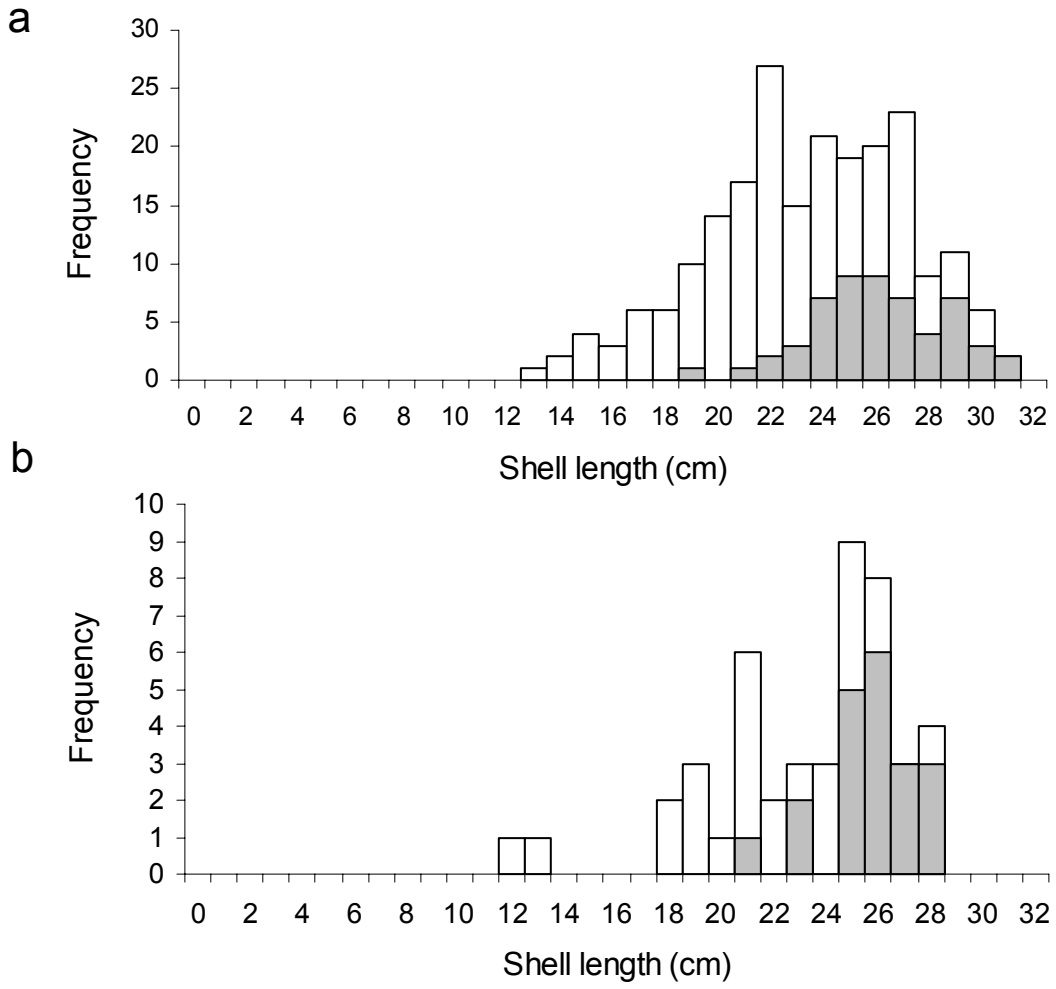

Figure 3.10: Comparison of size-frequency distribution of queen conch harvested from the (a) south and (b) west coasts of Barbados. Shaded bars represent sexually mature conch as determined by a flared lip of ≥ 4 mm thick.

3.1.7 Catch per trip

Based on a relatively small sample size of year-round conch fishers, the average catch rate per trip did not differ between south coast fishers using a boat and 2-4 divers (18.44 conch per trip) and west coast fishers swimming alone from shore (18.25 conch per trip) (Mann Whitney test: U = 16.5, n = 9, 4, P = 0.816; Table 3.4). As such the overall mean catch per fishing trip for conch

fishers in Barbados can be crudely estimated as 18.38 queen conch per trip. This translates to a mean catch rate per fisher per trip of 9.48 conch.

From the limited data available, it would appear that the average catch rate per fisher per trip varies markedly between south coast fishers (mean: 5.6 conch) and west coast fishers (mean: 18.3 conch) (Table 3.4; Mann Whitney test: U = 0.5, n = 9, 4, P = 0.007). However, this is perhaps more a reflection of the fishing operation than a real difference in the harvest success of the fishers, since the south coast fishers share their catch among all fishers present in the boat (which includes both the divers and a non-fishing boat operator), whilst the west coast fisher swims alone and does not share his catch.

Table 3.4: Mean catch rate of queen conch shown as number of conch per trip and number of conch per fisher per trip, overall and separately by coast and trip type.

Date	No. fishers	Trip type	Coast	Fishing ground	Catch rate	
					Conch/trip	Conch/fisher/trip
20-Mar-06	3	Boat	S	Sam Lords	27	9.00
29-Jul-06	4	Boat	S	Sam Lords	15	3.75
05-Aug-06	4	Boat	S	Sam Lords	12	3.00
12-Aug-06	4	Boat	S	Sam Lords	15	3.75
19-Aug-06	4	Boat	S	Sam Lords	8	2.00
11-Oct-06	4	Boat	S	Sam Lords	14	3.50
28-Oct-06	4	Boat	S	Sam Lords	30	7.50
04-Nov-06	4	Boat	S	Sam Lords	19	4.75
14-Jul-07	2	Boat	S	Sam Lords	26	13.00
S coast mean					18.44	5.58
SE					2.52	1.19
6-Mar-06	1	Swim	W	Paradise	14	14.00
13-Mar-06	1	Swim	W	Pile Bay	13	13.00
12-Nov-06	1	Swim	W	Pile Bay	21	21.00
15-Nov-06	1	Swim	W	Pile Bay	25	25.00
W coast mean					18.25	18.25
SE					2.87	2.87
Overall mean					**18.38**	**9.48**
SE					**1.89**	**2.03**

3.1.8 Annual harvest

A very crude, but conservative, estimate of the annual harvest was obtained using the overall observed catch per fisher per trip data, the number of year-round (12 months) and seasonal (4 months) fishers as obtained by interview, and an approximate annual frequency of conch harvesting trips per diver as obtained from interview data modified according to observational data. For example, a fisher who says he is a weekly fisher in actual fact may not fish every week due to bad weather, mechanical problems or other constraints. From observation, weekly fishers appear to fish about 60% of the times they intend to go out. As such a year-round weekly fisher is likely to make around 31 trips a year, whilst a seasonal weekly fisher may make 10 trips. This 60% level of activity was generally applied to all weekly, fortnightly and monthly fishers, whilst *ad hoc* fishers were conservatively estimated to fish once a season or twice a year (Table 3.5).

Table 3.5: Crude, conservative estimate of total annual conch landings in Barbados using the estimated number of conch fishers in each fisher group, the number of trips per year based on a 60% level of stated activity and an overall mean catch rate of 9.48 conchs per fisher per trip.

Fisher group	Harvest frequency	Total trips/yr	% conch fishers	Estimated actual no. conch fishers	Estimated total no. trips/yr	Estimated no. conchs harvested/yr
Not year-round (seasonal)	weekly	10	8	3.9	39.2	372
	fortnightly	5	8	3.9	19.6	186
	monthly	2	0	0.0	0.0	0
	ad hoc	1	36	17.6	17.6	167
Not year-round (not seasonal)	ad hoc	2	28	13.7	27.4	260
Year-round	weekly	31	12	5.9	182.3	1728
	fortnightly	15	4	2.0	29.4	279
	monthly	7	4	2.0	13.7	130
	ad hoc	2	0	0.0	0.0	0
Total		**74**	**100**	**49**	**329.3**	**3121**

The crude, conservative estimate of total landings in Barbados amount to 3,121 conchs a year (Table 3.5). This can be extrapolated (using the mean processed meat weight per conch of 90 g; see Section 3.2.1) to around 281 kg (0.28 mt) of processed conch meat per year. The year-round weekly fishers who represent about 12% of all conch fishers are responsible for the vast majority of the catch (55.4% of the total conchs landed) (Table 3.5). Seasonal weekly fishers land a further 11.9% of the total annual landings. *Ad hoc* fishers (representing 63.9% of all conch fishers), who harvest conchs opportunistically or when requested to do so by customers account for an estimated 13.7% of conch landings (Table 3.5).

It is not inconceivable that every fisher listed in the fisher registration database as a conch harvester (an additional 137 fishers) might take on average at least two shells a year. This would push the annual harvest estimate up by a further 274 conch. Furthermore, if the presumed 60% level of activity is not generally applied, and fishing frequency is taken as given by interviewed fishers, then a further 1,803 conch may be landed. This gives a very crude upper estimate of 5,198 conch harvested annually.

3.1.9 Changes in conch availability

Most (64%) of the fishers interviewed said that they had not noticed any change in the abundance of conch on their fishing grounds. However, 36% of the interviewed fishers did say that there had been a change, noting that there were slightly fewer (6 fishers) or a lot fewer (3 fishers) than there used to be. Perceived declines could not be attributed to any particular coast or fishing ground.

3.2 Post Harvest Sector

3.2.1 Processing catch

All of the conch fishers interviewed stated that they process and sell at least some, if not all, of their conch meat and shells. Most fishers (76%) retain some meat and the occasional shell for personal consumption or to give away. No meat is ever discarded, but shells are sometimes discarded, especially if they are heavily eroded (e.g. old poles).

Typically, if the shell is to be sold, the entire conch is frozen for at least one night. The frozen conch meat can then be extracted without damage to the shell by giving the shell a sharp tap and simply pulling the frozen meat out by the foot. The shell is then left to dry out in a cool shaded area for approximately one week, is then washed with soap and scrubbed to remove any algae, sediment or other epizooytes. After a final buffing, the shell is then ready for sale.

If the shell is to be discarded and only the meat sold, then the meat is extracted live, often while the boat is returning to shore, or on the shore immediately after landing. In this case, the shell is typically smashed completely using a metal rod and the meat removed. Evidence of this method can be seen by the large accumulation of broken conch shells under the Oistins jetty. The fishers noted that broken shells are never dumped on a fishing ground as they believe that this causes live conchs to avoid the area. A few fishers extract live conch meat by knocking a small aperture near the apex of the shell, severing the tissue attachment and pulling the meat out by the foot.

Once the meat is removed it is then processed by cutting off the operculum, head and entrails leaving only the muscular part of the conch. This is then rubbed in sand to remove the mucous covering, washed and sold fresh or frozen for later. From the few samples obtained (n = 11), meat processing appears to reduce the soft body weight by 65% from an average unprocessed meat weight of 247 g per conch to 90 g of useable meat.

3.2.2 Sale of conch meat

Fishers

Fourteen of the interviewed fishers shared information about the sale of meat. The majority (10 fishers) sell their conch meat (mostly queen conch but occasionally milk conch) directly to friends and private customers who regularly request conch. Some (5 fishers) sell to local vendors or agents, one of whom buys for export. A further two fishers provide conchs to a local shop that serves conch "pudding and souse", and directly to a restaurant with a predominantly tourist clientele.

The stated selling price for processed conch meat varies from as low as Bds$7-8/lb (Bds$15.40-17.60/kg) up to Bds$16/lb (Bds$35.2/kg), although the typical price, as stated by the majority of fisher respondents is Bds$10/lb (Bds$22.00/kg).

This could translate to an annual income of Bds$552.42 in meat sales for an average year-round weekly conch fisher (expected to make 31 trips, catch 9 conch per trip, and process 90 g meat per conch).

Seafood wholesalers/processors

Of the16 local seafood wholesalers/processors contacted, seven sell conch meat, with queen conch being the only conch species sold. One other used to deal in conch meat, imported from St Vincent and Belize, but has not bothered since the CITES permit requirements. The conch is generally sourced from overseas, regionally (from Belize and St Vincent) and internationally (from the USA). Four companies import very small amounts (between 100-200 lbs (45.5-90.9 kg) a year) stating that conch is not in high demand in Barbados. One company however brings in around 4,000 lb (1814.4 kg) of conch meat annually. This company along with one other wholesaler also purchases conch meat from local conch fishers to satisfy demand. These companies sell predominantly to the high-end hotels and restaurants and to one local supermarket chain.

3.2.3 Sale of conch shells

Fishers

Typically, shells are sold by the conch fishers to curio/shell vendors who then market the shells to the public. Of 23 fisher respondents, 15 market their shells through vendors, six sell to both vendors and individual customers and two sell only to individuals. According to the fishers, the price obtained for a shell depends on the size and condition and can vary from Bds$2-80, with the lowest price being for small juveniles (<8 cm shell length) sold to a shell vendor, and the highest price for large, richly coloured shells sold directly to a tourist. However, the typical price for an adult shell (a 'broad lip') is Bds$20-25, and for a medium to large juvenile (a 'roller") is Bds$10-15.

Fishers will often stockpile shells until they have perhaps 30 or more, before selling them on to a shell vendor.

Vendors

Shell vendors typically have temporary stalls, often comprising only a table and cloth that they can set up opportunistically along the roadside, particularly in areas frequented by tourists (Figure 3.11). Most have a favoured location and will remain there unless moved on by the law. Some move around to several different locations to coincide with high tourist visitation. A few sell from government beach market booths.

Figure 3.11: A typical shell vendor's stall with a selection of mature and immature conch for sale.

A total of 20 shell vendors were observed during this study, which is believed to represent the majority of shell vendors in Barbados. Of these, 17 were interviewed. There are also a large number of other vendors, particularly beach vendors selling clothes, jewellery and snacks who might sell one or two conch shells along with their primary stock when they get the chance. Shell vendors who sell queen conch, other conch species, helmet shells, whelks and cowries are located at Animal Flower Cave (5 vendors), Cherry Tree Hill/Harrison's Cave (1), Cherry Tree Hill / Speightstown (1), Holetown (1), outside the Bridgetown Port on Princess Alice Highway (1), on Chamberlain Bridge in Bridgetown (2), Accra Beach vendors market (3), St. Lawrence Gap (4) and Bathsheba craft market (2). Interviewed vendors stated that the majority of their customers are tourists, although locals also buy queen conch shells from time to time. All except one stated that they are supplied by local conch fishers with vendors buying from 1 to 5 different fishers. One vendor stated that he bought his shells from a Vincentian source, whilst

there is also anecdotal evidence of conchs occasionally being illegally imported into Barbados for sale (R. Marshall[2] *pers. comm.*).

Shell vendors sell mature adult queen conch for between Bds$30-50, large juveniles/subadults for Bds$20-30 and juveniles for Bds$5-30. Interviewed vendors indicated that queen conch are the most popular and frequently sold shells, and the majority of respondents indicated shell vending was their primary source of income. One vendor noted that they could earn as much as Bds$300 a day during the height of the tourist season.

Although none of the vendors admitted to knowing anything about the CITES regulations for queen conch, the initial reaction of many to being interviewed, was one of suspicion. The reason given was that they assumed data were being collected for the purpose of regulating conch sales. Two vendors did acknowledge that they knew of countries (e.g. Germany) where tourists could not take the shells purchased in Barbados.

[2] Ricardo Marshall, Project Manager. Sewerage and Solid Waste Project Unit, Ministry of Health. Barbados.

4.0 DISCUSSION

4.1 The fishery

The queen conch fishery in Barbados is a small-scale fishery with queen conch often taken as incidental catch when the fishers are targeting other species or harvested to fulfil specific orders from private customers. The nature of the fishery in Barbados then, is similar to that reported by Luckhurst and Marshalleck (2004) in other Eastern Caribbean islands with limited shelf areas such as Montserrat, Dominica and St. Kitts. While this is so, the number of fishers (49) and boats (16 – 22) that are actively involved in the conch fishery in Barbados, is greater than that seen in the fishery in the other islands mentioned, < 10 boats in St. Kitts and St. Lucia and < 10 fishers in Montserrat and Dominica (Luckhurst and Marshalleck 2004). None of the conch fishers in Barbados, nor in the other islands (see Luckhurst and Marshalleck 2004) rely solely on the income generated by their activity in the conch fishery. The techniques used for harvesting conch in Barbados are those seen in artisanal fisheries elsewhere, free diving either from shore or from a small boat, with the occasional use of SCUBA.

The estimated number of queen conch harvested per year in Barbados is somewhere between 3,121 and 5,198 shells, a number far greater than the 1,300 specimens reported previously. From these conch, between 281 and 468 kg (0.28 – 0.47 mt) of processed meat is extracted. This harvest is well below the landings of conch meat reported for 22 range states during the period 1993-2001 (CITES 2003a; Table 1-1). It is also much less than the 5,000 kg harvested in Dominica early in the1990s, a country considered by Theile (2001) and CITES (2003) to have a conch fishery similar to that of Barbados, namely an opportunistic, subsistence fishery for local consumption. Note however that Luckhurst and Marshalleck (2004) considered the conch fishery in Dominica to be a directed fishery albeit with only a few fishers, whilst FAO (2007) reported that currently there is no formal conch fishery in Dominica. The annual conch meat harvest in Barbados appears to be in the range of that taken in Montserrat in 1993 and 1994, 422 kg and 302 kg respectively (Luckhurst and Marshalleck 2004), but lower than the 3000 kg landed in1996 (CITES 2003a). It must be noted though, that neither of these authors had information on the processing grade of the conch meat. It is noteworthy that the fisheries in Dominica, Montserrat, St. Kitts and St. Lucia can realize a much greater harvest, than is seen in Barbados, from fewer fishers. In the present study, an overall mean catch of conch per fishing trip is estimated to be about 18. Luckhurst and Marshalleck (2004) report that in Gros Islet in the north of St. Lucia, a catch of 200 conch per trip was not uncommon, and the most recent national report for St. Lucia indicates catches of 100 – 500 conch per trip (FAO 2007).

To realize their harvest, Barbadian conch fishers exploit almost the entire coastline of the island and not primarily the east coast as reported by Luckhurst and Marshalleck (2004). Most of the harvest sites are on the west and south coasts, and conch is fished on the east coasts at only a few sites inside semi-protected lagoons where conditions allow for diving (Figure 3-1) and then by only 4 fishers. The greatest number (30) of fishers operates on the south coast. Conch are harvested within a depth range of 3 and 33 m, with most of the fishing grounds in shallow water less than 15 m deep, and a few in water 15 to 30 m deep. The narrow area shoreward of the bank reef appears to the main habitat for queen conch in Barbados. This depth range is similar to that in the other islands where conch is fished either in an artisanal or industrial fishery. Tewfik

(1996) reports on an artisanal zone (0 - 10 m) and an industrial zone (10 – 20 m) in Jamaica; Luckhurst and Marshalleck (2004) gives a depth range over which conch is fished of 18 – 27 m in Antigua, Jamaica, Nevis, St. Lucia and St. Vincent and the Grenadines, although CFMC/CFRAMP (1999) notes that commercial fishing in St. Lucia may occur at depths up to 60 m.

The size of the harvest in Barbados may in fact be a result of low stock abundances around the island. GOB (2001) states, "anecdotal evidence suggests that conch populations in Barbados are much smaller than those of neighbouring islands". This may very well prove to be true and could, in part, be explained by an offshore topography with limited suitable habitat for queen conch compared with that of other range states. Barbados has a coastline that is 92 km long and a shelf area of 320 square km, with the 180 m contour on average 1.8 km from shore (GOB 2004). The shallow shelf area (<30 m) where conch would typically be found is very restricted. The total shelf area of Barbados is small compared to shelf areas of other range states, e.g., Grenada – 900 square km; St. Kitts/Nevis – 854 square km (CFMC/CFRAMP 1999); Pedro Bank, Jamaica – 3750 square km (Aiken et al 1999); Caicos Bank, Turks and Caicos Islands – 6,140 square km (Medley 2005). Also, seagrass beds, preferred habitats for juvenile conch (Stoner et al 1988), are not common around the island and the location of Barbados, upstream of most conch populations in the region may limit recruitment to the local population. An assessment of the local conch population should provide definitive information on the size of the resource.

Another factor influencing the size of the fishery may be the lack of demand for conch meat by locals in Barbados. That there is a low demand for conch meat is suggested by the fact that there is no formal market for queen conch meat in Barbados. It is not openly sold at the fish markets around the island (GOB 2004), but instead the meat is generally consumed by the fisher or sold privately to individuals and store owners or at times given away, presumably to family and friends. Also, most conch fishers interviewed have sources of income other than that obtained from conch sales and do not generally target the species unless a specific request for conch is received or when large aggregations of conch are observed when fishing for other species. During this study it was observed that the only places where conch meat was regularly available were the small "rum shops" around the island where pickled conch is sold on Saturdays as a seafood alternative the traditional Barbadian Saturday dish – pudding and souse. Even in these establishments, only small amounts of conch meat are available for sale. Queen conch meat is occasionally available at the larger supermarket chains on the island, but is never a high selling item.

The low demand for conch meat may be historical and may be a consequence of historically low conch populations around the island, but there is no direct evidence at present to support this. Queen conch have been exploited in Barbados since prehistoric times when Ceramic Age peoples (Amerindians) used queen conch for food (Drewett 2002) and to make tools, e.g., the 'Barbados' type conch adze (Drewett 2004). There is little information on the use of queen conch by persons living in Barbados in the 18th and 19th centuries. The fishery in the 1900s presumably operated close to shore. Divers from these times did not possess masks, snorkels and fins, but instead used a viewing box, while searching from a boat, to locate conch. According to present day fishers, the modern Barbadian queen conch fishery is a relatively new one that started in the 1950s. It was from around this time that the first diving masks, made from the inner tubes of truck tyres and glass, were used.

The demand for conch meat may be low, but a conch fisher in Barbados can potentially make more money selling the shells than the conch meat. Fishers interviewed in this study reported an average price of Bds$22.00/kg = US$11/kg for processed conch meat = US$1.00 per conch (mean processed meat weight per conch this study is 90 g, requiring about 11 conch to obtain 1 kg conch meat. In contrast one shell can command a price of Bds$2-80 =US$1-40, depending on the size of the conch and whether it is sold to a vendor or directly to a tourist. Thus, in the Barbadian conch fishery, conch shells appear to be as important a commodity as the conch meat with fishers stating that they sell at least some if not all of their conch meat and shells. Conch meat is never discarded, although shells may be, particularly if they are eroded. In the majority of the other range states, shells are considered a by-product of the queen conch fishery with queen conch being harvested primarily for its meat and the shells often being discarded (Theile 2001). While this is so, artisanal fishers in Dominica create artwork and lamps with conch shells (Luckhurst and Marshalleck 2004) and many other range states trade in shells or shell products locally and internationally. The volume of international trade is variable and can be quite high, for example: 261,262 shells in 1999 from Haiti; 20,093 kg of shell from Honduras in 1996 (Theile 2001).

There are no figures available for imports or exports of conch shell from Barbados. All but one shell vendor in the present study reported that the queen conch shells on sale in their stalls were obtained from local conch fishers. This is contrary to the anecdotal information given for Barbados in FAO (2007) which indicates that conch shells are generally imported by shell vendors. One vendor stated that at the height of the tourist season, as much as Bds$300.00 (US$150.00) could be made in a day from selling conch shells. At the current rates for shells as reported by vendors this income could result from the sale of 6-10 adults, 10-15 large juveniles/subadults, 10-60 juveniles or some combination thereof. Vendors interviewed during this study also stated that the majority of their customers are tourists. As Barbados allows the export of up to three queen conch shells per person without the need for an export permit under the Personal Effects and Household Goods rule, Article VII.3 of CITES, there is no way at present of discovering how many of the approximately 3000 conchs landed annually leave the island.

The majority of fishers harvest conch during the summer months between July and October. This period coincides with the queen conch reproductive period reported in the literature (Stoner et al 1992) and indeed the fishers in Barbados state that the summer months are good for conch fishing because it is at this time the conch move inshore and form aggregations for breeding. These fishers are potentially removing conch from the population before they have reproduced, which can lead to reduced recruitment and contribute to population decline. A number of range states have enacted a closed season in the queen conch fishery (Theile 2001), e.g., in Belize and the U. S. Virgin Islands the closed season extends from July 1 to September 30 (CFMC/CFRAMP 1999).

In the current study, harvested queen conch ranged in shell length from 5.4 – 31 cm and in lip thickness from 0.5 – 23.9 mm; individuals from all size classes, from small juveniles to stoned conch were harvested. There was a large overlap in shell length between mature and immature animals. More than two thirds (71%) of the animals sampled in the study appeared to be immature, with the size class most frequently encountered in the catches examined being the large juveniles. Mature conch made up about a third or less of the vendors' stock or the fishers'

catch. It is not known at this time whether the size distribution of the catch is a reflection of the size distribution of the wild population.

While there was no difference in either mean shell length or mean lip thickness of queen conch landed on the west and south coasts, the harvest on the west coast comprised a greater proportion of mature conch (43.5%) than that on the south coast (25.5%). The data on catch per trip is limited, but suggest that fishers on the south coast reap fewer conch per fisher per trip (5.6) than fishers on the west coast (18.3). Whilst this is partially a result of the south coast fishers sharing the catch among all fishers present in the boat, including the driver, the difference could also indicate differences in the local abundance of conch on south and west coast fishing grounds. This may be indicative of differences in fishing pressure (supported by the observed differences between the coasts in the proportion of mature conch landed) or may indicate differences in the habitat quality. However, sample sizes in the current study are too small to know whether the differences in catch rate are real, and no data are available on habitat quality, nor conch population densities for either coast.

Processing of the catch is done at sea or on return to shore. When meat is the only desired commodity, or when shells are heavily eroded, the shells are generally completely smashed and the meat extracted and cleaned. The final processed meat is similar to the 65% cleaned or 'semi-fillet' grade in the Jamaican processing industry (Theile 2001). The average soft body weight per conch was determined to be 247 g (n=11). This is greater than the weight of unprocessed conch meat per conch (142.5 g) in the Jamaican fishery (Theile 2001), and may be a result of our small sample size. When a shell is to be sold, the entire animal is frozen and the frozen conch meat is later pulled from the shell leaving it intact. This type of processing is possible given the small quantities of conch landed per trip and is a point of difference in the post-harvest treatment of conch in Barbados compared with most other range states.

4.2 Economic contribution and trade

The queen conch fishery is small and the revenue obtained from this fishery will be only a small fraction of the revenue generated by the other fisheries on the island. However, the queen conch fishery provides a seasonal source of income for those involved in other fisheries as the queen conch harvesting season falls during the closed season for the pelagic flyingfish and dolphin fisheries. It also provides intermittent additional income to others such as spear fishers, pot fishers and 'seacat' (octopus) divers. The conch meat landed is consumed largely on the island. Only one agent buys for export, but no indication of the amount exported was given. Vendors also, are reliant on conch shells for their livelihoods.

4.3 Management

There is currently no management of the conch fishery in Barbados. This open access, unregulated fishery has allowed poor fishing practices to continue, such as the indiscriminate harvesting of juveniles and breeding adults. This is likely to have already resulted in population decline, although only 36% of fishers reported a decrease in abundance over the years they have been fishing.

Some of the management issues include:

- What is an effective way of monitoring landings given the opportunistic nature of the harvests and the ad hoc landing system? Conch are often landed at unregistered and

unmonitored landing sites and processed immediately on the shore. This means that reporting of harvest levels would rely almost entirely on voluntary reporting by the fishers. To report all landings would necessitate the use of mobile data collectors, the cost of which would be high.

- Of the restrictions currently employed in the conch fisheries of other range states, which would be most effective for the local fishery? GOB (2004) advocates the use of closed areas and seasons, minimum shell length or lip thickness, a catch quota system and the licensing of conch harvesters and vendors. The use of closed areas or a catch quota system would require much closer monitoring of the fishery than is currently done. A closed season during the breeding period (summer months) would particularly impact on those fishers who currently seek alternative fishing opportunities during the pelagic fishing off-season, which coincides with this period. The compulsory licensing of conch fishers and vendors would assist in monitoring the fishery. The use of a minimum size regulation based on lip thickness would be more sensible than shell length, given the large overlap in shell length between immature and mature conch.
- What measures are needed to inform conch fishers and vendors about the conch species and the regulations governing the fishery? Most fishers appear to have limited knowledge of the biology of the conch. For example, there are currently many fishers who consider juvenile queen conch known locally as 'round conch', large juveniles known as 'box conch' and mature adults know as 'broad lips' to be separate species. To further confuse matters, the local name for the king helmet (*Cassis tuberose*) is 'queen conch'. This name is never used by fishers when referring to *Strombus gigas*. Few appear to be aware of CITES or the implications of conch being an Appendix II species, and are unlikely to be aware of the SPAW protocol.
- What would be the socio-economic impact of suggested regulations on fishers and vendors? The fact that the majority of the current harvest comprises immature conch, means that regulations to restrict harvest to mature conch are likely to have a relatively high economic impact on conch fishers' and shell vendors' livelihoods.

4.4 Conclusion

The conch fishery in Barbados is a small and an informal one with most conch fishers harvesting conch opportunistically when they are encountered on fishing trips targeting finfish and octopus, or when a specific request for conch is made. The fishery is largely unknown to the public in Barbados. The size of the fishery, as estimated by the annual landings of conch determined in this study (0.28 – 0.47 mt), while larger than it was previously thought to be, is substantially smaller than those of the majority of queen conch range states. Harvested conch include a range of sizes from small juveniles to stoned adults. The harvest is usually processed on shore. Both meat and the shells are sold. Although the income derived from the sale of conch products is an important component of the annual income of conch fishers and vendors, its contribution to the gross national product is negligible. The open access nature of the fishery which has resulted in the indiscriminate harvesting of immature conch, and the lack of a closed season to protect breeding adults are of some concern and warrant a further assessment of the status of the conch resource.

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APPENDIX 1

CONCH FISHER SURVEY

Data Collector:……. Date:……

1. Location:……
2. What types pf shellfish do you catch?

   Queen Conch □ Milk Conch □ Helmet Shell □

   Whelks □ Others □……
3. Do you fish for conch year round? Yes □ No □
4. If yes? Weekly □ Fortnightly □ Monthly □
5. If no, At request □ By chance □

   Certain time(s) of the year:……
6. How do you catch conch? Scuba □ Snorkel □ Walking □
7. What do you dive from? Boat □ Shore □ Float □
8. Do you dive: Alone □ Partner(s) □ How many?.....
9. How long do you spend in the sea each trip?

   < 1 hr □ 1-2 hr □ 2-3 hr □ 3-4 hr □ 4-5 hr □ >6 hr □
10. Where do you dive for conch?

Site No.	Location	Depth	Distance offshore	Substrate type			
				sand	rubble	macro algae	seagrass
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

11. Do any other conch divers use your sites? Yes □ No □

12. If yes, which sites and state the number of other divers at each

13. Do you know of any other conch divers at all? Yes □ how many?.....

No □

14. Do you have a landing site? No □ Yes □,

Where?.....

15. Have you noticed a change in the number of conch at the sites? Yes □ No □

16. If Yes, Fewer □ Far fewer □ More □ Far more □

17. Do you process the meat yourself? Yes □ No □ Who?.....

18. What do you do with the meat & shells: sell (S), personal consumption (P), discard (D)?

Conch Type	Meat Use				Shell Use			Comments
	S	P	D		S	P	D	
queen conch								
helmet conch								
milk conch								
whelk								

19. To whom do you sell the shells: individuals (I), vendors (V), stores (St)?

Conch Type	Shell Consumer											Price ($)			Comments
	I				V				St						
	S	M	L		S	M	L		S	M	L	S	M	L	
queen conch															
helmet conch															
milk conch															
whelk															

APPENDIX 2

CONCH VENDOR SURVEY

Data Collector:……. Date:……

20. Location:……

21. What conch items are on sale?

Polished shells □ Jewelry □

Conch trumpets □ Other □…….....

22. Number of shells on sale.

Age	Queen Conch	Helmet Conch	Milk Conch	Fighting Conch	Price
Adult					
Intermediate					
Juvenile					
Total					

23. What species of conch is the most popular?.....

24. What size shell is the most preferred? Small □ Medium □ Large □

25. Were the conch shells/ products made from conch harvested in Barbados?

Yes □ No □

26. If no, Where and how are they obtained?.....

27. How do you obtain the shells? Diver □ Craftsman □ Other □

28. If diver, how many divers do you obtain shells from?.....

29. Who buys the products? In a percentage.

Locals…… Tourists…….....

APPENDIX 3

CONCH WHOLESALE SURVEY

Data Collector:……. Date:……

30. Company:……

31. Does your company purchase conch meat? Yes □ No □

32. If yes, where is it sourced?

Locally □……..

Imported □……

33. Do you sell conch meat to other businesses? Yes □ No □

If yes, Hotels □ Restaurants □ Other □

34. What is the retail and wholesale price of conch?

	Price (BDS$)
Retail	
Wholesale	

35. How much conch meat does your company purchase yearly?.....