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

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Front cover: Top - co-author Jeanel Georges (left) and conch fisher in Tobago (right)
Bottom – conch shells and craft for sale (left) and co-author Robin Ramdeen (right).
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EXECUTIVE SUMMARY

The queen conch, *Strombus gigas*, is a large marine gastropod, endemic to the Wider Caribbean where it supports important large and small scale fisheries across the region. In recent decades, excessive exploitation over much of its range has caused significant declines in conch populations and resulted in queen conch being listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1992, and on Annex III of the 2000 Protocol Concerning Specially Protected Areas and Wildlife (SPAW) of the regional Convention for Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention). As a CITES Appendix II species, monitoring of trade in queen conch is mandatory and member range states with a conch fishery, must ensure that their exploitation of queen conch is not detrimental to the ultimate survival of the species. Although Trinidad & Tobago acceded to CITES in 1984, they have not yet been in a position to report on the status of their queen conch fishery. This resulted in the twin island state being subjected to an export embargo for seven years (1999-2006) and in 2003 being listed as one of the range states where conch is considered a 'Species of Possible Concern'. Furthermore, as an Annex III species under SPAW, signatories must adopt appropriate measures to ensure the sustainable use of queen conch. Trinidad & Tobago acceded to SPAW in 2003 and are thus obligated to implement actions to protect this valuable species. However, they are currently constrained by lack of information on the local conch fishery. This preliminary study will help to address the current deficiency in information by formally describing the fishing and marketing of queen conch in Tobago for the first time. The study also provides the baseline information needed to begin the process of developing a management plan for queen conch in Tobago.

Information on fishing and marketing of queen conch in Tobago was gathered through formal interviews with key informants, fishers, fisher/vendors, shell/craft vendors, seafood retailers and wholesalers, and restaurateurs. This was supplemented through observation and informal conversation whilst accompanying fishers on conch fishing trips or casually interacting with fishers and vendors in their communities over a period of two months (July-August 2009). Additional information on retail and wholesale trade was gathered from visits to local groceries, seafood suppliers and restaurants around the island.

Conch fishing and marketing in Tobago is informal and small scale. Twenty-six fishers were identified as being actively involved in the harvest of conch. A minority of fishers (38%) utilize only free diving to collect conch from shallow waters while the other 62% utilize either SCUBA only or both SCUBA and free dive methods. Fishing grounds are concentrated along the southwest coast although there are a few other fishing grounds in the northeast of Tobago. Fishing grounds range in depth from 1 - 43 m and are generally accessed by small open boats with outboard engines. Most fishers (62.5%) reportedly harvest on a regular basis throughout the year, 25% harvest by chance and/or upon request of a private customer and 12.5% of fishers harvest conch seasonally.

Based on lip thickness, 65% of the conch harvested in Tobago are immature. Shell lengths range from 9.1 – 32.2 cm and lip thickness ranges from 0.3 – 33 mm. Based on interview data the modal reported catch per boat per trip is 36 conch, and from observation of just 12 trips the mean catch was 19 conch per boat per trip (disregarding two trips where conch harvesting was intended but abandoned due to poor conditions).

Both the meat and shells are of commercial importance to fishers. Whilst some fishers retain all of their conch meat for personal consumption, a total of 19 fishers are involved in the sale of conch meat, selling most directly to informal eateries and restaurants (47% of sales) and to private customers (45%) for prices ranging from TT$ 100 – 600[1] per dozen animals (modal price TT$ 300/doz). Conch meat is rarely seen in the official fish markets although it can be purchased from one non-fisher vendor acting as a 'middleman', and from three retail outlets and two wholesale seafood marts that mainly source imported conch via Trinidadian wholesalers. Conch meat is served in six of the island's informal eateries, two restaurants and by one catering delivery service. It can also be purchased as 'souse' from one roadside stall.

Conch are generally landed whole and the meat is then extracted live by knocking a small hole in the shell spire. The meat is further 'cleaned' (trimmed and washed) before sale. The shells are sold in bulk to shell/craft vendors (numbering around 14 persons), who clean them for sale as whole shells to tourists and Trinidadian visitors from road-side stalls and at souvenir shops in the Store Bay beach facility. Shells are sold at prices ranging from TT$ 20 – 150 depending on size and quality. Some shell/craft vendors also work the shells turning them into conch horns and other souvenir ornaments.

There is no management of the conch fishery or regulations pertaining specifically to conch harvesting or sale. There are also no fishery landings or sales records for conch meat or shells in Tobago and there is no commercial export, although shells purchased by tourists presumably leave the island as personal effects. A very crude estimate of the annual harvest, based on interview and observational data, indicates that somewhere between 19,271 and 42,588 conch may be harvested a year, yielding approximately 4.16 - 9.2 mt of uncleaned meat.

Although the Tobago conch fishery is small scale, conch meat has traditionally been popular among locals and remains in high demand. The whole shells are also valuable on the growing tourist market and conch horns have cultural significance. The lack of regulations and landings records for the conch fishery and the disregard for the no-take marine reserve, the anecdotal reports of significant declines in conch abundance and reported low density of conch, together with the high proportion of immature animals being harvested and sold, are cause for concern regarding the sustainable use of the queen conch resource.

Keywords: queen conch; *Strombus gigas*; small scale fishery; Trinidad & Tobago; CITES Appendix II species; SPAW Annex III species.

[1] US$1 = TT$6

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1.0 INTRODUCTION

1.1 General Biology

The queen conch (*Strombus gigas*) has been the subject of many scientific studies and several recent substantive reviews (e.g. Appeldoorn and Rodriguez 1994, Theile 2001, CITES 2003a, FAO 2007, Ehrhardt and Valle-Esquivel 2008), although they have been poorly studied in the southeastern Caribbean. Here we provide a brief summary of the key biological characteristics drawn from this published literature.

The queen conch is indigenous to the Wider Caribbean region, occurring in coastal waters from Bermuda and South Florida, the Gulf of Mexico, throughout the Caribbean to Brazil (Chakalall and Cochrane 1997, Leal 2002). Queen conch is reported to occur in the extended economic zones (EEZs) of 26 states and 13 overseas territories or departments. It is the largest of six species of true conch found in this region and can reach up to 30 cm in shell length and 3.0 kg in weight (Abbott and Dance 1982, Leal 2002).

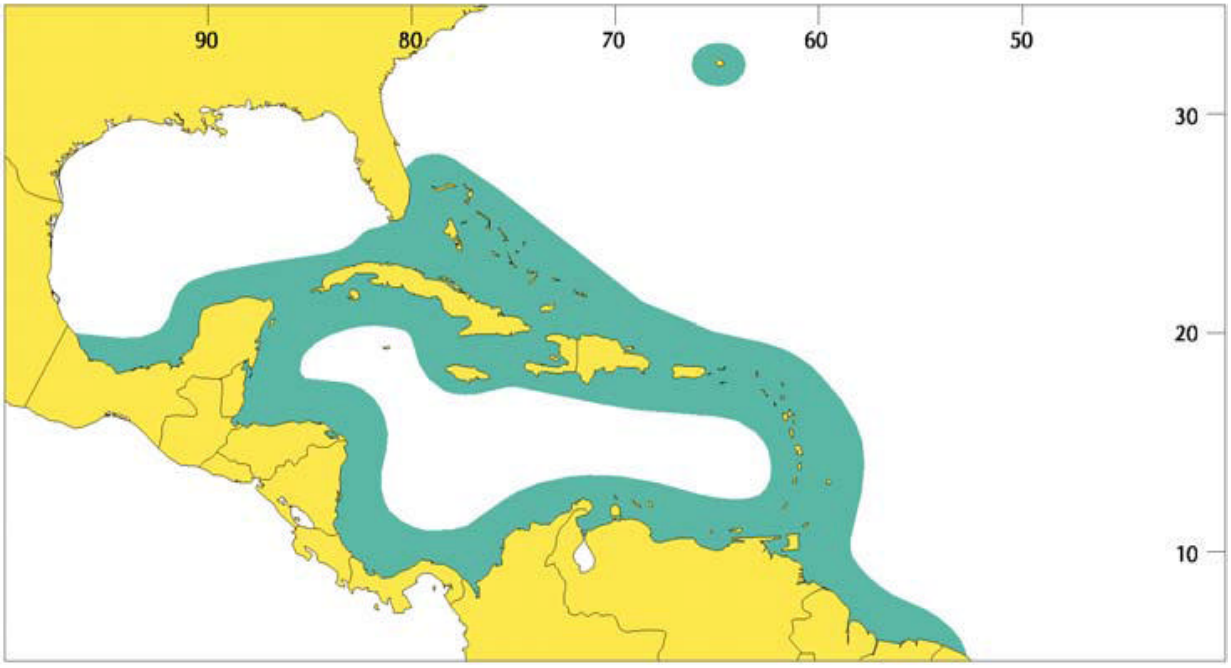

Figure 1.1. Geographic range of the queen conch, *Strombus gigas*. Source: Leal (2002)

Queen conch are benthic as juveniles and adults, and may inhabit a variety of habitats including seagrass meadows, adjacent sandy areas, algae-covered hard bottoms and coral rubble (Tewfik 1996, Leal 2002, Stoner 2003, Glazer and Kidney 2004). Queen conch are generally found in relatively shallow waters from < 1 m down to 30 m, but can occur at greater depths down to 60 m (Randall 1964). The diet of queen conch includes benthic diatoms, cyanobacteria, seagrass detritus, macroalgae, and particulate organic matter found in sediments (Stoner and Waite 1991, Ray and Stoner 1995).

Queen conch are gonochoric (have separate sexes) and fertilization is internal. They typically form spawning aggregations during the warm water months and females lay benthic egg masses containing between 300,000 and 1,500,000 eggs, usually on patches of sand. Eggs hatch after approximately 5 days and the free swimming larvae have an extended (2-3 week) pelagic stage, after which the free swimming veligers settle into the benthos, metamorphose and remain buried for most of their first year (Stoner et al. 1992).

The young conch increase in size until the adult shell length is reached and growth in shell length ceases. Around this time the characteristic flared lip develops and then thickens (Appeldoorn 1988). 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, 1995). Estimates put the age at first reproduction between 3 and 4 years and size at first reproduction between 18 and 27 cm shell length (Stoner and Lally 1994, Tewfik 1996), although the latter is known to be highly variable among habitats (Ehrhardt and Valle-Esquivel 2008). The life span of conch can exceed 20-30 years for unexploited populations (Appledoorn 1995) and has even been recorded in excess of 40 years in Bermuda (Cascorbi 2004).

These life-history characteristics: slow growth and late maturity, a tendency to aggregate, benthic juveniles and adults with low motility, and a preference for shallow-shelf waters makes queen conch highly vulnerable to over-exploitation.

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). An updated report was subsequently produced following consultations during the second review of significant trade in *Strombus gigas* for the Convention on International Trade in Endangered Species of Wild Fauna and Flora (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 description of the conch fisheries in the region, taken from the published literature, is provided here in Table 1-1 and summarised below.

Queen conch has been harvested in the Caribbean since prehistoric times by Amerindian peoples for its meat and shell (Wing 2001). Subsistence exploitation still continues today, but queen conch is a species of high commercial value throughout most of its range, and is considered one of the Caribbean's most valuable fishery resources, with targeted artisanal and industrial fisheries harvesting thousands of kilograms of conch meat yearly from at least 26 of the 39 range States (Theile 2001, Valle-Esquivel 2002, CITES 2003a). 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 improvements in global transport and communications that has facilitated the easy and safe transport of marine produce over long distances, has contributed to the increased demand. Likewise its current status as a luxury food item has seen growing numbers of hotels and restaurants placing queen conch on the menu to satisfy visitor demand (Theile 2001, Tewfik 2002, Cascorbi 2004).

The high demand and vulnerable life history characteristics of queen conch has resulted in severe over-exploitation and damage to the resource in many range States, to the point where the queen conch has become commercially extinct such that conch fishing is no longer economically

viable, or has been closed by management (e.g. Bermuda, Bonaire, Costa Rica, Florida, Saba Bank, Mexico, Venezuela; see Table 1.1) (Appeldoorn and Rodriguez 1994, Theile 2001).

1.3 Management of Queen Conch

The enormous value of queen conch to the region and the significant over-exploitation that has occurred widely across the Caribbean has attracted numerous management interventions over the last two decades including national, regional and international mechanisms (Theile 2005, FAO 2007). These are summarized in brief here.

Queen conch trade is now internationally managed through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It was first listed by CITES in 1985 and subsequently added to Appendix-II of CITES in 1992 as a result of serious concern over the dwindling numbers of queen conch and the continued heavy exploitation of, and international trade in, this species (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, member range States with a conch fishery must implement Article IV of the Convention including the requirement that Parties determine that their exploitation of queen conch is sustainable. 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 countries including: Jamaica (Tewfik 1996, Appeldoorn 1995); Belize (Appeldoorn & Rolke 1996, Acosta 2006); Cayos Cochinos, Honduras (Tewfik et al. 1998); Turks and Caicos (Medley and Ninnes 1999); 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 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 (CEP-UNEP 2006).

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 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. 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.

Table 1.1: Summary of information available on the queen conch fisheries for range states in the Wider Caribbean. Annual export data represent 10-yr means (1999-2008) of annual records in the CITES trade database at: http://www.cites.org/eng/resources/species.html**. Landings and fisher data are from a variety of years (1990s to present), representing the latest known values. '-' indicates data not available.**

Country	Fishery	Fishers	Landings (mt)	Exports (mt)	Management Tools Regulations include	Comments
Anguilla	Subsistence	-	-	0	-	Domestic use
Antigua & Barbuda	Commercial - small scale. Subsistence only (Barbuda)	40	35-74	0	Size (length, lip, weight) restrictions, closed season, closed area	Domestic use and export
Aruba	None	0	0	1	Harvest prohibited	-
Bahamas	Commercial - large scale	-	454-680	162	Size (lip) restriction, closed areas, no SCUBA	Illegal harvesting by foreign & recreational fishers. Domestic use and export
Barbados	Small scale, artisanal	49	0.28-0.47	0	None	Domestic use, not a targeted fishery
Belize	Commercial – medium scale industrial	-	138-263	227	Size (length, weight) restrictions, closed season and areas, no SCUBA or hookah	Illegal harvest by fishers from Guatemala, Honduras
Bermuda	None	0	0	0	Harvesting prohibited	-
Brazil	No commercial fishery; incidental catch	-	-	0	-	-
British Virgin Is.	Small scale	-	4.9-6.2	0	Size (length) restriction, proposed closed season	Some unreported imports
Cayman Islands	Small scale	-	-	0	-	Some unreported imports
Columbia	Commercial - Industrial	-	100-240	85	-	Mainly export
Costa Rica	None	0	0	0	Harvesting prohibited	-
Cuba	Commercial - Small scale		20-141	15	Quotas, size (lip) restriction, restricted fishing areas (depth limits), closed season	Domestic use and export
Dominica	No formal fishery - Subsistence	3-5	-	0	Gear restriction, closed season	Restrictions imposed under the precautionary principle
Dominican Republic	Commercial – small scale and Industrial		1222-2669	243	Size (length) restriction, closed season, closed area,	Domestic and export. Exports currently suspended.
Grenada	Commercial - small scale	90-168	24-26	0	Size (length, lip, weight) restrictions, closed season	Domestic and some unrecorded export
Guadeloupe	Commercial - medium scale	-	-	0	Size (weight) restriction, gear restriction, registered boats only, closed season, closed areas	Major importer
Guatemala	Commercial -small scale	-	-	0	None specific to conch	Poached from Belizian EEZ

Country	Fishery	Fishers	Landings (mt)	Exports (mt)	Management Tools Regulations include	Comments
Haiti	Commercial – small scale	312	55-70	2	Size (lip) restriction, no SCUBA or hookah	Closed since Sept 2003. Export suspension.
Honduras	Commercial – industrial	-	450-1328	552	-	Mainly for export
Jamaica	Commercial – small scale as well as Industrial large scale	-	1366-3000	491	Management based on conch fishery management areas (CFMAs). Industrial fishery has quotas, weight restriction, closed season, closed areas, limited entry	IUU fishing by foreign nationals is a major issue.
Martinique	Small scale	-	27-50	0	Size (length, lip) restrictions, gear restrictions	Major importer
Mexico	Commercial fishery closed in 1985	-	42-45	0	Quotas, size and gear restrictions, limited entry	Harvesting continues for domestic use.
Montserrat	Subsistence	40	0.05-3.5	0		No harvest since 1996
Navassa Island, US	Subsistence	-	-	0	-	Fishers are Haitian
Netherland Antilles: Bonaire, Curaçao St. Eustatius, St. Maarten, Saba	Subsistence Harvesting prohibited in Bonaire and Saba	-	-	0	Quotas, size and gear restrictions, closed areas present in St. Eustatius	Mostly import
Nicaragua	Commercial - small scale	-	17-65	68	Size (length, lip) restrictions	Mainly export
Panama	Small scale	-	5-372	0	No regulations specific to conch, but SCUBA cannot be used to harvest marine resources	Mainly domestic use
Puerto Rico, USA	Commercial - small scale	-	75-128	15		-
St. Kitts & Nevis	Commercial - small scale	20	68	31	Size (length, lip, weight) restrictions; provisions for closed season	Mainly export
St. Lucia	Commercial - small scale	>40	13-41	0	Size (length, lip, weight) restrictions; provisions for closed season, fisher licensing	Domestic and export
St. Vincent & the Grenadines	Commercial - small scale	45-150	11-200	26	Size (length, lip, weight) restrictions; provisions for closed season	Domestic and export
Trinidad & Tobago	Subsistence in Tobago	-	-	0	Unregulated	Domestic use
Turks & Caicos Islands	Commercial Small scale	366	737-965	331	Quotas, size restrictions, gear restrictions, seasonal closures, licensing requirement	Mainly for export. Aquaculture also exports
USA (continental)	None	0	0	0	Harvest prohibited	Major importer
U.S. Virgin Islands	Small scale	-	8.9-35	0	Quotas, size (length, lip) and gear restrictions, closed areas and seasons	-
Venezuela	None	-	0	0	Commercial harvest prohibited	Illegal harvesting occurs

Sources: Acosta 2006, Baldwin 2008, Belize Fisheries Department 2006, Catarci 2004, CFMC 2007, CFMC/CFRAMP 1999, CITES 2003a, Davis 2003, FAO 2007, Horsford 2004, Huitric 2005, Luckhurst & Marshalleck 2004, Miller et al 2003, Oxenford et al 2007, 2008, Rudd 2003, Smith et al 2008, Tewfik & Guzman 2003, Tewfik 2002, Theile 2001, 2005.

The Caribbean Regional Fisheries Mechanism (CFRM), the successor to CFRAMP, continues to collect data on and to monitor the region's conch fisheries, as well as assist in developing management plans and conducting stock assessments at the annual scientific meetings (CFRAMP 1997, CFMC/CFRAMP 1999, Haughton 2005, FAO 2007).

Most nations in the Caribbean region have at least some regulations governing the harvest of queen conch, notable exceptions being Barbados and Trinidad & Tobago (Theile 2001, GOB 2004). Typical regulations for conch fisheries 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; Table 1.1).

1.4 Marketing of Queen Conch

The main product of queen conch is the meat, which is marketed fresh on domestic markets and mostly traded frozen on the international market (Theile 2001). The international conch meat trade is very valuable, the last estimate in the mid 1990s being US$ 60 million annually (Chakalall and Cochrane 1997). Other important products include whole shells, shell carvings and pearls, which are also traded in considerable quantities internationally (Theile 2005, CITES trade database). International queen conch trade is controlled through CITES (see section 1.3). As an Appendix II species, any international trade must be accompanied by export and import permits, issued by the national Scientific/Management Authority of the relevant countries and reported to the CITES Secretariat annually. Based on these reported export and import data, the main conch meat exporting countries over the last decade include Jamaica, Honduras, Turks & Caicos, Dominican Republic, Belize and Bahamas (Figure 1.2, Table 1.2) and the key importers are the USA (including US Caribbean) and France (mostly Martinique and Guadeloupe). Other relatively consistent exporters include Colombia, Nicaragua, St Kitts & Nevis, St Vincent &

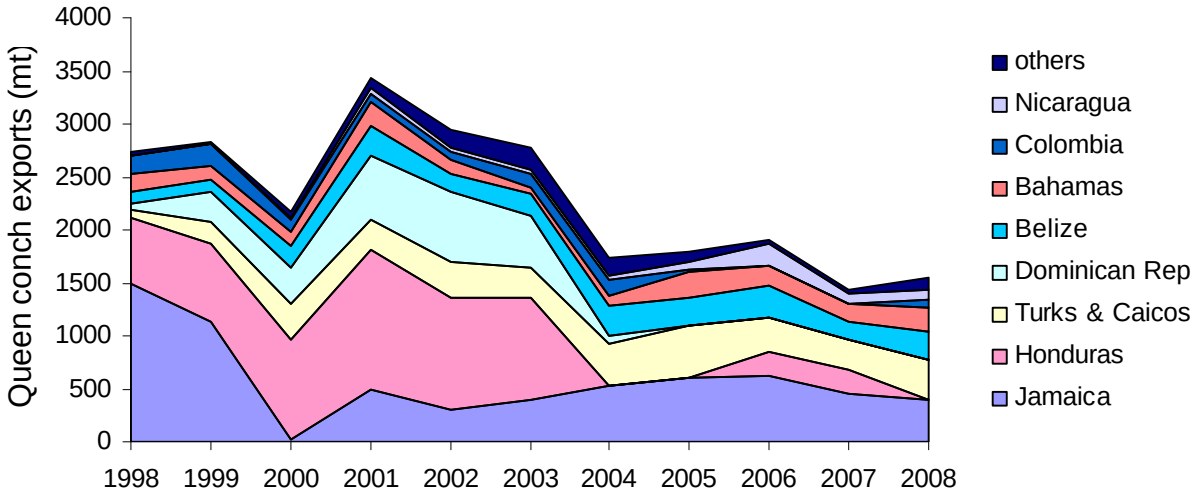

Figure 1.2. Queen conch exports from 1998-2008 shown separately for the major producers. Countries included in 'others' are listed in Table 1.2. Data source: CITES trade database at http://www.cites.org/eng/resources/species.html

Table 1.2. Summary of annual queen conch export data (kg) reported to CITES for the period 1998-2008. Data source: CITES trade database at http://www.cites.org/eng/resources/species.html

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Jamaica	1,497,455	1,125,849	9,712	491,661	305,700	393,226	527,550	595,803	615,452	455,732	391,631
Honduras	611,735	746,854	957,589	1,328,118	1,055,335	973,458	2	0	231,921	225,259	0
Turks & Caicos	81,528	205,382	343,267	279,527	340,181	273,097	401,510	491,197	317,301	279,640	382,088
Dominican Rep	58,640	276,009	338,561	604,102	662,450	483,833	67,807	38	5	8	109
Belize	111,133	111,547	198,358	275,463	169,616	218,147	281,508	272,764	310,642	166,783	264,431
Bahamas	175,940	142,953	129,193	219,787	132,179	62,505	102,642	237,547	183,206	179,822	232,195
Colombia	155,826	196,043	123,816	90,512	79,133	122,301	149,854	29,280	0	0	62,125
Nicaragua	6,750	9,897	19,999	44,371	35,772	45,037	37,626	80,904	207,702	93,009	102,144
St Kitts & Nevis	0	0	0	0	18,491	54,033	46,962	58,894	15,323	12,412	100,825
St Vincent & Grenadines	145	2,274	9,583	6,415	69,207	53,839	110,139	8,439	2,574	1,453	0
USA	34,627	12,743	6,000	46,844	6,803	64,694	0	0	0	12,591	682
Cuba	0	0	9,994	40,000	25,000	15,852	15,328	7,450	19,320	2,960	12,502
El Salvador	0	0	25,909	0	12,927	0	0	1,407	0	0	0
France	0	0	0	0	20,000	0	0	0	0	0	0
Haiti	0	0	541	1,091	7,512	7,737	0	57	44	0	0
Aruba	0	0	0	0	5,805	0	0	0	0	0	0
Venezuela	4,930	0	0	0	0	0	0	0	0	0	0
Guadeloupe	0	0	0	0	0	0	0	0	0	0	2,068
Trinidad & Tobago	0	0	23	1,587	0	0	182	0	0	0	0
St Lucia	0	0	0	0	979	214	0	0	0	0	0
Bermuda	0	836	0	0	0	0	0	0	0	0	0
Cayman Islands	0	0	454	0	0	0	0	0	0	0	0
Antigua & Barbuda	0	0	0	4	0	0	138	33	2	50	9
Virgin Islands (GB)	0	0	5	0	0	0	3	109	0	0	0
Grenada	0	0	0	1	0	0	1	0	11	3	0
Virgin Islands (US)	0	0	0	0	0	0	6	0	0	0	0
Totals	**2,738,709**	**2,830,387**	**2,173,004**	**3,429,483**	**2,947,090**	**2,767,973**	**1,741,258**	**1,783,922**	**1,903,503**	**1,429,722**	**1,550,809**

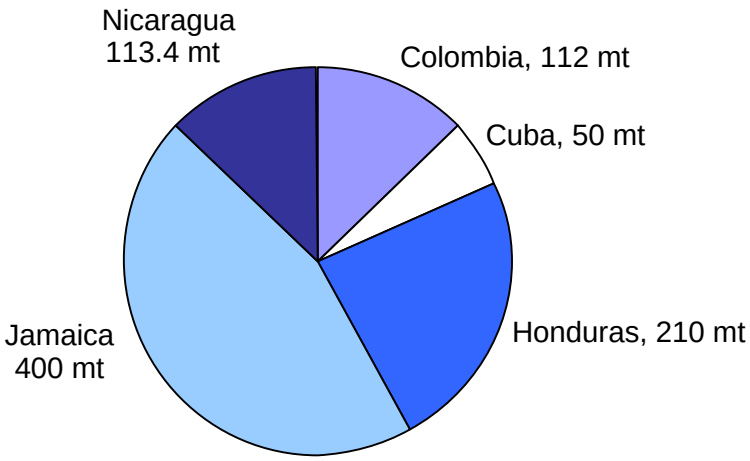

Figure 1.3. Nationally established CITES export quotas for queen conch meat in 2008. Data source: CITES trade database at http://www.cites.org/eng/resources/species.html

the Grenadines and Cuba, whilst many other range states record sporadic exports (Table 1.2). Several countries have been placed under export suspensions by CITES over the last decade and these remain in effect for Haiti and Grenada.

In recent years CITES has adopted the use of nationally established annual export quotas to manage trade. These are usually established by a member State unilaterally, although they can be set by the Conference of the Parties, and must be in line the requirement that the export will not be detrimental to the survival of the species. Countries registering export quotas in 2008 are shown in Figure 1.3.

Domestic consumption of conch meat is not well documented, but is known to be very high in some range states, for example in the US (Florida and Puerto Rico) and French Antilles, Martinique and Guadeloupe, where significant quantities of conch meat are imported to meet demand, and in the Bahamas where Government policy restricts exports.

Conch shells are usually considered a by-product, but nonetheless are an important export in several countries both as whole and worked shells, and an important component of domestic trade in others. The main exporters of conch shells over the last decade, according to the CITES trade database include the Bahamas, Turks & Caicos, Nicaragua and Haiti (until the suspension of exports from the latter). In some countries, such as Barbados, where the fishery is very small, the sale of shells is just as important as the sale of meat to most fishers (Oxenford et al. 2008).

Conch pearls are also a valuable by-product and chiefly exported by Colombia at least until 2005 and more recently by the Bahamas (CITES trade database).

1.5 Queen Conch in Trinidad & Tobago

There has been very little written on the biology of queen conch in Trinidad & Tobago and only a few publications mentioning the conch fishery in the twin island state.

1.5.1 Biology

Percharde (1968) noted that queen conch were 'reasonably common' around the Bocas Islands and along the northwest coast of Trinidad, and were found in most bays in Tobago. He further reported active spawning of a small aggregation of queen conch in Bombshell Bay to the east end of Gaspar Grande Island in June 1968 (Percharde 1970). Lovelace (2002) examined the density and habitat preferences of juvenile and adult conch on the southwestern shelf of Tobago, noting that conch densities were generally very low, that juveniles were most abundant in shallow (< 10 m depth) seagrass habitats and adults were most abundant in deep (20-30 m) algal dominated habitats. Most recently, van Bochove et al (2009a,b) report extremely low densities of conch along the NW Caribbean coast and off Speyside at the northeast end of Tobago, and attribute this to severe overfishing.

1.5.2 Fishery

The main island of Trinidad does not have a queen conch fishery (Luckhurst and Marshalleck 2004), and probably never has supported a productive fishery, due to low salinities and high turbidity associated with the big continental rivers and numerous Trinidadian streams (Percharde 1968). Although shell middens from early Amerindian settlers can be found at a number of prehistoric coastal sites around Trinidad, the conch reported from these (e.g. Fewkes 1914, Saunders 2005) are almost certainly the Caribbean crown conch (*Melongena melongena*)[2]. There remains a small fishery for the crown conch today in the estuarine areas of the west coast (Luckhurst and Marshalleck 2004), and conch (presumably crown conch) are also taken as by-catch in the west coast artisanal shrimp trawl fishery on the Otaheiti and Orange Valley fishing grounds[3]. However, there must have been some harvesting of queen conch in the 1970s, as Brownell and Stevely (1981) report anecdotal evidence that the queen conch reported around the Bocas Islands and northwest tip of Trinidad by Percharde (1968) were 'fished out'.

In contrast, the twin island of Tobago, which is less influenced by continental river effluent, does have a conch fishery which was apparently highly productive in the 1960s and 1970s, although increased demand there and in Trinidad has reportedly led to severe overfishing in recent decades (Percharde 1968, Brownell and Stevely 1981, Lovelace 2002, Luckhurst and Marshalleck 2004, van Bochove et al. 2009a,b). Furthermore, the Buccoo Reef Marine Park, established as a no-take zone, is still regularly fished by some conch fishers (Lovelace 2002).

Tobago does not keep conch landings records, has no register of conch fishers and no estimates of the size of the fishery. However, the twin island state has sporadically reported small exports (up to 1.5 mt; Table 1.2) and occasional imports of conch meat to CITES over the last decade. The most comprehensive documentation specifically on conch fishing in Tobago is a study by Lovelace (2002) in which he collected interview data from a small number of fishers (6) and other stakeholders (3) to describe aspects of the fishery in the vicinity of Buccoo Reef, and provides anecdotal evidence of drastic declines in conch abundance over the previous three decades. There is also mention of the Tobago conch fishery in documentation prepared for the second CITES Review of Significant Trade of *Strombus gigas* in 2001, and subsequent updates (Theile 2001, CITES 2003a, 2006), where it is either described as being largely unknown or as a marginal and artisanal fishery only.

[2] Personal comm.: Dr. Basil Reid , Senior Lecturer in Archaeology, University of the West Indies, St. Augustine, Trinidad.

[3] Personal comm..: Mark Farrell, Trinidad, phone conversation, 31 July, 2009.

1.5.3 International Standing

Although Trinidad & Tobago acceded to CITES in 1984, they have not yet enacted CITES legislation, nor been in a position to report on the status of their queen conch fishery. As a result Trinidad & Tobago were one of just five range states to be placed under a trade suspension in 1999 for failing to provide a satisfactory response to requests from the CITES secretariat (CITES 2006). Trinidad & Tobago were further labelled with 12 other states in 2003 as a country where conch is a species of "possible concern" (CITES 2003b). Despite several re-considerations, this label and the trade ban remained until May 2006 when Trinidad & Tobago, together with all other range states, except Grenada and Haiti, were removed from the Review of Significant Trade process after attendance and submissions to a special workshop (Workshop on the Implementation by 16 Range States of Recommendations Formulated in the Context of the CITES Review of Significant Trade in *Strombus gigas*), held in the Dominican Republic in December 2005 (CITES 2006).

Trinidad & Tobago acceded to SPAW in 2003 and are thus obligated to implement actions to protect this valuable species. However, the twin island state is currently constrained by lack of information on the local conch fishery and its conservation and management has remained low priority. Trinidad & Tobago did not attend the 1999 CFMC/CFRAMP 'Queen Conch Stock Assessment and Management Workshop' and, although they were represented at the 2006 FAO 'Regional Workshop on the Monitoring and Management of Queen Conch', no national report was presented and no draft national management plan for conch was attempted (FAO 2007).

1.6 Purpose of Study

The unregulated and unmonitored harvesting of queen conch in Tobago 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. This dearth of knowledge has made it impossible for Trinidad & Tobago, who acceded to CITES in 1984, to offer a non-detriment finding with regards to the exploitation and export of its queen conch resource. Furthermore, although acceding to the SPAW protocol of the regional Cartagena Convention in 2003, Trinidad & Tobago is also unable to fulfil its obligations with regard to protecting queen conch.

Without active management, the islands' valuable queen conch resource is highly likely to be severely depleted, and the local conch fishery and post-harvest sector collapse, as has already been witnessed in many other territories across the wider Caribbean including the continental USA, Puerto Rico, Venezuela, Mexico, Bermuda, Cuba and Costa Rica (Theile 2001).

The purpose of this study is to document the extent and nature of the conch fishery and marketing structure in Tobago, including the number of active conch fishers and vendors, their average catches and sales, the main fishing grounds, fishing practices, seasonal patterns in harvest and the size/age structure of the landings. The data collected will facilitate the development of a national management plan by providing a basis for informed management decisions and the selection of appropriate management tools to ensure a sustainable queen conch resource is maintained into the future. Furthermore, identification of the key stakeholders (fishers and vendors) will enable their engagement in co-management of the fishery, protection of their livelihood and incorporation of traditional knowledge into education and awareness programmes. It is anticipated that this study will also provide the information necessary for Trinidad & Tobago to begin fulfilling its commitments to CITES and the SPAW Protocol.

2.0 METHODOLOGY

2.1 Field Interviews and Observations

2.1.1 Conch Fishing

Information about the fishery was gathered from conch fishers throughout Tobago during July and August 2009 by formal structured interviews (Appendix I). These questionnaires were developed in consultation with the Tobago House of Assembly's Department of Marine Resources and Fisheries (THA/DMRF) and field tested with two key informants to improve the relevance of the questions to the local setting. The questionnaires were supplemented by observation and informal conversation whilst interacting with fishers at their landing/vending sites and whilst accompanying fishers on conch harvesting trips whenever possible. Additional, historic anecdotal information was gained from informal interviews with retired conch fishers and long-standing DMRF personnel.

Potential conch fishers were identified through names provided by the DMRF and the Buccoo Reef Trust. Subsequently most of the conch fishers were identified via referrals from other conch fishers, shell vendors and food kiosk operators. A few other fishers were identified by scoping all of the fishing villages along the northwest and southeast coasts of Tobago.

The fisher questionnaire sought information on the conch fishery including: the number of active fishers, 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, catch rates, sales and observed changes in the abundance of conch over time. Interviews were conducted in person and via telephone in a few instances where additional information or clarification was needed. Data collected by questionnaire were verified by accompanying fishers on trips when convenient and at a stakeholder workshop held near the end of the study period.

Benthic habitats on the conch fishing grounds were observed and noted whilst accompanying fishers, using a mask and snorkel, and precise locations of fishing grounds were obtained using a hand held GPS.

2.1.2 Conch Marketing

As with the conch fishery, most information about the processing and marketing of conch was gathered from conch fisher/vendors and shell/craft vendors throughout Tobago during July and August 2009 by formal structured interviews (Appendix II). Again, the questionnaire was developed in consultation with the THA/DMRF and field tested before use. The questionnaire was supplemented by observation and informal conversation whilst interacting with fishers at their landing/vending sites, and with vendors at their market stalls. Additional information was sought from one non-fisher meat vendor, seafood retailers, wholesalers and restaurateurs through a short questionnaire administered at their places of business and/or by telephone (Appendix III).

Conch fisher/vendors were located as described in section 2.1.1. Shell/craft vendors where located simply by visiting all well known tourist areas around the island including popular beaches, souvenir shopping areas and well-known site seeing spots. Unlike the fisher/vendors,

they were relatively easy to find as they operate out of permanent or temporary souvenir stands at fixed locations.

The vendor questionnaire gathered information on processing and distribution of conch meat and shells for sale, shell species, source of shells, prices, sales volume, customers, seasonal patterns and basic socio-economic information including age, sex, education level and livelihood dependence (Appendix II).

The wholesaler/retailer questionnaire was short and just sought information on the sources of conch meat, business to business sales, retail and wholesale prices and quantity traded (Appendix III).

2.2 Biological Measurements

Biological data were collected from fishers during fishing trips and from shell vendor stocks and recorded on standard data collection forms (Appendix IV). When possible the gender, total mass of the whole conch (shell and meat), wet-mass (mass of unprocessed meat) and the mass of processed meat were recorded to the nearest 10.0 g and 1.0 g respectively, using a spring balance. The shell length (from the tip of shell spire to the extremity of the opposite end) was measured to the nearest 0.1 cm using a tape measure and lip thickness was measured to the nearest 0.1 mm using vernier callipers (Figure 2.1).

For the purpose of this study a minimum lip thickness of 4 mm was used to classify adults. Measured conch were further categorised into one of six size/maturity classes following Appeldoorn (1995). These are defined in Table 2.1 with an additional criterion of a lip thickness = 2 < 4 mm for subadults following Oxenford et al. (2007). All conch which were 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). The gender of live specimens was noted whenever possible.

Table 2.1. Size/maturity categories used for queen conch, *Strombus gigas*, as adapted from Appeldoorn (1995). Sourced from Oxenford et al. (2007).

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

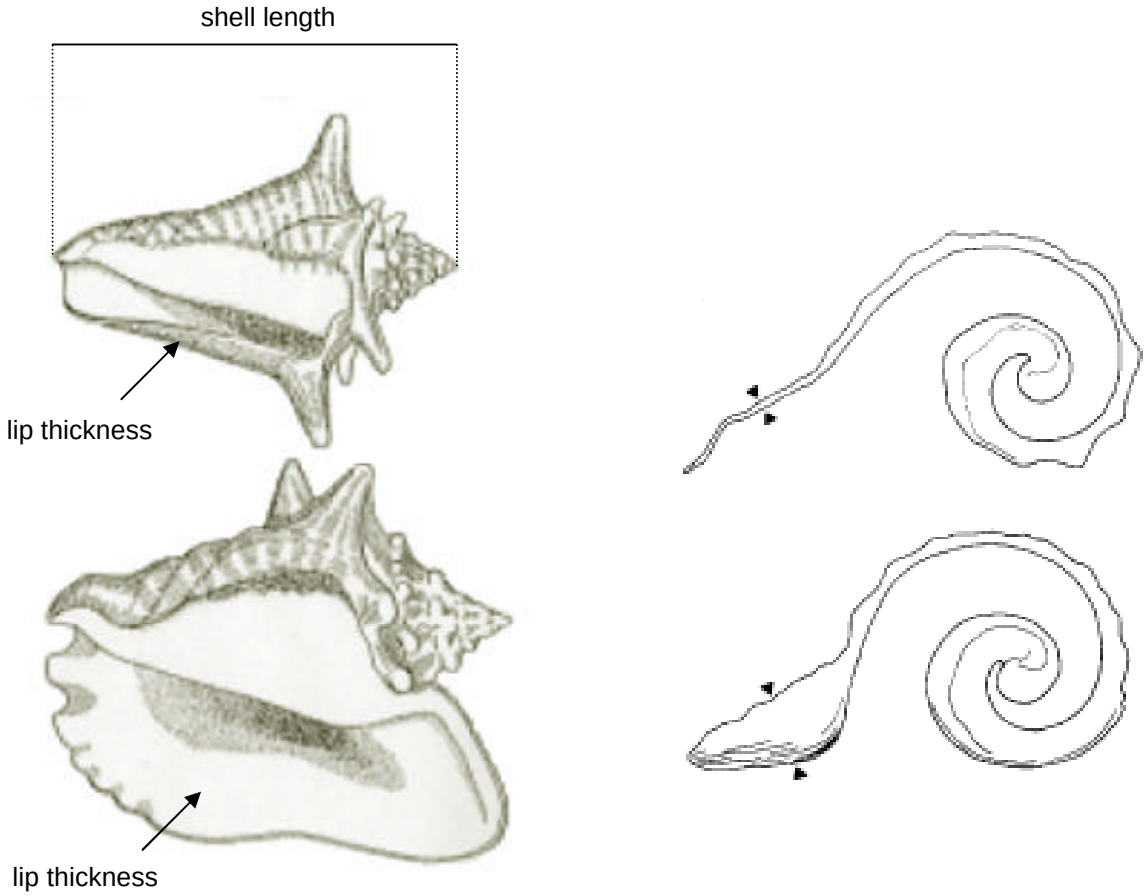

Figure 2.1. Diagrams of queen conch, *Strombus gigas,* showing where size measurements were taken. Diagrams to left are adapted from Berg and Olsen (1989) and show shell length and positions where lip thickness was measured on an immature (top) and a mature (bottom) shell. Diagrams to right are adapted 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.

3.0 RESULTS

3.1 Harvest Sector

3.1.1 Fishers

A total of 26 active, regular conch fishers were identified of whom 24 were formally interviewed. However, the upper estimate of the number of fishers actually harvesting conch remains uncertain since a few fishers allege that there are many more individuals who harvest conch at least in an *ad hoc* manner. Informal conversations also revealed that recreational SCUBA divers who may happen across aggregations of spawning conch may also take the opportunity to harvest them.

The 24 conch fishers interviewed here live in 10 communities, most of which are located in the southwest of Tobago (Table 3.1, Figure 3.1). Most conch fishers (32%) reside in Buccoo village. Other communities with more than one conch fisher include Pigeon Point, Store Bay and Lambeau in SW Tobago and Speyside in NE Tobago (Table 3.1, Figure 3.1).

All but one of the conch harvesters interviewed were male. The majority of individuals fish only part-time and are otherwise employed in a variety of occupations including: construction workers; government workers; tour guides; dive shop operators; and park rangers *inter alia* (Table 3.2). None of the fishers target only conch, but also engage in spearfishing, pot-fishing, line-fishing and 'bank' fishing.

3.1.2 Fishing Grounds

A total of 38 locally named conch fishing grounds were recorded, most of which occur off the southwestern end of Tobago, particularly in the vicinity of Buccoo and some even within the Buccoo Reef Marine Park, a designated no-take area (Table 3.1, Figures 3.1, 3.2). The fishing grounds are split fairly evenly between the leeward northwest coast (Caribbean side) and the windward southeast coast (Atlantic side). Drew Shallows, Emerald Shoals (off NE Trinidad), the Sisters and Divers Dream are all popular recreational dive sites from which conch are harvested.

Fishing grounds range from as shallow as 0.9 m to as deep as 43 m and are located from as near as 400 m to more than 9 km from landing sites and even as far as 45 km offshore in the case of Emerald Shoals.

Conch are harvested from a variety of habitats, but primarily coral rubble and sand, while a few fishers reported that they find conch in seagrass beds and algal flats.

3.1.3 Landing Sites

Eight fishers (42%) do not have a specific landing site for processing their catch. Most of the fishers from Buccoo utilize the Buccoo Point Fishery Complex. The other landing sites are generally the beaches from which the fisher departs. One fisher lands conch at his roadside stall in Mt. Irvine, where he sells conch, lobster and finfish.

Table 3.1. Number of active conch fishers, and names of conch grounds utilized by fishing communities including their approximate depth and distance from shore as reported by interviewed fishers in Tobago.

Fishing community	No. fishers	Conch grounds	Reported depth (ft)	Reported depth converted (m)	Reported distance from shore/landing (mi)
Buccoo	8	Anchor Pass	12	4	1
		Battery	60	18	2
		Big Roller	65	20	2-3
		Buccoo	5-10	2-3	>1
		Bu'n Ground	25-30	8-9	1.5
		Canoe Bay	15-45	5-19	>1
		Cap'n Door	15	4.6	1
		Divers Dream	60-100	18-31	>1
		The Shallows	35-45	11-14	5-6
		Kilgwyn	23-70	7-21	3
		Kings Bay	60	18	-
		Lambeau	35-45	11-19	2
		Long Reef	5-10	2-3	-
		Parlatuvier	40	12	-
		Red Rock	30	9	-
		Scarborough	30	9	0.25
		Sisters	50	15	1.5
		White Hole	5	2	1
Lambeau	2	Bulldog Shoals	8	2	-
		Canoe Bay	15-45	5-19	1
		Charlotteville	90-100	27-30	-
		Crown Point	-	-	-
		Diver's Dream	40-45	12-18	3
		Red Reef	30	9	-
		Red Rock	20	6	-
Lowlands	1	Charlotteville/Speyside	80	24	-
		The Shallows	40-60	12-18	-
		Emerald Shoals	40-60	12-18	
Mt Irvine	1	Coral Gardens	10-15	3-4	1-2
		Marianne	4-15	1-5	>1
Pigeon Point	3	The Shallows	35-40	11-12	2
		Majeston	30-60	9-18	2
		Pigeon Point	4-6	1-2	0.5
		South Tobago	35-45	9-19	2
Prospect	1	Kilgwyn	50	15	1-2
		Red Rock	35	11	-
		Sisters	40	12	-
Roxborough	1	Roxborough	20-25	2-8	0.5
		Speyside	120	37	2
Store Bay	3	Atlantic	5-20	2-6	1-2
		Coral Gardens	18-19	5-6	-
		Nylon Pool	3-4	1	-
		Store Bay	20-30	6-9	2
Speyside	3	Little Tobago	60-140	18-43	-
		St Giles	80-140	24-43	6
Whim	1	Drew Shallows	60	18	5
		Emerald Shoals	50-70	15-21	-

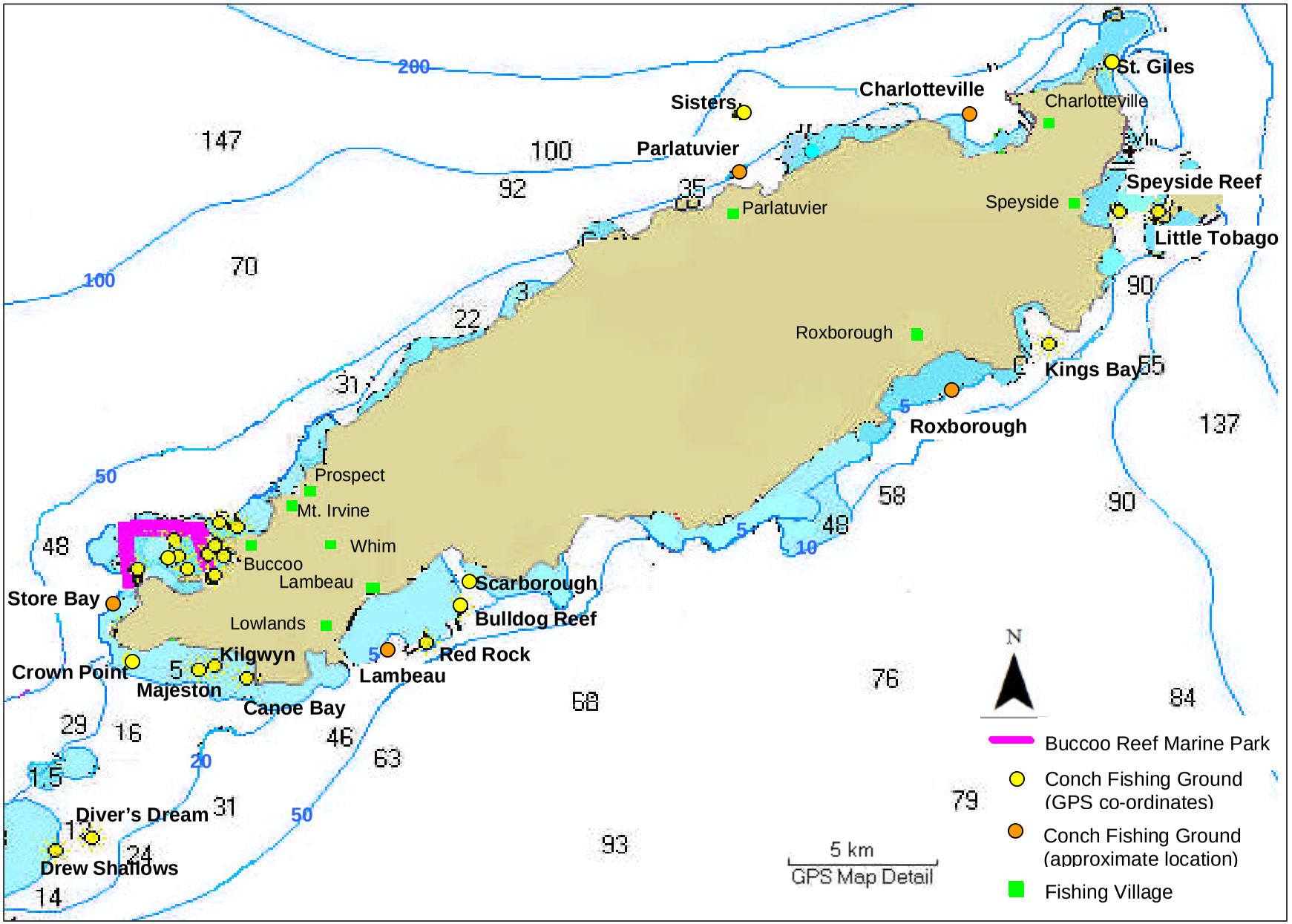

Figure 3.1. Map of Tobago showing fishing communities with active conch fishers and locations of most conch fishing grounds. Map created by author, extracted and adapted from MapSource Blue Chart Americas v. 8.0 © Garmin Ltd. 1995-2005; GPS locations for named fishing grounds were provided by the Buccoo Reef Trust and/or collected by author. Depths (black) and contours (blue) shown in metres.

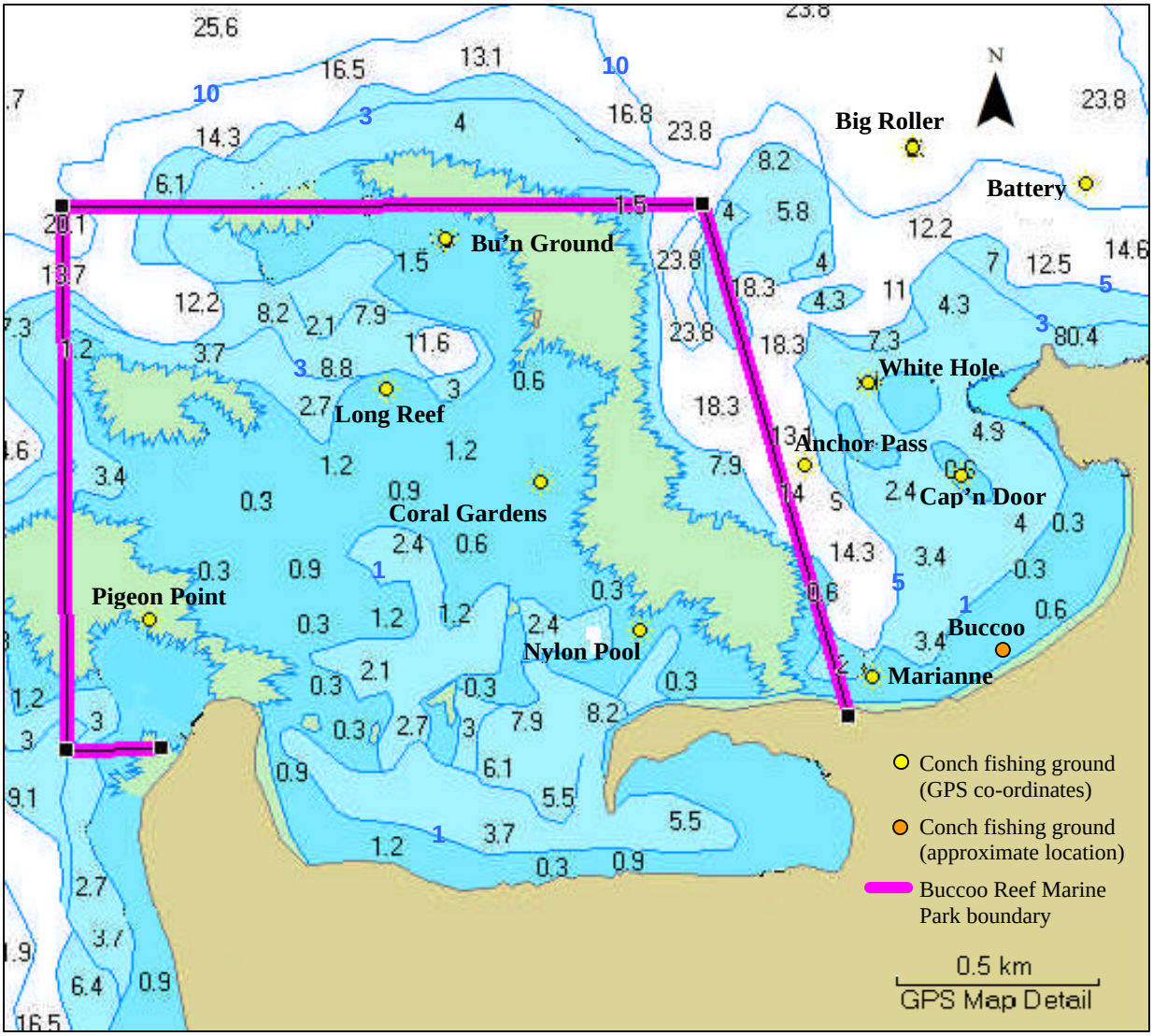

Figure 3.2. Map of southwestern end of Tobago showing detailed bathymetry and conch fishing grounds in the vicinity of Buccoo. Map created by author, extracted and adapted from MapSource Blue Chart Americas v. 8.0 © Garmin Ltd. 1995-2005. GPS locations for named fishing grounds were provided by Buccoo Reef Trust and/or collected by author. Depths (black) shown in metres, contours (blue) shown in fathoms.

3.1.4 Fishing Methods

Both free diving and SCUBA are used to harvest conch (Table 3.2). Nine of the fishers (38%) free dive only, using mask, snorkel and fins, and will dive down to depths of up to 14 m to harvest conch. Seven fishers (29%) fish for conch using SCUBA only, accessing grounds as deep as 43 m, whilst eight fishers (33%) use both free diving and SCUBA depending on the depth of the fishing grounds.

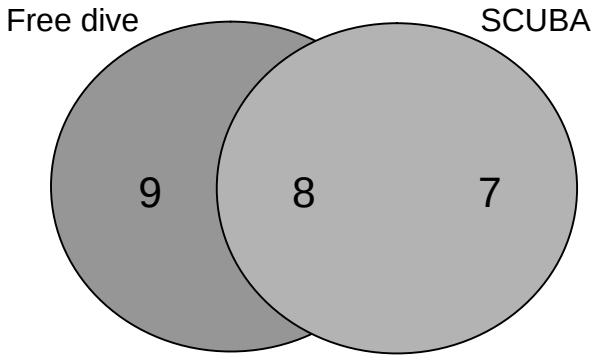

Figure 3.3. Proportion of fishers in Tobago using each fishing technique to harvest conch.

Most (96%) fishers use a boat, generally a 4-7 m pirogue, powered by an outboard engine (Figure 3.4) and only one fisher swims to his fishing ground from shore (Table 3.2). This fisher carries a mesh bag, surface float, knife and a screw driver and removes the meat from their shells in the water, since the shells are too heavy to swim ashore.

Typically 2-3 fishers will work together on a trip: one or two divers and a boat operator, although the range reported was 0 – 4 partners. The fishers motor out to a known conch fishing ground and the diver(s) snorkels at the surface in search of conch, sometimes duck-diving to get a closer look at the bottom. Once spotted from the surface, free divers will duck-dive to collect the conch, carrying 2-4 conch at a time in their arms, back to the boat. SCUBA divers may use a lift bag or their own buoyancy control device (BCD) inflated with air, to lift conch to the surface. One retired conch fisher who harvested heavily in the 1960's reported using a metal basket which was lowered over the side of the boat, filled with up to 20 conch at a time, then hauled up again into the boat by hand. None of the fishers presently use this basket method. When diving for conch, fishers will often spearfish and hunt for lobsters simultaneously.

Figure 3.4. Typical boat (pirogue) used by conch fishers at Buccoo Point.

Table 3.2. Tobago conch fishers' harvest method, main occupation, harvest frequency and mean catch rate (conch per boat per trip) as reported during interview. '-' indicates question not answered, * refers to total catch for season.

Main occupation	Harvest periodicity	Harvest frequency	Reported catch/trip (dozen)	Median catch/trip (no. conch)	Harvest method			
					SCUBA	Free dive	Boat	Swim
Marine park ranger	weekly	1	2	24	Y		Y	
Oil rig mechanic	weekly	2	3	36		Y	Y	
Fisher	weekly	2-3	2	24		Y	Y	
Retired lifeguard	weekly	2	3	36	Y	Y	Y	
Groundsman	weekly	2-3	2-3	30		Y		Y
Reef tour guide	weekly	1	2-4	36		Y	Y	
Sanitation worker	weekly	2	3	36	Y		Y	
Mean				31.7				
Reef tour guide	fortnightly	2	3	36	Y	Y	Y	
Marine park ranger	fortnightly	1	2	24	Y	Y	Y	
Government employee	monthly	2-3	2-5	42	Y	Y	Y	
-	monthly	1	2	24	Y	Y	Y	
-	monthly	1-2	4-5	54	Y		Y	
-	monthly	4	2-7	54	Y	Y	Y	
Dive master	monthly	1	1	12	Y		Y	
Self employed	monthly	1	12	144	Y	Y	Y	
Mean				48.8				
-	by chance	4/year	2-3	30	Y		Y	
Fisher	by request	-	1	12		Y	Y	
-	by request	4-5/yr	1-3	24	Y	Y	Y	
Mechanic	by request	4-5/yr	10-12	132		Y	Y	
Dive operator	chance/ request	4/year	5	60	Y		Y	
Dive operator	chance/ request	-	2	24	Y		Y	
		once/year	12	144				
Mean				47				
Reef tour guide	season	2/yr	1-2	18		Y	Y	
Boat repairs	season	4-6	7	84		Y	Y	
Fisher	season	21/season	65-100*	47		Y	Y	
Mean				49.7				

3.1.5 Harvest Frequency

Fishing frequency varies widely (Table 3.2). Presently none of the fishers harvest conch daily although one fisher reports having dived daily for the past 38 years. The latter states that the reduced frequency of his current harvest is due to increased age, and not due to availability of the resource. There are 7 fishers who consider themselves weekly fishers, 8 fishers who report harvesting monthly (including fortnightly), and 6 individuals who fish with no particular regularity, diving for conch occasionally and/or at the request of a customer (Table 3.3). A further three fishers only harvest seasonally. One seasonal fisher reports that adult conch breed from November-December and are thus more abundant and easier to catch at this time. Interestingly, a number of other fishers report that at this time of year the waters are too rough for conch fishing. Another seasonal fisher reports that February-March and August-December are periods when conch are more abundant and he therefore harvests only during these two 'seasons'. The third seasonal fisher reports harvesting conch three months out of the year during the 'off-season' for pelagic fish (August-October), at an average frequency of seven trips per month. One fisher, who reports harvesting monthly, claims that the 'high season' for conch abundance is between April and May, although he continues to harvest conch year round. All fishers agree that conch abundance varies with the full moon and that conch are 'uncovered' a few days before and after the full moon. However there was no observed increase in conch harvesting around that lunar stage during the course of this study. Most conch fishers also report that conch are more visible after stormy weather since the rough seas 'stir them up' from the sea bed.

Fishers who use SCUBA tend to harvest occasionally or upon request, although a few of them fish as frequently as 1-2 times per month and one SCUBA fisher reports harvesting twice weekly. Most (56%) of the fishers who do not use SCUBA but rather free dive only, report that they are weekly fishers. Fishers who harvest in the northeast of Tobago use only SCUBA gear on these grounds, and harvest less frequently than fishers in other parts of the island.

In summary, based on the interview data, weekly fishers harvest conch 1-3 times a week. Monthly fishers make 1-4 trips a month, while those who fish seasonally, by chance or by request harvest 2-6 times a year (Table 3.2). From observation the reported frequency is likely to be more than the actual frequency, as factors such as work schedule, engine repair, weather, sea conditions and health may often interrupt a fisher's schedule. Using the actual number of trips made by three fishers (who each reported fishing 2-3 times a week) observed over July-September 2009 (Table 3.3), it appears that fishers may actually harvest conch only about 58% of the time that they report doing so. During the observational period, sea conditions (especially

Table 3.3. Comparison of reported and observed frequency of conch harvesting trips made by weekly fishers in Tobago.

Fisher	Reported trips/week	Total number of trips made	Observation time (weeks)	Expected no. of trips	Actual frequency (% of reported frequency)
A	2	7	9	18	39
B	2 -3	9	6	15	60
C	2	6	4	8	75
Mean					58

water clarity) played an important role in determining whether conch fishers could harvest. On several occasions during the summer, Tobago was engulfed in turbid, green water discharge from the Orinoco River or experienced very strong surface currents, rendering underwater visibility and diving conditions unsuitable for conch harvesting. According to fishers, these are relatively frequent occurrences throughout the year, but particularly during the wet season (June – November).

3.1.6 Fishing Effort and Catch

The time spent per fishing trip was given by fishers as the total time spent at sea and not exclusively the amount of time spent harvesting conch. Equal numbers of fishers reported spending 1-2 hours as did those who spent more than 6 hours total time per conch fishing trip (Figure 3.5). Interestingly, fishers who free dive report spending on average 30 minutes longer per trip than do those who SCUBA dive only.

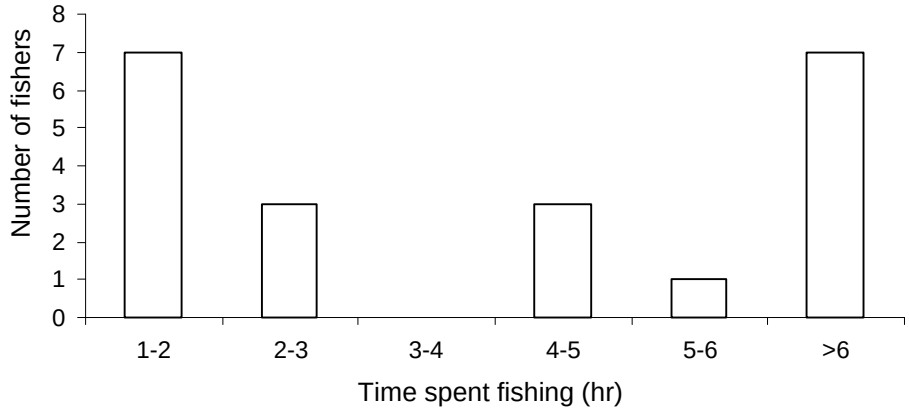

Figure 3.5. Typical length of a conch fishing trip reported by interviewed fishers in Tobago.

3.1.7 Species Composition

Although queen conch is not a targeted fishery unless a fisher is fulfilling a specific request, it is the main Strombid species harvested in Tobago whilst targeting a variety of reef fishes and lobsters. Most (96%) fishers state that they harvest only queen conch (*S. gigas*) while 4% (1 fisher) also collects milk conch (*S. costatus*) when queen conch are scarce on the fishing grounds. One other fisher on the northeast coast also reports finding Cassidae, locally known as helmet conch, on very rare occasions, but he does not harvest them. The various maturity stages (shell morphologies) of queen conch are often referred to by Tobagonian fishers by separate local names (Figure 3.6). For example a mature queen conch with a flared lip is called a “broad fin” conch, whilst an adult whose lip has spread upwards towards the crown is called a “fighting conch”. A subadult, with a large shell but no flare is referred to as a “swell back” and a young juvenile still with pronounced shell spines is called a “roller”. Some fishers are under the impression that these are in fact separate species of conch.

Figure 3.6. Queen conch, *Strombus gigas*, showing shell morphologies known by Tobagonian fishers by separate local names. Mature conch (a) – "broad fin", (b) – "fighting conch", and immature conch (c) – "swell back"

3.1.8 Size and Gender

Shell size

A total of 206 queen conch sampled opportunistically (64 from fishers, 142 from vendors) were measured for shell length and lip thickness. Additionally 82 shells observed but not measured at shell vendor stalls, were categorized as either juvenile, intermediate or adult according to size and the presence or absence of a flared lip. Shells sampled from fishers ranged in size from 17.3 – 30.2 cm shell length with a mean of 24.0 cm (Figure 3.7a). The larger number of shells sampled from vendors ranged in size from 9.1 – 32.2 cm shell length with a mean of 23.1 cm (Figure 3.7b). However, there was no statistically significant difference in the size of conch sampled from shell vendors and fishers (Mann Whitney test: $U = 4157$, $n = 206$, $p = 0.328$) and given that all vendors reportedly sourced their conch shells from local fishers, the samples were pooled to give a representative size-frequency distribution for queen conch harvested in Tobago (Figure 3.8). The combined sample indicate that harvested queen conch range in size from 9.1 – 32.2 cm shell length and from 0.3 – 33 mm in lip thickness (mean shell length: 23.3 cm, mean lip thickness: 6.3 mm) (Figure 3.8a,b). There is an overlap in shell size between immature and mature conch (the latter being determined by a shell lip thickness = 4 mm). Harvested immature conch range in size from 9.1 – 28.7 cm shell length (mean: 21.3 cm) whilst the harvested mature conch range from 22.4 – 32.2 cm shell length (mean: 27.3 cm). A common belief among fishers is that the age of conch is related to the number of nodes on each whorl.

Based on these data and observations, it would appear that at least 73.0% of the queen conch ($n = 224$) harvested in Tobago are immature, with only 27% being sexually mature (Figure 3.9).

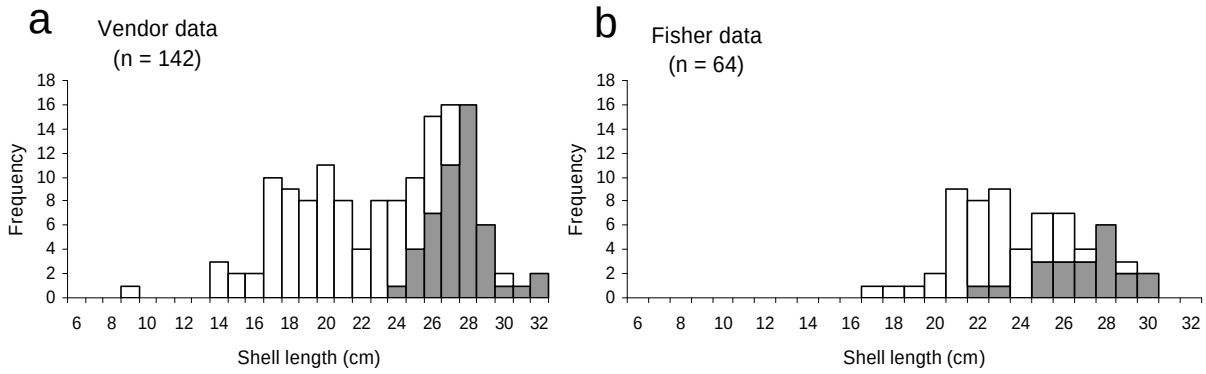

Figure 3.7. Shell length frequency distribution of queen conch sampled from shell vendors (a) and fishers (b) in Tobago. Shaded bars indicate sexually mature conch as determined by a flared lip of = 4 mm thick.

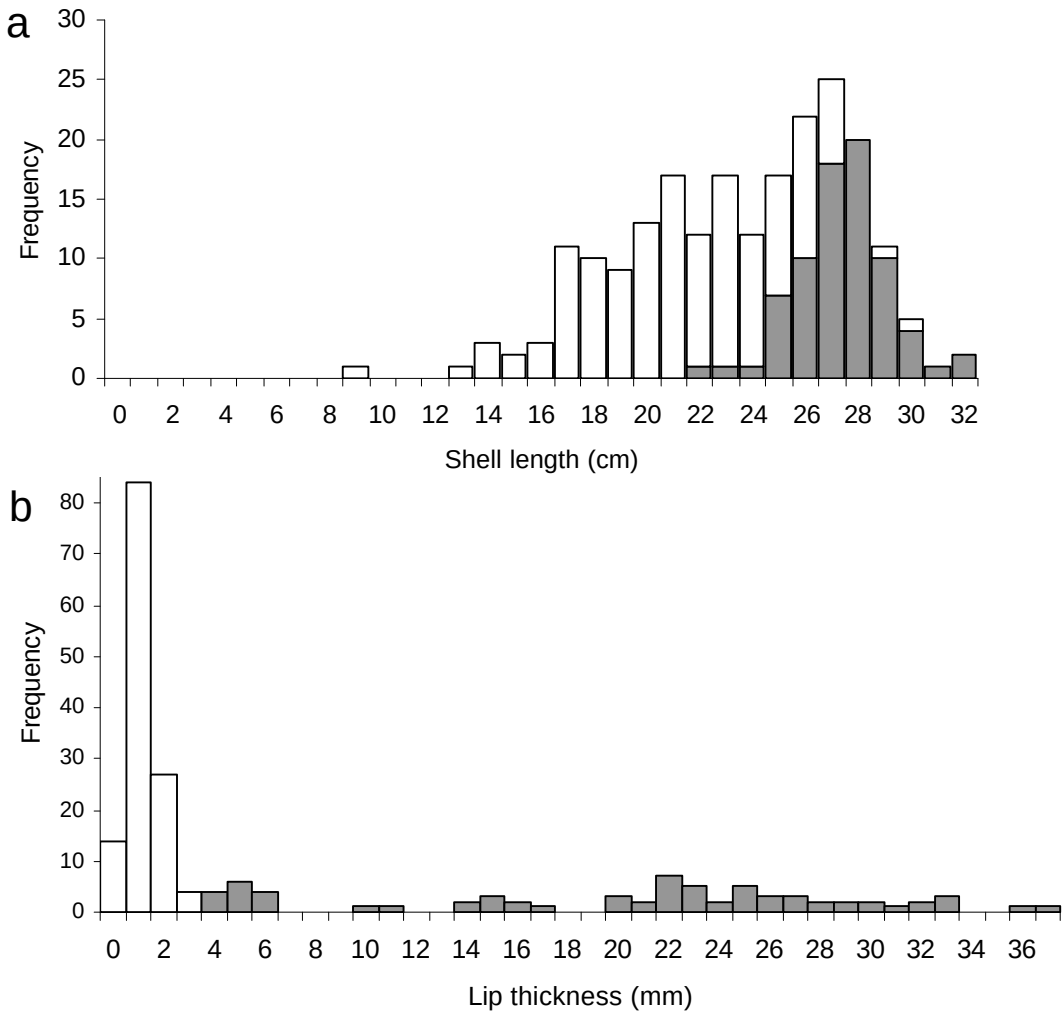

Figure3.8. Size-frequency distribution of queen conch (n = 206) harvested in Tobago, showing (a) shell length and (b) shell lip thickness. Data are pooled from shell vendor and fisher samples. Shaded bars indicate sexually mature conch as determined by a flared lip of = 4 mm thick.

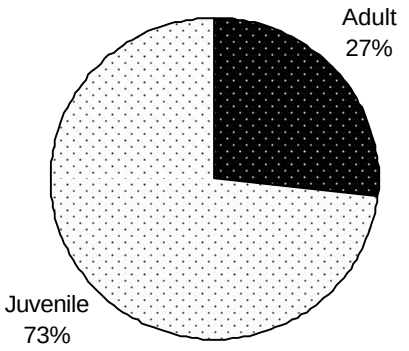

Figure 3.9. Percentage distribution of adult and juvenile conch harvested in Tobago

Large juveniles are most frequently harvested, accounting for 27% of the total sample (Figure 3.10). Adult and stoned conch make up 23% and 4% respectively. Medium juveniles account for 22% of the sample and small juveniles make up 20%. Subadults, i.e. conch which have begun to flare and have a lip thickness = 2 < 4 mm (see Table 1.1), comprise 4% of the harvested conch sampled in this study (Figure 3.10).

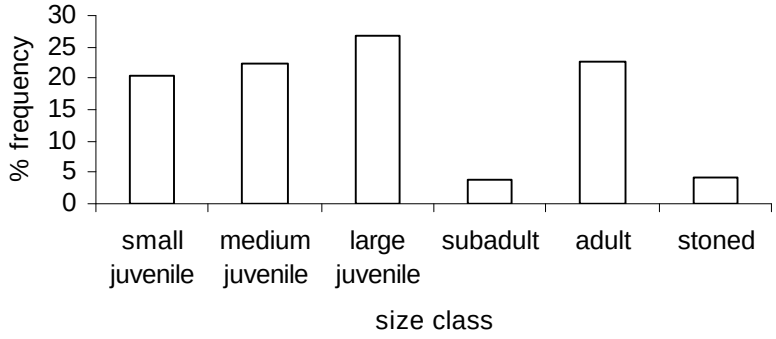

Figure 3.10. Size/maturity class distribution for queen conch harvested in Tobago

Meat weight

The total live mass (i.e. shell and meat) of harvested queen conch was recorded for 36 specimens, and ranged from 460-2,200 g with a mean mass of 1,130 g. The wet-mass of meat (i.e. uncleaned meat) was measured for 64 specimens and ranged from 60-680 g, with a mean of 216 g. The relationship between whole live weight and uncleaned meat weight was examined for a relatively small sample (n = 36) and is shown in Figure 3.11a. A small sample (n = 16) was measured before and after cleaning i.e. after removal of the digestive gland, eyes and tip of proboscis (Figure 3.11b), and indicated that the rough cleaning process reduces meat mass by an average of 31%. Applying this 31% mass reduction to the average individual uncleaned meat weight of 216 g, gives an estimated yield of 149 g of cleaned meat per conch.

Gender

A limited sample of 24 conch collected from one fishing trip was checked for gender. The harvest comprised primarily of females (79%), only four of which were sexually mature. Three of the male conch from this catch were adult and two were subadult. Note however that this small sample size cannot be considered representative of all conch harvested in Tobago.

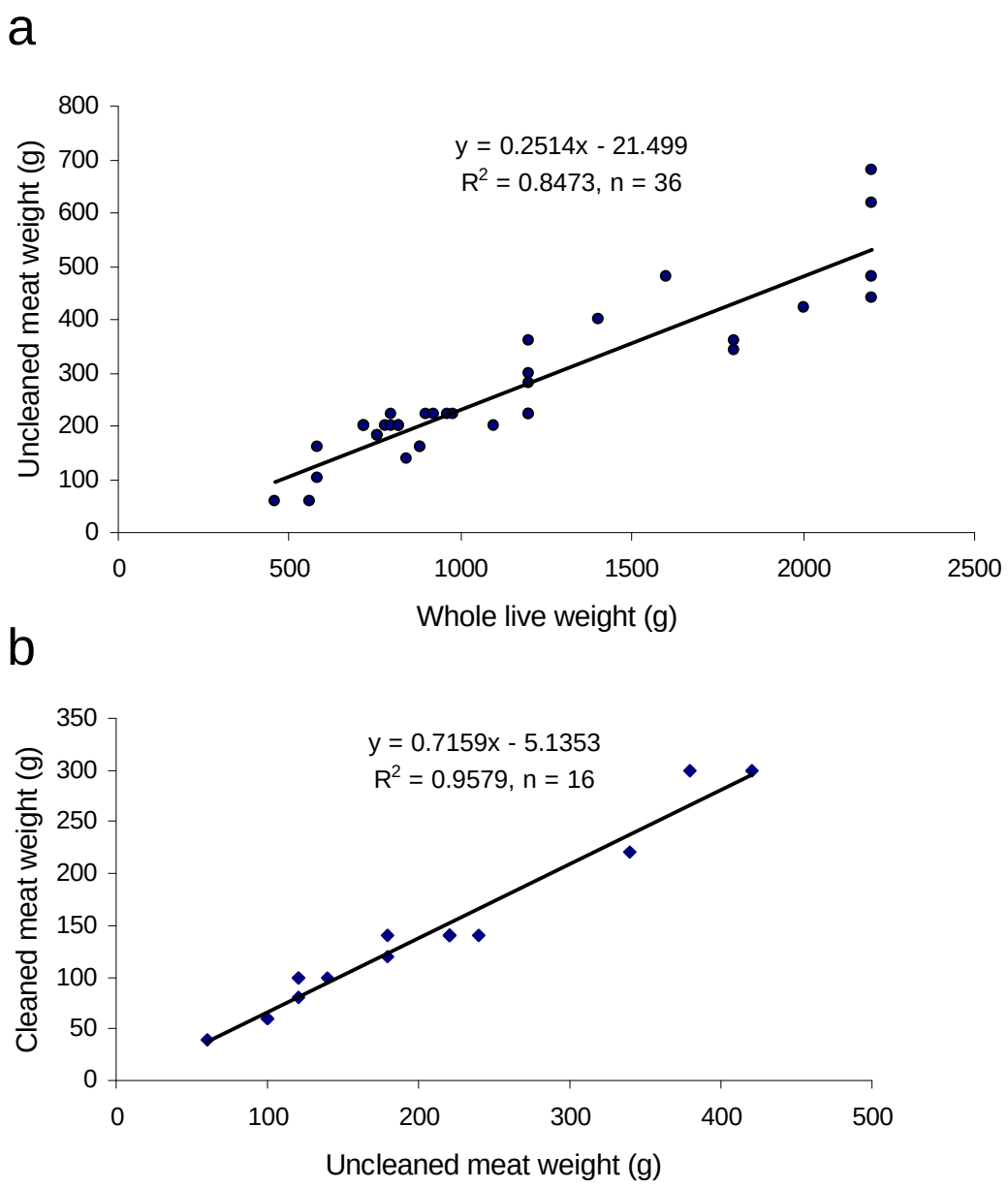

Figure 3.11. Weight-weight relationships for queen conch harvested in Tobago, showing (a) whole live shell and meat vs uncleaned meat, and (b) uncleaned vs cleaned meat.

3.1.9 Catch Rate

Fishers record catches of conch by the dozen and report catches ranging between 1-12 dozen (i.e.12-144 conch) per boat per fishing trip (Table 3.2). The most frequently reported catch is three dozen conch and a crude estimate of the average catch per boat per trip across all fishers, as determined from interviews, is 43 conch. This figure is likely to be biased by a few fishers who report very high harvests a few times a year, catching as many as 84-132 conch in one trip (Table 3.2). When these high values are omitted from the calculation, the average catch per trip drops to the modal catch of 36 conch.

Catch rates appear to vary with harvest method. Based on interview data, the estimated average catch per boat per trip for free divers is 47, while that of SCUBA divers is 34 conch per boat per trip (Table 3.4). Those fishers who utilize both diving methods average 48 conch per trip; this value includes the large catches of one diver who harvests up to 144 conch once per year using SCUBA, as well as another fisher who harvests heavily over a 3 month period.

Table 3.4. Mean catch rate of queen conch (number of conch per boat per fishing trip) reported by interviewed fishers, shown separately by harvest method.

Harvest method	Averaged catch/trip	No. fishers	Subtotal
Free dive	12	1	12
	18	1	18
	24	1	24
	30	1	30
	36	2	72
	47	1	47
	84	1	84
	132	1	132
Mean catch/trip		n = 9	46.6
SCUBA	12	1	12
	24	2	48
	30	1	30
	36	1	36
	54	1	54
	60	1	60
Mean catch/trip		n = 7	34.3*
SCUBA/Free dive	24	3	72
	36	2	72
	42	1	42
	54	1	54
	144	1	144
Mean catch/trip		n = 8	48

* A single catch of 144 conch reported by a fisher normally catching 24 conch per trip (see Table 3.2) has been omitted here.

Catch rates also appear to vary with the frequency of harvesting. Based on reported catches, weekly fishers catch an average 32 conch per trip; monthly fishers report 49 conch per trip; seasonal fishers average 50 conch per trip; and those who fish by request or by chance report an average of 47 conch per trip (Table 3.2).

Actual catch per trip was recorded for 14 fishing trips by six different fishers over the period July to September 2009 (Table 3.5). Data were obtained through personal observation while accompanying fishers on all but three of the trips. From these data the average catch per trip was 16 conch (Table 3.5). Even if the two trips which yielded no conch as a result of poor visibility and a third trip which was cut short due to bad weather are ignored, then the average catch rate is 19 conch per trip, which is still considerably lower than the average reported in interviews (Tables 3.2, 3.4).

Table 3.5. Mean catch rate of queen conch as determined by observation of six fishers, over a total of 14 conch fishing trips, shown as number of conch per trip. Dates and fishing grounds harvested are also shown.

Date	No. of fishers	Trip type	Fishing grounds	Conch per trip	Conch per fisher	Comments
18/07/09	1	boat	Long Reef	8	8	
19/07/09	1	boat	Marianne	12	12	
21/07/09	1	boat	Long Reef	24	24	
22/07/09	1	boat	Marianne/Coral Gardens	26	26	
23/07/09	1	swim	Pigeon Point	24	24	
25/07/09	1	swim	Pigeon Point	20	20	
30/07/09	1	boat	Buccoo	0	0	Poor visibility, harvesting abandoned
01/08/09	2	boat	Canoe Bay	12	6	
14/08/09	1	swim	Pigeon Point	21	21	
19/08/09	1	boat	Majeston	0	0	Poor visibility, harvesting abandoned
22/08/09	1	swim	Pigeon Point	8	8	Trip shortened due to bad weather
05/09/09	1	boat	Buccoo	24	24	Data obtained via phone call
09/09/09	1	boat	Drew Shallows	20	20	Data obtained via phone call
11/09/09	1	boat	Drew Shallows	24	24	Data obtained via phone call
Mean				15.9	15.5	
Mean (ignoring shortened trips or zero catches)				19.5	19.0	

3.1.10 Annual Harvest

A very crude estimate of annual harvest was calculated using each fisher's mean catch per trip as determined from stated catch per trip (Table 3.2), reported harvest frequencies converted to number of trips per month and reduced by the 57.9% observed harvest frequency (Table 3.3) across all fishers. This gave a somewhat conservative estimate of 17,789 conch landed per year by the 24 fishers interviewed plus an additional estimated mean of 741 conch per fisher for the two other known conch fishers not interviewed, giving an overall estimate of 19,271 conch landed per year (Table 3.6). Using the average weight of unprocessed meat (216 g, n = 64) the overall harvest translates to an estimated 4.16 mt of uncleaned meat landed per year.

An even more conservative estimate would be obtained if the extrapolation was based on the observed catch rates of just 14 fishing trips (Table 3.6), which were towards the lower end of the range of their stated catch per trip. However, if fishers estimates are taken at face value and fishers really do harvest as frequently, and catch as many conch as they stated in interviews, then the annual harvest of the 24 interviewed fishers could be as high as 39,312 conch, representing an overall harvest by all 26 known fishers of 42,588 conch (9.2 mt of unprocessed meat) (Table 3.6). Note also that landings of conch by recreational divers remain undetermined, although it is known that some recreational divers do take conch and dive operators who observe conch while accompanying clients may return to the grounds later to harvest them

Table 3.6. Summary of data used to obtain a crude estimate of total annual conch landings in Tobago, based on the stated number of trips per year reduced to 57.8% observed level of stated activity, and mean reported catch per trip for the 24 interviewed fishers.

Fishing periodicity	**Stated approx. no. trips/month**	**Median stated catch/trip (no. conch)**	**Extrapolated catch/month (no. conch)**	**Upper estimate of annual catch (no. conch)**	**Adjusted approx. no. trips/month** (57.8% reduction)	**Adjusted annual catch (no. conch)**
by chance	0.08	12	1	12	0.05	7
by chance	0.08	144	7	144	0.05	83
by chance	0.38	132	29	720	0.22	349
by chance/request	0.33	60	11	240	0.19	138
by request	0.38	24	5	180	0.22	63
by request	1.00	144	83	1728	0.58	1001
fortnightly	4.00	36	83	1728	2.32	1001
fortnightly	2.00	24	28	576	1.16	334
monthly	2.50	42	61	2160	1.45	730
monthly	1.50	54	47	1440	0.87	563
monthly	4.00	54	125	4032	2.32	1501
monthly	1.00	12	7	144	0.58	83
monthly	1.00	24	14	288	0.58	167
occasional	0.33	30	6	144	0.19	69
seasonal	1.75	47	48	1200	1.01	571
seasonal	0.17	18	2	48	0.10	21
seasonal	0.42	84	20	3024	0.24	243
weekly	4.00	24	56	1152	2.32	667
weekly	10.00	24	139	3456	5.79	1668
weekly	8.00	26	120	2496	4.63	1445
weekly	10.00	30	174	5184	5.79	2084
weekly	4.00	36	83	2304	2.32	1001
weekly	8.00	36	167	3456	4.63	2001
weekly	8.00	36	167	3456	4.63	2001
Annual total				**39312**		**17789**
Average per fisher per year				**1638**		**741**
Overall annual total (includes 2 additional known fishers)				**42588**		**19271**

3.1.11 Perceived Changes in Abundance

The majority of fishers interviewed (71%) reported observing a decline in the abundance of conch. Two fishers in particular stated that there are now far fewer conch available than in the past 5-10 years. A small group 21% said that they had observed no change in the density of conch and 2 fishers (8%) are of the opinion that conch are now more abundant than they have been in the past. The fishers who believe that there has been a decline in conch abundance, are experienced fishers who have been harvesting conch for between 6 - 40 years.

In addition, a past fisheries officer, and three retired fishers who used to harvest conch heavily between the mid 1960s and early 1990s all reported that there are now far fewer conch than in the past, and that fishers now have to go much further from shore to harvest them.

More than half (65%) of the fishers who have observed a reduction in numbers, believe that overfishing is the cause of the decline. One fisher believes that pollution is primarily responsible for the decreased availability of conch. All interviewed fishers stated that empty conch shells which have been discarded in the water are responsible for driving live conch away from near shore to areas further out to sea.

3.1.12 Perspectives on Management

When asked to suggest means of managing the conch fishery most (67%) interviewed fishers did not make any recommendations. The fishers (8) who did respond suggested a variety of tools including closed seasons and closed areas; a few (3) suggested a 5-year ban on conch fishing; and one fisher suggested that reducing marine pollution and improving that state of coral reefs would improve the state of conch stocks. Other suggestions included developing a conch farm and educating fishers on the growth rate and biology of queen conch.

3.2 Post Harvest Sector

3.2.1 Processing of Conch Meat and Shells

Typically, conch are landed whole and the meat is extracted live by knocking a small hole in between the whorls of the shell spire, severing the tissue attachment and pulling the meat out by its operculum. One fisher, however, reported boiling the entire shelled animal to get the meat out. Processing is typically done by the fisher/vendor on-shore, using a hammer, small axe or another conch shell to make the hole in the shell and a screw-driver or knife to severe the tissue attachment and pull the animal out of the shell (Figure 3.12). The meat is further 'cleaned' by removing the hard operculum, proboscis and eye stalks, the intestines/digestive gland/gonads and the 'apron' (mantle and gills) of the animal. The removed tissue is either discarded or used as bait in fish pots and the remaining muscular part of the conch is washed with water or rubbed in sand to remove the mucous covering. This rough cleaning process reduces the meat weight by an average of 31% (Figure 3.11b).

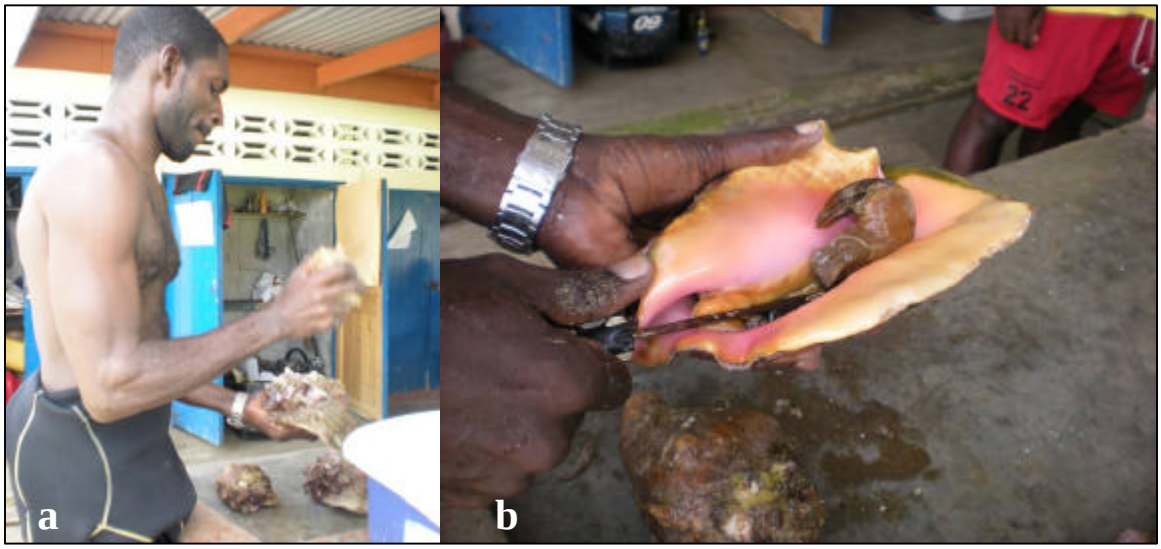

Figure 3.12. Fisher processing his queen conch catch at the Buccoo fish market in Tobago showing (a) an empty conch shell being used to knock a hole in the shell of another live specimen, and (b) a screwdriver being used to pull the animal out of the shell after severing the tissue attachment via the hole.

Fishers generally sell unprocessed shells to shell/craft vendors who do the processing and finishing themselves. This requires that shells are left out to dry in a cool shaded area for at least a week, to allow any remnants of the animal to rot and fall out. Shells are then scrubbed with water and sometimes soap to remove any algae, sediment or epizooytes. Shells may then be buffed for sale as whole shells, or further cut and fashioned into conch horns ('blowers') by cutting off the top of the spire, or into decorative half sections (Figure 3.13).

Figure 3.13. Whole and sectioned queen conch shells displayed for sale on shell/craft vendor stall in Tobago

3.2.2 Sale of Conch Meat

Both conch meat and conch shells are valued products of the fishery, but are processed and marketed through different channels by meat vendors and shell/craft vendors respectively.

There are four types of conch meat vendor in Tobago, namely: fisher-vendors, hawkers, seafood wholesaler/retailers, and restaurateurs. The first group in the market chain, the fishers, are the most numerous and comprise the major focus of this study.

Fisher/vendors

Of the 24 interviewed conch fishers in Tobago, the majority (19) report selling all or part of their catch, whilst five said that they did not sell their conch meat, but kept it for personal consumption (Figure 3.14). In particular, those fishers who harvest conch from deep waters using SCUBA prefer to keep their catch, since they report that it is a 'dangerous and strenuous activity' and they do not view it as economically worthwhile to sell their catch. No conch meat is ever discarded. Of the 19 fishers selling conch meat, 17 considered themselves regular meat vendors, whilst two reported only occasional sales. All but one of the 17 fisher/vendors and one of the two occasional vendors were interviewed further about their processing and vending activities and socio-economic characteristics.

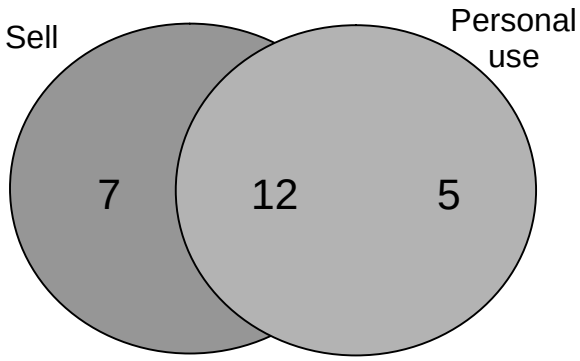

Figure 3.14. Use of queen conch meat as reported by 24 interviewed conch fishers in Tobago

Gender and age: All but one of the fisher/vendors in Tobago is male, with only one female conch fisher/vendor operating in the island. Ages ranged widely from 21 to over 60 years old, with the modal age group being 41-50 years old.

Education and experience: Half (8/16) of the fisher/vendors interviewed had completed primary and attained some level of secondary education, whilst four reported only completing primary education, although all were certainly literate. Fisher/vendors reported having between 8 – 50 years experience fishing and selling conch meat, with most having around 10 years experience.

Vending: Most conch meat is sold privately to individual customers or restaurants, either from the fisher's home, or delivered directly to the customer (Figure 3.15). Occasionally conch meat may be sold by the fishers from beach-side fish stalls or a fish market facility (Figure 3.15). None of the fishers reported selling to supermarkets or hotels. Fishers typically sell conch meat by the dozen, partially cleaned, and either fresh or frozen depending on the customer requests.

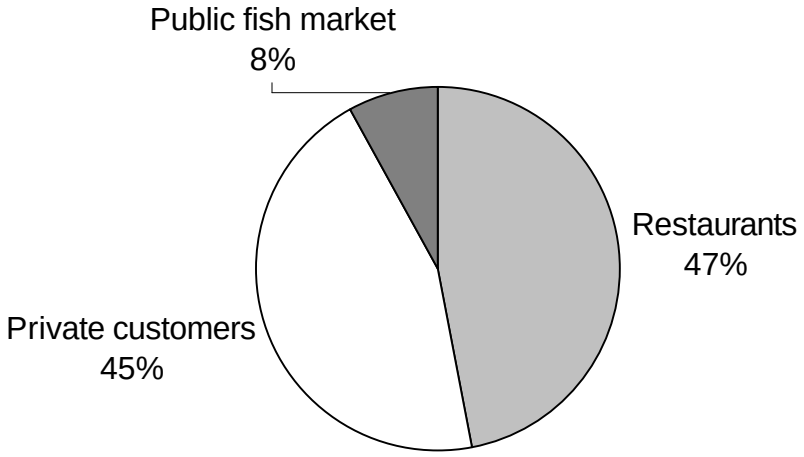

Figure 3.15. Proportion of conch meat sales to customers in Tobago as reported by 17 interviewed conch fisher/vendors

Market prices of local conch meat are set by individual fishers, with considerable variation ranging from TT$ 100 – 600 per dozen[4], with a modal price of TT$ 300 per dozen, based on interview data. While some fish/vendors report using a standard price per dozen, others will determine prices based on the sizes of the individual conch, since the weight of a dozen conch can range widely (e.g. cleaned meat weight for an individual conch ranges from 40 – 300 g, n = 16; Figure 3.11b). In at least one case, the identity of the buyer also plays a role in price-setting, with conch meat being sold to familiar villagers at TT$ 200 per dozen, and to restaurateurs at TT$ 300 – 500 per dozen. Physical location of conch sales also appears to affect market price, with the cheapest conch being available in Store Bay and Speyside (average price < TT$ 300 per dozen) and the most expensive in the Buccoo and Mt Irvine fish markets (average price > TT$ 450 per dozen; Figure 3.16).

Using an average cleaned meat weight of 149 g per conch (see section 3.1.8), fishers apparently sell their conch meat for between TT$ 55 – 336 per kg. Using the modal price (TT$ 300 per doz.) the price would equate to TT$ 168 per kg.

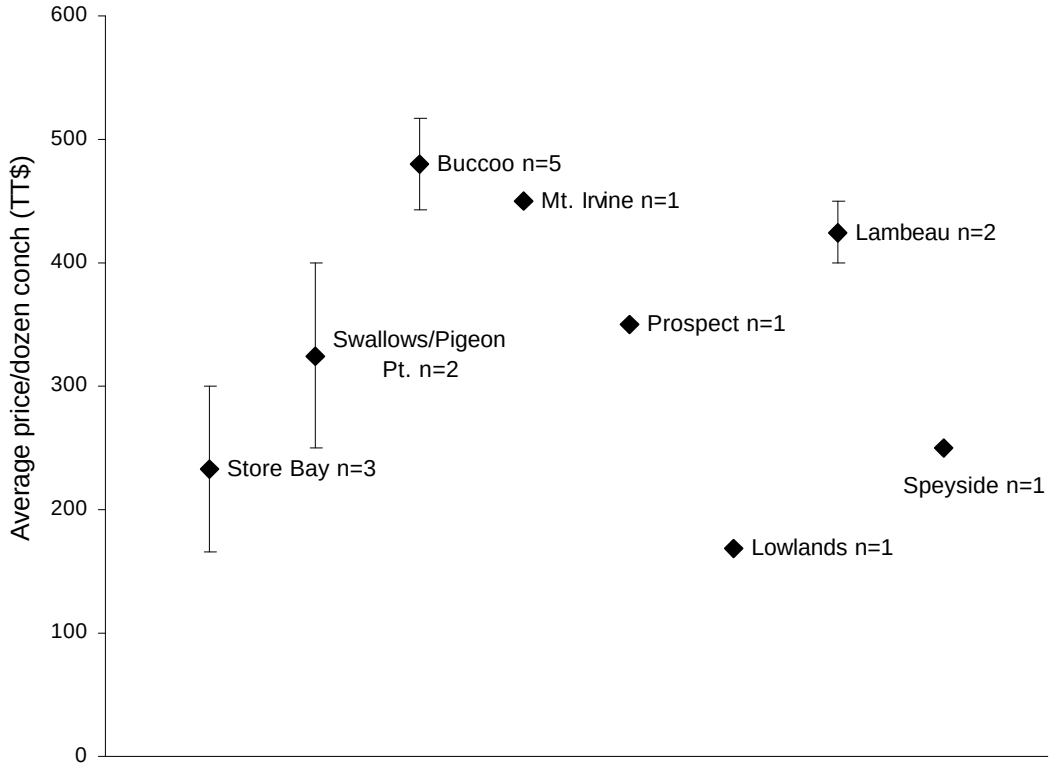

Figure 3.16. Average price of cleaned conch meat sold by fisher/vendors as reported by 16 interviewees, shown separately by vending location around Tobago. Where a price range was given, the median price was used. Bars show standard error about the mean

Earnings and livelihood dependence: Only 10 of the fishers interviewed were able to report on the average quantity of conch meat sold in a week and this ranged widely, from just 1 dozen to as many as 25 dozen. Given the modal price of TT$ 300 per dozen conch, and the amount of conch reportedly sold in a week (1-25 dozen), a fisher/vendor can gross anywhere between TT$ 300

[4] US$ 1 = TT$ 6

and TT$ 7,500 in a week from the sale of conch meat. However, whilst conch vending can certainly provide income, none of the conch vendors interviewed are dependent on the sale of conch meat as their sole source of income, and the vast majority (13/16) of fisher/vendors stated that conch sales contributed less than 25% to their annual income. Commonly cited additional livelihood activities included other types of fishing and vending, reef tour guiding and car mechanics.

Hawkers

There is just one individual who acts as a middleman, purchasing conch meat from fishers for resale to customers at his home-based business 'Guns Seafood', located in Whim. Conch meat is sold whole, frozen and in 5 lb packages for TT$ 200 per package (i.e. at TT$ 88/kg). This hawker reports trading up to 800 lb (364 kg) in a month, but acknowledges seasonality in supply and sales.

Retailers and wholesalers

There are three retailers in Tobago that sell a mixture of local and imported conch: 'R.T. Morshead' in Mt. Pleasant, and two of the three branches of 'Penny Savers Supermarket' in Carnbee and Bon Accord (the Scarborough branch does not sell conch meat[5]). There are also two well established wholesalers on the island where conch meat (local and imported) can be purchased: the 'Seafood Shop' in Canaan and 'Yats Meat Store' in Scarborough.

Retailers report sourcing their conch meat from suppliers in Trinidad who in turn are believed to import conch from Grenada and possibly Antigua. They sell frozen conch meat labelled as 'lambie' in a finely chopped form at a retail price of TT$ 199.97 per kg, and in individual single conch packages at a retail price of TT$ 77.22 per kg. The retailers reported sales ranging from 15-58 kg of conch meat monthly, and one retailer stated that demand sometimes outstripped available supply.

One Tobago based wholesaler also sources conch meat from a supplier in Trinidad who imports from Grenada and/or St Vincent, and sells wholesale at TT$ 85 per lb (TT$ 187/kg). The other wholesaler sources both locally caught conch and imported conch from Grenada, and sells whole, frozen conch in 5 lb packages at a wholesale price of TT$ 285 a packet (i.e. at TT$ 125/kg). Wholesalers reported sales ranging from 23-455 kg of conch meat monthly, with one stating that there were no problems meeting demand whilst the other reported that meeting demand was a common problem.

Restaurateurs

A total of eight restaurateurs, one caterer and a road-side vendor offering conch meat for gastronomy were identified on the island. These include: privately operated small eateries (Miss Esmies, Sylvia's, Alma's, Joycie's, Miss Trims, and Miss Jeans) located in the Store Bay beach facility; two more up-scale restaurants, 'Bamboo Mile' in Bon Accord and 'Blue Crab' in Scarborough; the 'souse lady' selling conch souse on Saturdays from a road-side stall in Carnbee; and a caterer 'Ah Love It' offering an island-wide food delivery service.

The six small Store Bay eateries offer a wide variety of tasty local cuisine and source their conch directly from local fishers, representing the most important buyers of local conch meat in the restaurant market. A popular dish amongst locals and tourists alike (but particularly reported as a

[5] Angela, branch manager, Penny Savers, Scarborough, telephone interview with author , 11th January 2010.

favourite of white Trinidadian visitors), served by these operators is 'conch and dumplin' comprising finely chopped conch simmered in coconut milk and curry sauce, and served with flour dumplings for around TT$60-65 per plate. One employee indicated that as many as 25 conch meals a day would be served by a single eatery at the height of the Trinidadian visitor season (July-August) indicating that conch is an important product for these restaurants.

One of the two up-scale restaurants buys local conch from a hawker, whilst the other buys imported conch from a local supermarket. The 'souse lady' and the caterer both source their conch from local fishers.

Marketing pathway

The structure of the marketing pathway in Tobago for locally caught and imported conch meat is summarised in Figure 3.17. There is apparently no export of Tobagonian conch, although Trinidad appears in the CITES trade database as an occasional exporter. This is likely to represent a re-export of foreign caught conch.

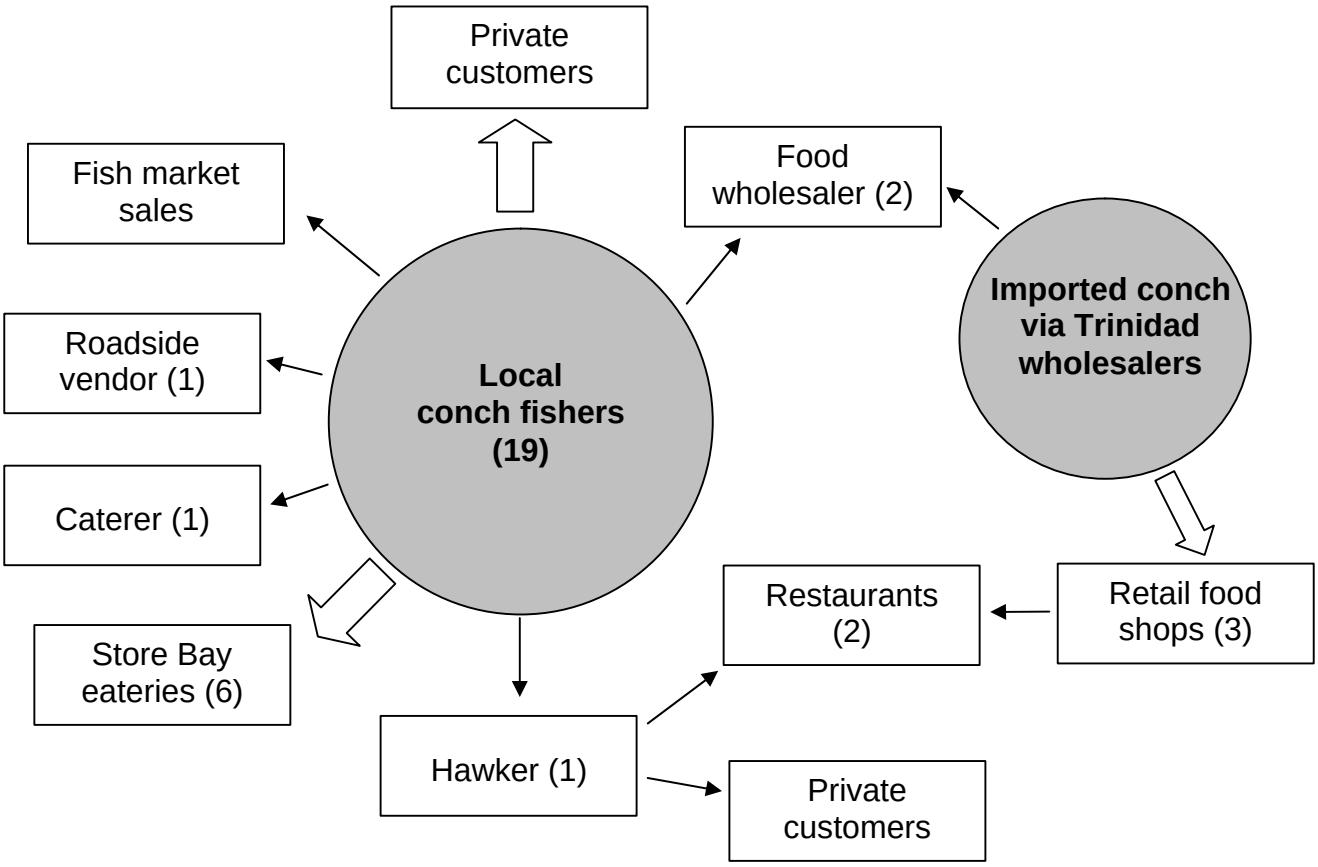

Figure 3.17. Marketing pathways for locally caught and imported queen conch meat in Tobago as determined from interviews with stakeholders. Size of arrow indicates approximate importance of pathway, numbers of operators/establishments shown in parentheses where known.

3.2.3 Sale of Conch Shells

Of the 24 interviewed conch fishers in Tobago, 23 responded to questions regarding the sale of conch shells. About half of them (12) reported selling all or part of their catch, whilst two said

that they did not sell their conch shells, but kept all or some of them for personal use (Figure 3.18). Contrary to the use of conch meat, around half of the interviewed fishers (12) also stated that they discarded all or some of their shells (Figure 3.18), usually on the landing beach, for beach combers and children to take. Fishers typically sell uncleaned shells in bulk to shell/craft vendors for between TT$ 5 – 20 each, and apparently do not usually sell directly to private customers, although one fisher has his own shell craft stall and three fishers report occasional sales of conch horns.

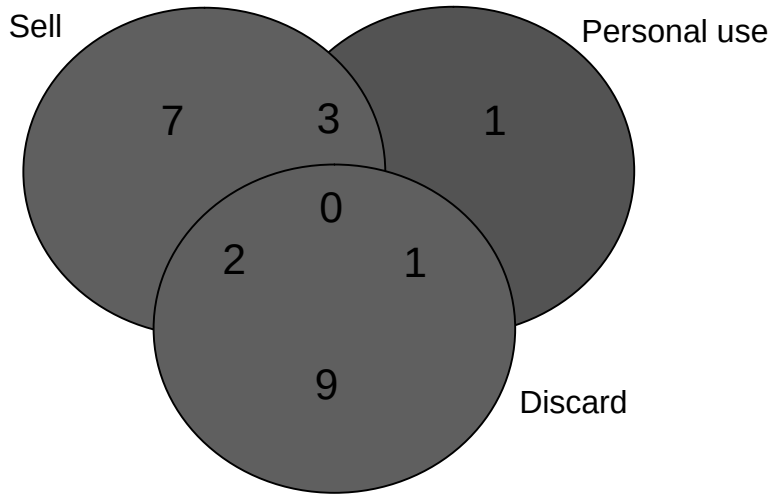

Figure 3.18. Use of queen conch shells as reported by 23 interviewed conch fishers in Tobago

Shell/craft vendors

Shell/craft vendors who all sell a variety of souvenir items are the main stakeholders in the island's shell market. A total of 14 shell/craft vendors were interviewed for this study, which is believed to represent the majority of shell vendors in Tobago. Thirteen of these can be categorized and general craft vendors, while one individual is an active conch fisher who processes and sells conch shells and horns at his roadside fish market in Mt. Irvine.

Gender and age: The majority of shell/craft vendors in Tobago are male, with just four females identified. Ages of these stakeholders ranged broadly from 21 to 60 years with the modal age group being 41-50 years old.

Education and experience: Most (9/14) of the shell/craft vendors have received at least some secondary education, whilst two reported only completing primary education and three did not respond to the question. Their level of experience vending shells ranged from 2 to 35 years in the trade.

Vending: Shell/craft vendors operate from purpose-built kiosks or road-side stalls (Figure 3.19) located around the island at Swallows/Pigeon Point (5), Store Bay (6), Mt. Irvine (1), Castara (1) and Speyside (1) in areas generally frequented by tourists. Half of the interviewed vendors live in the area where they operate their stalls, whilst the other half travel to their vending locations, including one vendor who sometimes sells in Trinidad.

Figure 3.19. Typical road-side stalls and kiosks used by shell/craft vendors in Tobago.

All shell/craft vendors in Tobago sell whole queen conch, *Strombus gigas*, shells reportedly obtained only from local fishers or in one case from a beach comber picking up discarded shells. Other species of molluscs observed for sale as whole shells on vendors' stalls were also reported as harvested locally. These include the true strombids: milk conch (*S. costatus*) observed on 57% of stalls, roostertail conch (*S. gallus*) and hawkwing conch *S. raninus* (only one specimen each of these latter species seen); and other mollusc species such as tulip shells (*Fasciolaria* sp.) locally named 'cone conch', tritons (*Charonia variegata*), the West Indian top shell (*Cittarium pica*) locally known as 'whilk', and the freshwater apple snail (probably *Pomacea urceus*) locally

known as ‘canal conch’ (Figure 3.20). Queen conch was the most frequently observed and most abundant shell for sale, and milk conch the second most frequently available, whilst no West Indian fighting conch (*Strombus pugilis*) were seen (Figure 3.21).

Figure 3.20. Sample of shells displayed for sale on a shell/craft vendor’s road-side stall in Tobago. Shown are mature adult and juvenile queen conch, *S. gigas* (back rows), a single mature adult milk conch, *S. costatus* (second row, right), several dark apple snails, possibly *Pomacea urceus* (front row left), a hawkwing conch, *S. raninus* (front centre), an Atlantic triton, *Charonia variegata* (front row, second from right) and two tulip shells, *Fasciolaria tulipa* (front row, first and third from right).

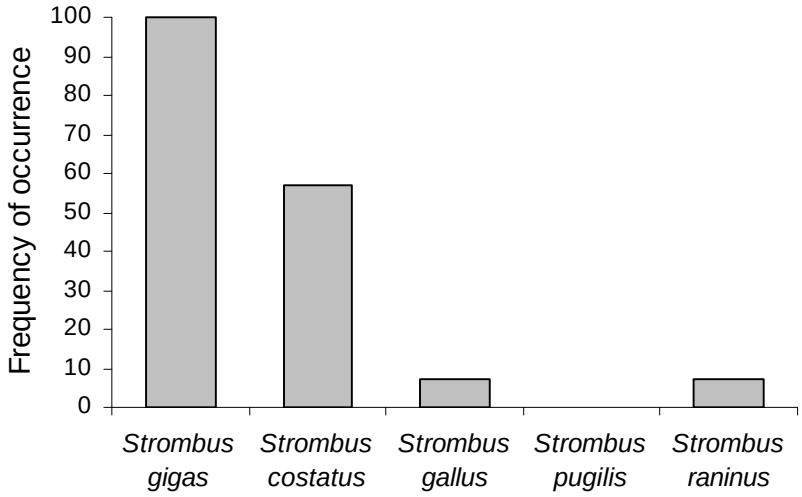

Figure 3.21. Observed frequency of occurrence of *Strombus* species displayed for sale on shell/craft vendors’ stalls in Tobago.

Whole shells are sold primarily to locals and tourists alike, and three vendors also reported sales to specialty craftsmen. Conch shells are sold year round and most shell vendors state that demand is high, although it varies with the strength of the tourist season. The majority (9/14) of shell/craft vendors state that the queen conch is the most popular species of conch shell among customers, whilst the preferred size of shell reportedly varies. One vendor mentioned that he knew of countries where tourists could not take conch shells, but none appeared to have been aware of the 1999-2006 trade embargo in conch products imposed on Trinidad and Tobago.

Shell prices are fairly standard among vendors, typically ranging between TT$ 20-50 for small 'rollers', around TT$ 50 – 75 for large juveniles/subadults and TT$ 75-150 for large mature adults with a fully formed lip. Interestingly half of the shell vendors interviewed admitted that they increase their prices during high visitor periods and reduce them during the low season in order to remain competitive.

Most shell/craft vendors (8/14) also sell queen conch shells fashioned into conch blowers and some sell decorative conch halves (Figure 3.13). The main buyers of conch blowers are locals, especially Trinidadians of East Indian descent and Hindu priests known as 'pundits'. Prices of conch horns range between TT$ 50 – 100.

Most shell/craft vendors were unable or unwilling to report their typical volume of sales. However, one vendor reported selling around 9 - 12 queen conch shells per week, and another reported sales of 6 to 10 blowers a week.

Earnings and livelihood dependence: With prices ranging from TT$ 20 for small roller shells up to TT$ 150 for large adult shells, a vendor can gross anywhere between TT$ 180 and TT$ 1,800 in a week if he/she sells the stated range of 9 to 12 shells a week. However, although shell vending can clearly generate income, none of the vendors are dependent on queen conch shell sales for their survival, and most (10/14) attribute less than 25% of their annual income to conch shell sales. These vendors also sell a variety of other items including crafts, and many of them cited additional occupations as sources of income including: carpentry, masonry and welding.

Marketing pathway

The structure of the marketing pathway in Tobago for locally caught conch shells is very simple and is summarised in Figure 3.22. Whilst there are no export records for conch shells, those sold to tourists presumably leave the country as personal effects.

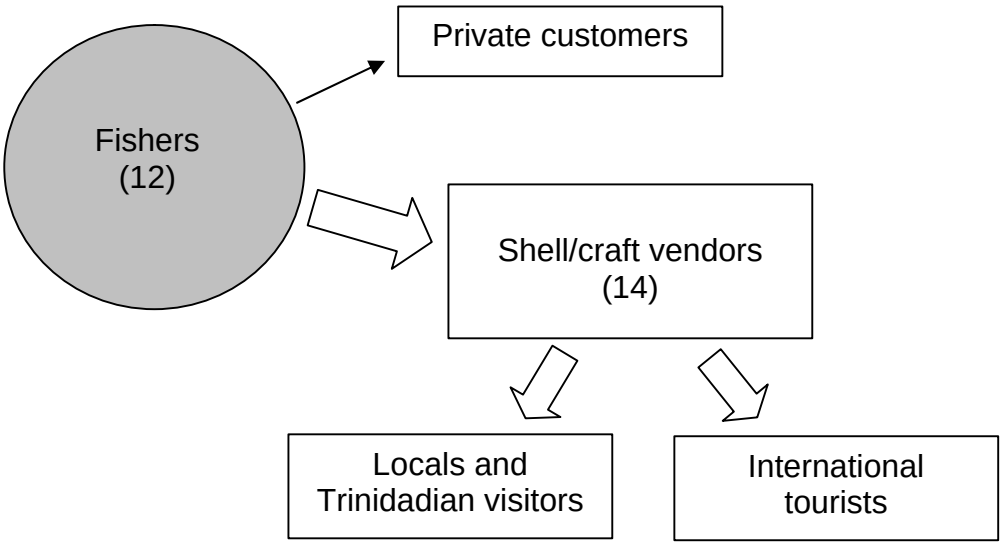

Figure 3.22. Marketing pathways for locally caught queen conch shells in Tobago as determined from interviews with stakeholders. Size of arrow indicates approximate importance of pathway, numbers of operators shown in parentheses where known.

4.0 DISCUSSION

4.1 The Fishery

The Tobago queen conch fishery is similar to that of several other eastern Caribbean islands with small shelf areas, in that it is small scale, artisanal, open access and unmonitored (Table 1.1, Theile 2001, Luckhurst and Marshalleck 2004). Also in common with other eastern Caribbean islands, especially Barbados, the queen conch is not often the target species unless a specific customer request is being fulfilled (Oxenford et al. 2008); rather it is harvested opportunistically while fishers engage in other forms of fishing, such as spearfishing for reef fishes or diving for the higher priced spiny lobster. Furthermore, as with Barbados, catch per fisher per trip is low (modal reported catch: 36 conch per trip; observed catch: 16 conch per trip), and none of the fishers rely solely on their conch harvest, although it does contribute to their livelihood. However, unlike Barbados, there are strong indications that the Tobago conch fishery was once an established and thriving fishery in the 1960s and 1970s, and is now in a severely depleted state (e.g. Lovelace 2002, Luckhurst and Marshalleck 2004).

A total of 26 fishers, from 10 communities around the island were identified as being active in today's conch fishery. The majority of these fishers are located in southwest Tobago, particularly in Buccoo village. Conch is also harvested occasionally by recreational divers, although the numbers of such divers and frequency of their opportunistic harvest remains unknown.

Most of the conch fishing grounds are located on the southwest shelf of Tobago although a few are located off the northeast coast. All the grounds in the northeast are deeper than 14 m and require the use of SCUBA. As such, they are harvested less frequently than those in the southwest, most of which are within 1-14 m depth and accessible by free diving.

Based on observation and interviews with the 24 fishers a crude estimate of the annual conch harvest in Tobago currently lies somewhere between 19,000 and 43,000 conch, yielding somewhere between 4 and 9 mt of uncleaned meat annually. The estimated annual catch is less than that reported by many range states with similar numbers of active fishers (Table 1.1) but is likely greater than the landings perceived by the Tobago House of Assembly's DMRF. Furthermore, the annual harvests of conch in Tobago today would appear to be considerably smaller than they have been over the past two decades, given the anecdotal evidence of declining stocks (Brownell and Stevely 1981, Lovelace 2002) and the past catches of several retired fishers interviewed during this study, who reported that landings of 15-20 dozen conch per boat per day for six months of the year where not unusual (c.f. today's modal reported catch of 3 dozen per trip).

The majority (63%) of conch fishers use SCUBA at least some of the time and some fishers reported diving as deep at 140 ft (43 m) to harvest conch. The use of SCUBA for harvesting conch is generally a matter of concern for the conservation of the resource as it allows fishers to exploit queen conch at greater depths and in larger numbers than is possible with free diving (Theile, 2001). Adult conch are often found in deeper waters which, if they remain inaccessible, could serve as a refuge for breeding stock. This is particularly important where densities of adults on shallow fishing grounds are low, since a high density of spawning individuals (>56 conch ha^{-1}) is believed necessary for successful reproduction and stock replenishment (Stoner

and Ray-Culp 2000, Gascoigne and Lipcius 2004). A further factor to be considered in allowing the use of SCUBA gear is that of unsafe diving practices which were reported by a few of the interviewed Tobago conch fishers in this study. Diving deep and without proper training and equipment clearly has implications for fishers' health and safety. It is well known that as conch become scarce in shallow water, and fishers begin harvesting them at greater and greater depths, so dive related accidents and even fatalities become more frequent (Espeut 1997).

The majority of Tobagonian fishers report harvesting conch year-round, although some noted that conch were more abundant at certain times of the year. Most agreed that the 'best fishing' was in the summer through to December, which coincides with the warmest water and probably with breeding aggregation behaviour. Stoner et al. (1992) report that breeding in most of the queen conch range states tends to be concentrated during the summer months, although in the southern Caribbean he notes that it may extend beyond the summer. As such, most countries exercise a summer closed season to protect breeding aggregations. Furthermore, most countries have a minimum legal size, to ensure that conch reach sexual maturity before harvesting begins. Although there is no size restriction in Tobago on conch harvested, some fishers were observed leaving small juveniles 'so that they could mature', and a few fishers even attempt to conceal small conch in seagrass or in rock crevices in order to protect them from being harvested by other conch fishers. However, there does not appear to be a consensus among Tobagonian fishers on what the minimum harvestable size should be. There is indeed, considerable overlap in shell length between large juveniles and mature adults in Tobago, and meat weight is very similar, complicating the selection of a rational minimum size based on either shell length or meat weight. Presence of a flared lip is therefore likely to be a more sensible criterion for selecting a legal size, as in done in several other fisheries (Table 1.1).

Since large juveniles and adults are equally valuable for their meat, all sized shells are in demand. Furthermore, there are no legal restrictions on harvesting conch (apart from within the no-take Buccoo Reef Marine Park which appears to be disregarded by many fishers anyway). It is therefore not surprising that the current harvest is dominated by juveniles (73% of the catch) that tend to be more abundant in nearshore, shallow water which is more accessible. However, this has serious implications for the ability of the current stock to replenish itself.

4.2 Processing and Marketing

Considering the small-scale nature of the fishery it is not surprising that there is no formal system for the landing, processing and selling of conch on the island. Rather, the marketing of conch meat is done by individual fishers directly to private customers; whilst shells are generally sold in bulk to shell/craft vendors for processing and retail. This appears typical of other small scale fisheries, for example the conch fishery in Barbados (Oxenford et al. 2008). The vast majority of the catch is processed ashore, removing the meat by 'knocking' a small hole in the shell, which is subsequently sold on to shell/craft vendors. This is in contrast to Barbados, where the meat is extracted after freezing if the shell is to be sold, so that shell remains 'undamaged'.

The fishers avoid discarding shells in the water since it is believed that this practice causes conch to vacate the area. Meat processed for sale in Tobago appears to be 'cleaned' to the same extent as a 65% or 'semi-fillet' grade in the Jamaican conch processing industry. However, from the very small sample size in this study, it would appear that the average soft body weight per 'cleaned' conch (196.3 g, n=16) is much greater than the weight of a 'semi-fillet' grade in the

Jamaican fishery (108.9 g; Theile 2001), but less than a cleaned conch in Barbados (247 g, n=11; Oxenford et al. 2007).

The conch market in Tobago can be described as a rather exclusive one. Tobagonian conch meat is marketed primarily to private customers and informal 'eateries' located in Store Bay, frequented by locals and visiting Trinidadians. Curried conch and dumplings is available on the menu of all six Store Bay beach kiosks year round. Conch souse was once a very popular dish, and was sold in villages throughout Tobago in the past, but is no longer as common (DeLarosa, pers. comm.)[6]. The reduced availability of conch dishes may be indicative of a diminishing supply.

Demand for conch meat in Tobago is apparently higher than the local supply, as the supermarkets and wholesalers regularly import conch meat to satisfy demand and there is no export of conch meat from Tobago. A similar situation is reported for Guadeloupe, Martinique and the Netherland Antilles, where domestic demand far exceeds local supply (Mulliken 1996). Imported conch fillets can be purchased from supermarkets for TT$ 77 – 85 per kg, whilst local conch sells for TT$ 55 – 333 per kg. The modal price of approximately US$ 20 per kg is considered relatively high, for example in Jamaica a typical supermarket price would be US$ 7 per kg (Theile 2001) and even in Barbados conch meat typically sells for US$ 8 – 18 per kg (Oxenford 2007). This may be a further indication of a diminishing resource in Tobago.

Conch meat is never discarded although this is often the fate for shells. Like the majority of the other range states, conch shells are considered a by-product of the fishery. The primary market for sale of conch shells in Tobago is generalized souvenir shops, this is different from the shell market of Barbados with 20 vendor stalls specialising in shells only (Oxenford et al. 2007). The price of conch shells in Tobago ranges from US$ 3 -25 depending on size and quality, which is similar to the range of prices reported by Oxenford et al. (2007) for the Barbados shell market. Unlike the Barbados shell market that is supported primarily by international tourist customers, the Tobago shell market is commonly patronised by locals and visiting Trinidadians.

4.3 Socioeconomic Contribution

The queen conch fishery is relatively small and the revenue generated is a likely a small fraction of the revenue generated by the other fisheries on the island. However, the fishery clearly provides significant supplementary income to both the fishers and shell/craft vendors, although none of those interviewed said they were totally dependent on the sale of conch for their livelihood. Given the modal price of TT$ 300 per dozen conch, and the amount of conch reportedly sold in a week (1-25 dozen), a typical fisher/vendor could gross anywhere between TT$ 300 and TT$ 7,500 in a week from the sale of conch meat. Likewise, shell vending could generate gross earnings of up to TT$ 1,800 per week.

The fishery also has cultural significance, providing conch horns for religious and musical festivals and supporting traditional menus.

[6] Reginald DeLarosa, interview with the author, 26 August, 2009.

4.4 Management

Most fishers perceive that conch abundance has declined in Tobago, but consider it to be only a slight decrease. As such, the majority of fishers did not suggest any management options since they do not see the fishery as being threatened. This apparent lack of support for management will make the task harder and indicates that stakeholder participation will be very important in the management planning process, if it is to have any success. While the fishers were cooperative in participating in the questionnaire, some of them were unwilling to attend a stakeholder meeting for fear of being identified by the DMRF. This expressed suspicion in the absence of regulations on queen conch, further indicates the need for fisher participation in the decision making process.

There is currently no regulation of the conch fishery in Tobago. This open access and unmonitored fishery has facilitated the poor fishing practices seen in Tobago today, such as the indiscriminate harvesting of juveniles, the harvesting of conch year-round and from spawning aggregations, and the disregard for the no-take Buccoo Reef Marine Park. Lovelace (2002) even suggested that the protected area is more heavily fished for conch than unprotected areas.

Some management issues include:

1. *What measures are needed to inform conch fishers and vendors about the species and its status?* Some conch fishers have limited knowledge on the biology of the species. For instance, there are many fishers who commonly refer to large juveniles as 'swell backs' and mature adults as 'broad fins', and regard them as 2 separate species. Many shell vendors believe mature adults are hundreds of years old. Furthermore, few appear to be aware of CITES, or the Appendix II status of conch and its implications.

2. *How to monitor such an informal and opportunistic fishery?* The DMRF in Tobago has initiated a system of registration for fishers; however, to date there are no individuals registered as conch fishers. Since conch fishing is opportunistic and there is no formal landing site or market for conch, it will be very difficult to know when and where fishers are diving for conch or landing it. This will make it very difficult to monitor landings or enforce gear and size restrictions unless it is done voluntarily under some sort of co-management arrangement between conch fishers and the DMRF.

3. *Which of the existing management tools available would be most effective for the conch fishery of Tobago?* Gear and size restrictions will be very hard to monitor in the existing fishery (as stated above). Although it may be possible to prevent the use of SCUBA; without other regulations it would likely result in increased fishing pressure on shallow water juvenile conch. Limiting harvest through quotas would not be practical in the absence of landings records. A closed season to coincide with peak spawning may be feasible, and improving the enforcement of the no-take Buccoo Reef Marine Park would certainly help in protecting a breeding population. A complete closure of the fishery for a number of years to allow recovery may be warranted and was even suggested by more than one fisher. Initiating some form of co-management between the conch fishers and vendors and the DMRF with the introduction of a limited entry system would seem the most practical option, especially given the small size of the fishery and the relatively few fisher and vendor stakeholders.

4. *What are the socioeconomic implications for fishers and vendors of implementing management?* Earnings from the conch fishery appear to be negligible and the majority of the stakeholders attributed less than 25% of their income to the harvest and sale of conch. Given this, and the fact that all stakeholders had other sources of income, the impacts of reduced catches/sales of conch are unlikely to be devastating to anyone. As such a closed season, and/or effective closed area(s) or even a complete closure of the fishery for a few years may be feasible, especially as compensation for loss over the short term would not be astronomical given the small number of stakeholders.

4.5 Conclusion

This study has documented the extent and nature of the current conch fishery and marketing structure in Tobago, identifying 26 active conch fishers and 14 shell/craft vendors, their average catches and sales, the main fishing grounds, fishing practices, seasonal patterns in harvest and the size/age structure of the landings.

It is fairly clear that today's fishery is still culturally important, and contributes to the livelihoods of approximately 40 key stakeholders, but is in a depleted state when compared with anecdotal reports of Tobago's conch fishery in the 1960s and 1970s. Conservation-based management will be critical if the resource is to be replenished and the fishery revived in the future.

These data should facilitate the development of a national management plan by providing a basis for informed management decisions and the selection of appropriate management tools to ensure a sustainable queen conch resource is maintained into the future. Furthermore, identification of the key stakeholders (fishers and vendors) will enable their engagement in co-management of the fishery, protection of their livelihood and incorporation of traditional knowledge into education and awareness programmes. This will be particularly important given their current knowledge gaps regarding conch biology, stock status and international regulation, and their perception that management is not warranted in this fishery.

The information provided here will also allow Trinidad & Tobago to begin fulfilling its commitments to CITES and the SPAW Protocol.

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APPENDIX 1

CONCH FISHER SURVEY

Data Collector:……. Date:……

Fisherman:…… No.:…….

1. Location:..... …….....…

2. Are you a resident of this area? Yes ? No ? where.....

3. What types of shellfish do you catch?
   Queen Conch ? Milk Conch ? Helmet Shell ? Fighting Conch ?
   Whelks ? Others ? ……

4. Do you fish for conch year round? Yes ? No ?

5. a. If yes: Daily ? Weekly ? Fortnightly ? Monthly ?
   b. How many trips do you make: Daily:…….Weekly:……Fortnightly: ……..Monthly:……

6. If no: At request ? By chance ?
   Certain time(s) of the year:……
   Reason for preferred season:……

7. How many conch, on average, do you catch per trip?.....

8. How do you catch conch? SCUBA/tank ? Snorkel/free dive ? Other ……

9. What do you dive from? Boat ? Shore ? Float ?

10. Do you dive: Alone ? Partner(s) ? How many?.....

11. 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 ?

12. Where do you dive for conch?

Site No	Location	Depth	Distance offshore	Substrate type			
				Sand	Rubble	Seaweed (Macro algae)	Seagrass
1							
2							
3							

4							
5							
6							
7							
8							
9							
10							

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

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

15. Do you know of any other conch divers at all? Yes ? how many?..... No ?
Name/contact:

16. Do you have a landing site? Yes ? No ?
Where?.....
17. Have you noticed a change in the number of conch at the sites? Yes ? No ?

18. If Yes, Fewer ? Far fewer ? More ? Far more ?

19. Over what time period have you noticed this change? …….

20. What do you think is the cause of this change?.....
.....

21. What do you think can be done to maintain/increase the amount of conch available?

22. Do you process the meat yourself? Yes ? No ? Who?.....

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

Conch Type Meat Use Shell Use	Meat use			Shell use			Comments
	S	P	D	S	P	D	
Queen conch							
Helmet conch							
Milk conch							
Fighting conch							
Whelk							
S – sell, P – personal consumption, D - discard							

24. To whom do you sell the shells: individuals (I), vendors (V), stores (St) and in what numbers per month?

Conch type	Shell customer									Price			Comments
	I			V			St						
	S	M	L	S	M	L	S	M	L	S	M	L	
Queen conch													
Helmet conch													
Milk conch													
Fighting conch													
Whelk													
I – individual, Vendor, St – store, S – small, M – medium, L - large													

APPENDIX II

CONCH MEAT VENDOR OR SHELL/CRAFT VENDOR SURVEY

Data Collector:……. Date:……
Location:…… Vendor Type: .....

1. What conch items are on sale?
Conch Meat ? Whole shells ? Jewellery ? Conch horns ?
Other ? …….....

SHELL VENDORS

2. How do you obtain the conch shells?
Self (S) ? Other Diver/fisher ? No. of divers ..... Other ? …….

Please provide names and contact information of 'other fishers/divers' if at all possible:
.....
.....
3. Where do the other conch shell products/crafts come from?
Self (S) ? Other Craftsman (OC) ? Imported (I) ? from .....

4. List all the conch curio items on sale and their prices.

Name of item and Source	Purchase price	Retail price

5. What price do you pay for/sell the various sizes and species of conch shells?

Conch type	Shell source			Purchase Price			Retail Price		
	S	**OF**	**I**	S	M	L	S	M	L
Queen conch									
Helmet conch									
Milk conch									
Fighting conch									
Whelk									
S – Self, **OF** – Other fisher, **I** – Imported, S – Small, M – Medium, L - Large									

6. Which is the most popular/frequently sold species of shell?
.....

7. Where do you sell the conch shells?
Beach ? Roadside Stand ? Souvenir Store ? Other ? ……

8. Who buys the conch shell items and in what numbers per month?

Shell items	Number of buyers					
	Locals	Tourists	Vendors	Craftsmen	Stores	Other
Whole shells						
Jewellery						
Conch horns						

Details of main buyers:
.....
.....

MEAT VENDORS

9. Where does the conch meat come from?
Self (S) ? Other Fisher (OF) ? #.....Imported (I) ? from .....

Please provide names and contact information of 'other fishers/divers' if at all possible:
.....
.....

10. Where do you typically sell your conch meat and at what price? What percent of catch is sold in the following markets? Complete table:

Market	Name	Price per dozen	Percent of total sales
Restaurant/Hotel			
Supermarket			
Beach market			
Private sale			
Consumed in household	NA		
Other			

11. What quantity of conch meat do you sell a week?.....

12. Who buys the conch meat and in what percentage?
Individuals ? …… Vendors ? ……. Restaurants …… Stores ……..

Details of purchasing arrangement …….....
.....

ALL VENDORS

13. What is the seasonal availability of conch (meat and shells)?
.....

14. Could you sell more conch meat or shells if you could get more? Yes ? No ?
Explain.....
.....
15. Are there different prices during different times of the year? Yes ? No ?
Explain.....
.....
16. How many regular customers do you have?

Meat:..... Shells: .....

17. How many buyers does the product usually pass through from fisher to customer?

Meat:..... Shells: .....

SOCIO-ECONOMIC CHARACTERISTICS

18. Gender of Vendor: Male? Female ?

19. What age group do you belong to?

20 & under ? 21-30 ? 31-40 ? 41-50 ? 51- 60 ? over 60 ?

20. Are you a resident of this area?.....

21. How long have you been selling conch products?.....

22. What is your level of education/training and literacy? Complete table:

Education (primary only, secondary)	Other training (certificates, diplomas)	Ability to read/write

23. Is conch vending your sole source of income? Yes ? No ?

24. If no, from what other activities do you earn income? List all in order of importance and provide details of the season:
.....
.....
25. What percentage of your annual income would you say is derived from the sale of conch products?
<25% ? 25-50% ? 50-75% ? >75% ?

APPENDIX III

CONCH WHOLESALE SURVEY

Data Collector:……. Date:……

Company:……

1. Does your company purchase conch meat? Yes ? No ?

2. If yes, where is it sourced?
Locally ? from…… Imported ? from……

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

If yes, Hotels ? Restaurants ? Other ?

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

PRICE	**Price (TTD$)**
RETAIL	
WHOLESALE	

5. How much conch meat does your company purchase monthly?
.....

6. How much conch meat does your company sell monthly?
.....

7. Are there ever problems with supplying the demand?
.....

8. Do you supply conch meat year round or seasonally?
.....

Notes e.g. product details.....
.....
.....
.....

APPENDIX VI

BIOLOGICAL DATA COLLECTION FORM

Location: _____ Date: _____

Fisher: _____ Total catch: _____

Species	Depth	Substrate type	Shell length (cm)	Lip (mm)	Total mass (kg)	Meat mass (g)		Sex	Adult/ juvenile
						whole	cleaned		