

Using Local Knowledge and Mapping to Illustrate the Use of Queen Conch Harvesting Areas in The Sea of Abaco, Bahamas

Olivia Patterson. Friends of the Environment. Marsh Harbour, Abaco, Bahamas.

www.friendsoftheenvironment.org

Abstract

Friends of the Environment (FRIENDS) is a non-governmental organization which was established in 1988 in Abaco, Bahamas with a mission to preserve and protect Abaco's marine and terrestrial environments in order to achieve sustainable living for the wildlife and people of Abaco, Bahamas (Friends of the Environment, 2013). This project utilizes valuable local knowledge to map usage of Queen Conch (*Strombus gigas*) harvesting areas in an attempt to identify temporal changes in use of these areas. There appear to be some trending differences in usage between recreational and commercial users as well as current harvesters versus fishermen who no longer harvest conch. This project highlights the value of local knowledge and is a first step in engaging the community in a dialogue on queen conch conservation and can contribute to FRIENDS' partnership in a national "conchservation" campaign.

Keywords: Queen Conch, local knowledge, mapping

Introduction

Friends of the Environment (FRIENDS) is a non-governmental organization which was established in 1988 in Abaco, Bahamas with a mission to preserve and protect Abaco's marine and terrestrial environments in order to achieve sustainable living for the wildlife and people of Abaco, Bahamas (Friends of the Environment, 2013). FRIENDS operates under a strategic plan with four main goals: Habitat Conservation, Minimizing Human Impacts on the Marine Environment, Litter Reduction and Awareness, and Reducing Invasive Species (Friends of the Environment, 2013). This project will help inform FRIENDS' marine conservation programs. Building relationships with fishermen and putting stock in their knowledge as well as helping them to understand the status of queen conch and their

role in its conservation are all key to future conservation efforts in Abaco and The Bahamas.

The Queen Conch, locally known as conch (pronounced "konk") is a gastropod mollusc (Appendix E), which is very important to Bahamians nutritionally and culturally (Carstarphen, 1983; Randall, 1964). The Queen conch is known to exist historically throughout The Caribbean and Gulf of Mexico as well as in Bermuda, The Bahamas and Brazil (NOAA Fisheries, 2013; Randall, 1964) though some populations have become severely depleted (NOAA Fisheries, 2013). Queen conch typically live among seagrass beds or on sand flats and feed on algae (Randall, 1964). Conchs are naturally predated upon by turtles, rays, sharks, octopi and other molluscs (Randall, 1964). Because conchs are slow-moving and predictable, their

populations have been exploited by humans since the pre-Columbian arrival of Arawak and Lucayan Indians to the archipelago (Carstarphen, 1983). Conch reproduce through copulation and internal fertilization; due to their slow movement there must be a certain density of conch available to ensure successful mating (Randall, 1964; Stoner and Ray-Culp, 2000). A study in the Florida Keys using acoustic telemetry reports the home range of queen conch as 5.98 hectares (Glazer *et. al.*, 2003), while Hesse (1979) notes that the range of queen conch seems to expand as they age.

Based upon general conversations with fishermen and personal observations the author believes that there may be a shift occurring in the quantity and size of areas used by conch fishermen as the years go by. By interviewing fishermen and investigating the use of queen conch harvesting areas across generations through a mapping activity this study aims to document and illustrate any changes that have occurred (Neis *et.al.*, 1999; Pauly, 1995). The information obtained during this project can and will be used to inform future conservation projects through Friends of the Environment. The act of engaging community members in the mapping exercise inspired a lot of interesting discussion and thoughts which could be valuable to conservation planning. This project can serve as a bridge to future conservation activities that will connect the local community with the national “Conchservation” campaign, of which FRIENDS is a partner.

Methods

The target population are male fishermen (recreational or commercial) 18 years or older who live on Elbow Cay (Figure 1). The main settlement on Elbow Cay is called Hope Town. The island of Elbow Cay is often referred to as Hope Town because of

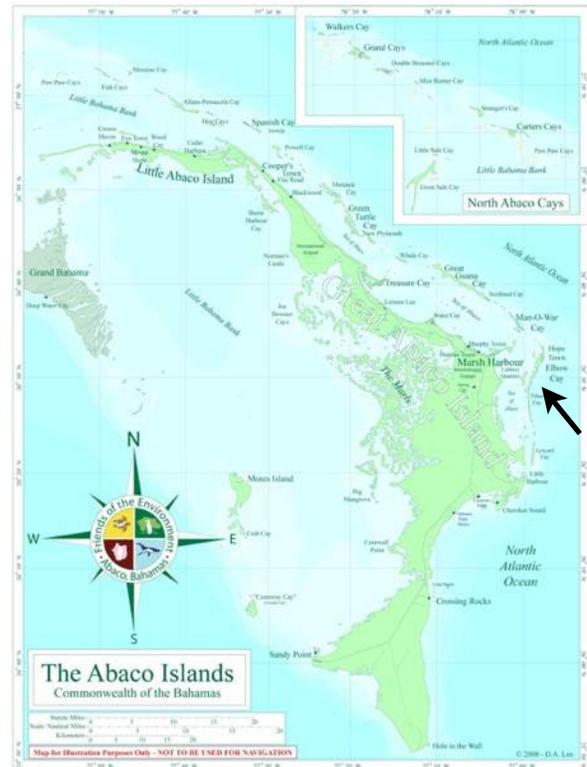


Figure 1. The Abaco Islands. Elbow Cay is marked with an arrow.

The 2010 Bahamas census lists a population of 235 males (and 223 females) in Hope Town, however these may not all be people who harvest conch. The total number of conch harvesters (or even people who consume conch) is unknown. Anecdotally, conching is not known to be a major industry for the island of Elbow Cay, but it is a very popular recreational activity and it is a common item on the menu at local

restaurants. The grouping “conch fishermen” may include those who harvest conch to sell or for personal use. Males are being targeted for this project because historically conch fishermen in Elbow Cay were mostly male. Even though many females now harvest conch, the population has been narrowed to males for the purposes of this study in order to make an appropriate comparison with older generations.

Data was collected via one-on-one interview. During each interview a short series of questions was asked (see Appendix A). Following that, interviewees were asked to outline the areas they use to harvest conch (whether current, or historical, if the fishermen does not currently harvest conch) on a hardcopy Google Earth map of The Sea of Abaco (Google Earth Pro, 2013). This area is approximately 36 miles long, so each interviewee was provided with a set of maps; section A, B and C (see Appendix B). By using Google Earth images instead of traditional charts interviewees are able to use landmarks and natural features to help reference where to delineate their harvesting areas. Islands and landmarks were pointed out to the interviewees in order to familiarize them to the maps.

Each Google Earth map image was saved at a set eye altitude of 13.46 miles and overlaid with a grid to provide some reference points to use when transcribing the maps to the computer. Some error was anticipated in the process of transcribing paper maps to the computer (Close and Hall, 2006). This error was mitigated by placing the hardcopy maps over a brightly light computer screen displaying Google Earth at

13.46 miles eye altitude. This allowed the researcher to see both the Google Earth program on the screen and the hardcopy map at the same time and accurately match and transcribe the markings of each interviewee onto the Google Earth interface.

Each harvest area that was marked by an interviewee was plotted out as a polygon on Google Earth with a shape fill of medium opacity (see Figure 4). The more harvesting areas overlap the more opaque the images become; this gives a sense of fishing pressure on an area. This allows for the most commonly used areas to be isolated for illustration purposes. Future studies could rate the level of use taking into account the number of overlaps in each geographic area. Google Earth Pro (2013) provided the area within each polygon in square meters. For simplification an online tool for area unit conversions was used as needed (Advameg, Inc., 2013). The number of sites identified by each fisherman was quantified and the average harvesting area used by all the fishermen was found.

Due to the small sample size, the author wished to extend the study beyond face to face interviews to get a better idea of the conching practices of Bahamian residents. The application “Polls for Facebook” was used to pose one of the survey questions electronically: “When was the last time you went conching?”. Respondents were allowed to vote by choosing one of six options (see Appendix C), the question was open to both males and females and it is possible that it was answered by non-Bahamian residents. The question was shared on the author’s personal Facebook page as well as that of

Friends of the Environment, and BEINGS (Bahamians Educated in Natural and Geological Sciences).

Results

About the Study Population

Ten male residents of Elbow Cay were interviewed. Of those who were asked, only one person refused the interview. Age ranges were fairly evenly distributed, however two of the respondents fell into the 55-59 age category (Figure 2).

The number of people living in each household ranges from one to five, with an average of three. This is representative of data presented in The Bahamas’ 2010 census, where the average household size in North Hope Town was 2.87 and the average for South Hope Town was 2.97 (Bahamas Department of Statistics, 2013). All interviewees and their family members eat conch. The list of family members represents

a typical population with a 50:50 male to female ratio (15:14).

Harvesting Practices

90% (n=10) of interviewees currently harvest conch, while one interviewee stopped harvesting conch in the last ten years. When looking at the number of family members that harvest or have harvested conch, a total of 50 percent (n=20) currently participate in the act of harvesting conch (not including cleaning or preparing as food). 5% stopped conching in the last five years; 10% have not collected conch in more than a decade; 10% have not collected conch for 20 years or more, 20% have never collected conch before (to the best knowledge of the interviewee) and 5% of interviewees had no additional people living in the house. If the interviewees and their family members were pooled, that would mean a total of 63.33% of people interviewed on Elbow Cay currently harvest conch

Age distribution of male interviewees from Elbow Cay, Abaco, Bahamas

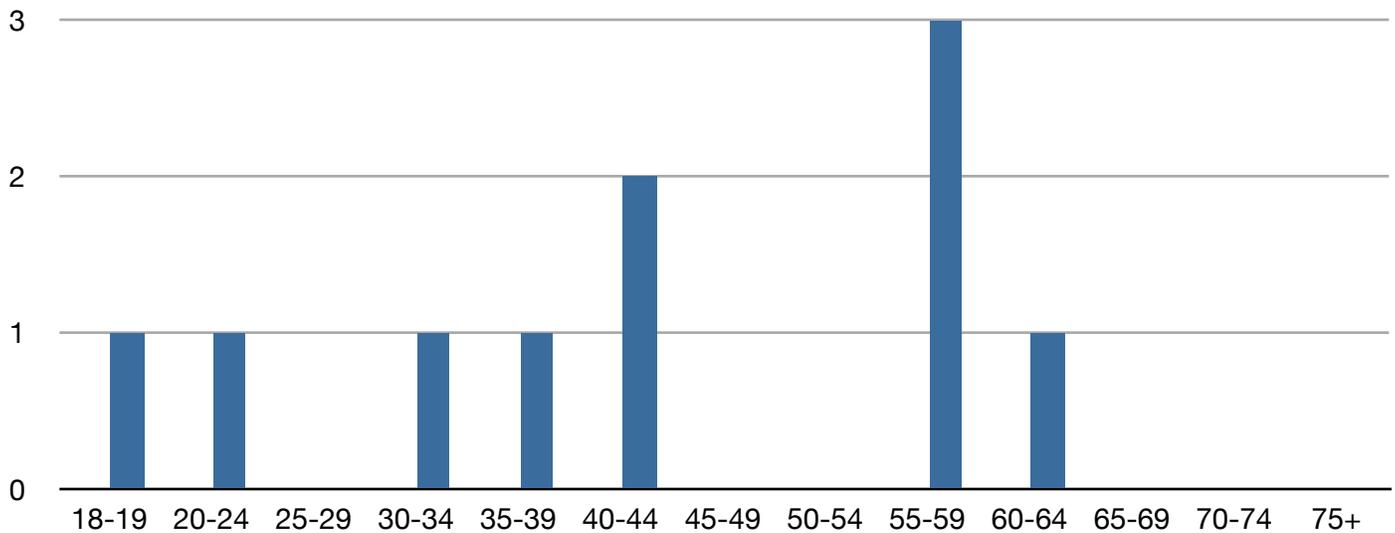


Figure 2. The age distribution of male interviewees who are resident to Elbow Cay, Abaco, Bahamas. (n=10)

(n=30). For interest, these data were combined with the results of the Facebook Poll (Appendix C) to increase the sample size to 54. The graph in Figure 3 represents responses from males and females of varying

ages who are residents of islands in The Bahamas. Because there was no way to exclude any non-residents from answering the poll is possible that some of the responses are from non-Bahamians.

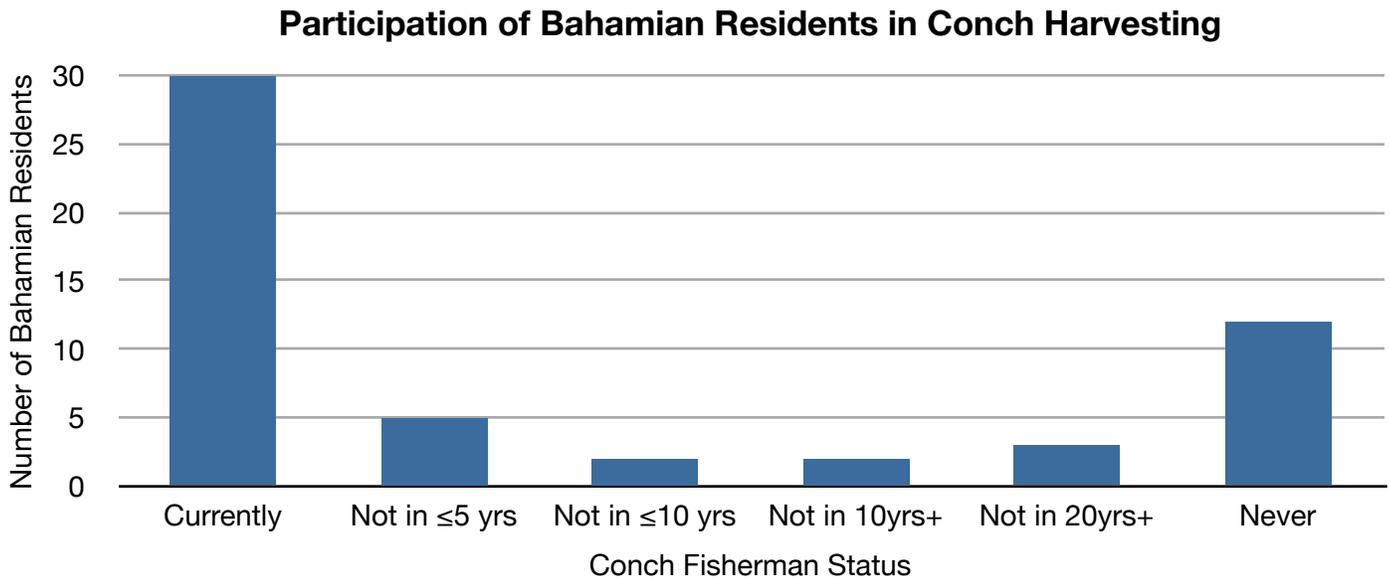


Figure 3. A chart showing the interaction of Bahamian residents in conch harvesting over generations (n=54). Respondents selected either: I currently fish for conch, I stopped in the last 5 years, I stopped in the last 10 years, I have not collected conch for more than a decade, I have not collected conch for more than 20 years, or I have never harvested conch before.

The most common gear types cited are power boats and snorkeling gear as these are the modern method of harvesting conch. Older interviewees have used or observed the use of other gear such as sailboats and conch hooks (Figure 4). Interviewees who currently go conching do so an average of 20.22 times per year (standard deviation=17.13, median=15 times/yr) and collect 13.67 conch per day, on average (standard deviation=7.63, median=12 conch/day).

The majority of conch currently harvested by interviewees is for personal consumption. The one respondent who

stopped harvesting conch in the last ten years used to sell about 75% of the conch he harvested; while a current commercial fisherman sells 98% of the conch he collects.

The average number of conch harvested by recreational users is 11.63 per day (standard deviation=4.87, n=8), while the average number harvested by commercial users is 75 per day (standard deviation=63.64, n=2).

Mapping

The mapping exercise showed some grouping in areas commonly used for



Figure 4. An Abaco fisherman using a conch hook (photo credit: Cindy Pinder)

harvesting conch. In particular, one site off the North End of Elbow Cay is frequently visited (Figure 4). Fishermen who currently harvest conch ($n=9$) mapped out an average of 3 sites ($st.dev.=1.87$). The fisherman who stopped conching in the last ten years ($n=1$) mapped out 7 sites. The average total harvesting area used by fishermen who currently collect conch is 5.87 square kilometers ($st.dev.=10.84$ km. sq.). The total harvesting area used by the fisherman who stopped conching in the last ten years is 1.84 square kilometers.

Locations where harvesting areas marked by two or more fishermen overlapped were isolated (Figure 6) and the total area in square meters was quantified. Figure 6 illustrates the areas of common overlap in

harvesting off the North End of Elbow Cay (Figure 5).

The total area of harvesting locations identified by interviewees was 54,705,093 square meters. The total area of polygon overlaps (by two or more polygons) was 9,510,514 square meters or 9.51 square kilometers.

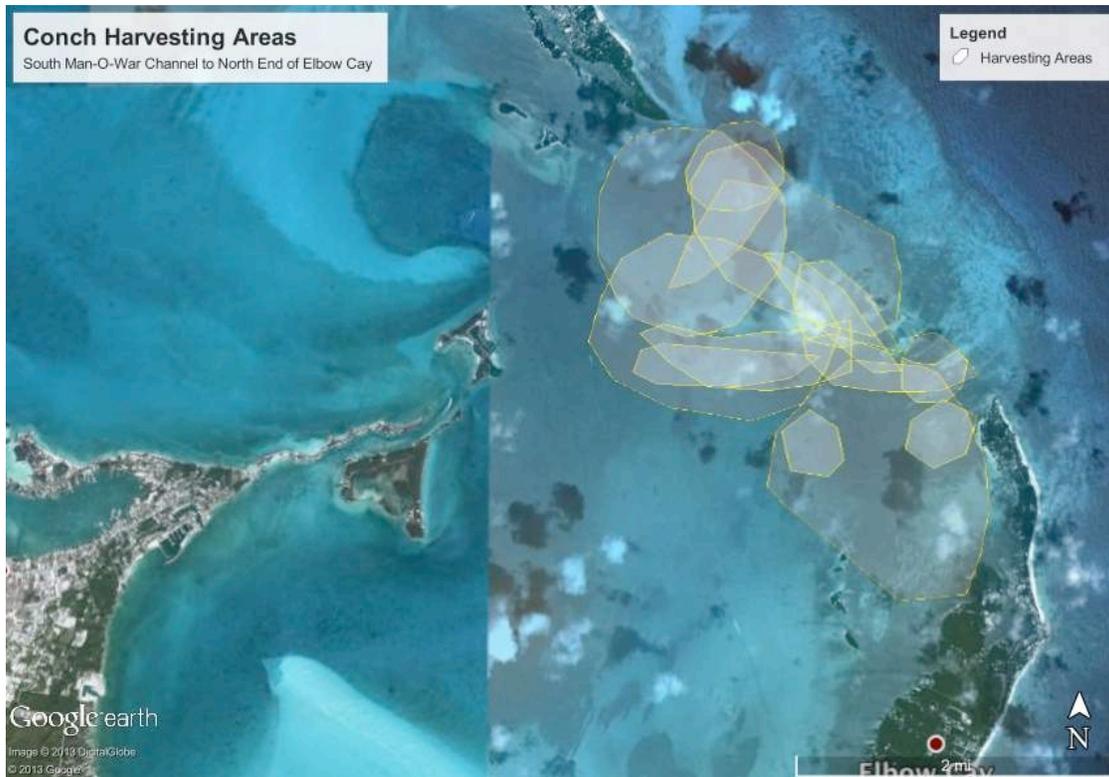


Figure 5. A sample of the mapping data showing the most frequently cited queen conch harvesting area for Elbow Cay fishermen in the Sea of Abaco, off the north end of Elbow Cay (Google Earth Pro, 2013).



Figure 6. Commonly used harvesting grounds off the north end of Elbow Cay. All areas within the red lines are used by 2 or more fishermen interviewed for the study.

Since most of the interviewees currently collect conch, the researcher decided to group responses by age (see Figure 2) to see if that was a factor in the number of areas used for harvesting and the size of those areas.

Table 1. Conching practices of Elbow Cay males who currently harvest conch by age group

	18-24	30-44	45-54
Average # of conch harvested	12.5	14.5 (rec.+comm.)* 9.33 (rec. only)	13.3
Average # of sites identified	3.5	3.25	2.3
Total average harvesting area (km sq)	1.62	9.40 (rec.+comm.)* 1.12 (rec. only)	4.01

* rec.=recreational, comm.=commercial

Table 2. Conching Practices of Elbow Cay males by activity type

	Average # of conch harvested per day	Standard Deviation	Average # of sites identified	Standard Deviation
Current harvesters	13.67	7.63	3	1.87
Commercial harvesters (past and present)	75	63.64	6.5	1.6
Recreational harvesters (past and present)	11.62	4.87	2.62	0.71

Some randomly selected comments from interviewees include (see Appendix D for full responses):

- Conching for me has always been a Bahamian family and cultural experience. I hope it is still possible for my grandkids.
- There should be a conch season.

- There aren't many conch left, so many people don't go conching anymore.
- Conching is fun. It's a good experience to be able to catch your own food.
- People are catching undersized conch - especially tourists. Most know the rules, but they still break them.

Discussion and Reflection

The process of doing the interviews actually engaged community members a lot more than expected; and it was enjoyable to host them. Once the men began answering questions about their conching practices, they also began talking about their most favourite experiences and what conching means to them. All interviewees eat conch and the majority of fishermen who currently harvest conch expressed how much they enjoy the experience: from the search, to harvesting and cleaning, and preparing to eat queen conch. Conching is an activity that involves the whole family (and friends) and provides a way for people to enjoy the outdoors and a true Bahamian cultural experience. Visitors to Abaco enjoy participating in the experience as well (L. Rolle, personal communication, October 8, 2013). The owner/captain of a small local island-hopping boat excursion said that 25% of his customers ask to go conching (J.S. Patterson, personal communication, October 9, 2013); as part of the experience they learn how to harvest and clean conch and the captain prepares a local dish - conch salad - for them to try.

On November 22, 2013, FRIENDS held an Abaco-wide science fair under the theme "Human Impacts to the Marine Environment". Participating schools were encouraged to investigate current issues in Bahamian marine conservation and discuss possible solutions to problems being faced in our islands. The winning project in the upper primary category was entered by Hope Town

School; their focus was the Queen Conch and they collected data through a survey (Appendix G). Since their topic paired so well with the current study, the author made a visit to the school on November 28, 2013 to discuss this study and interview the students about their project. The author also gave a lesson on using Google Earth for mapping and collecting data about land use (i.e. we investigated if there was a gender-based difference in how the class uses the local sports park). The students and their teacher gave permission to share some of their results as part of this paper.

The majority of Bahamian residents in this study currently harvest conch or have done so at some point in their lives. While the averages are all very similar, it seems that older fishermen tend to use less harvesting sites, but cover more ground and commercial fishermen collect more conch from more locations than recreational fishermen. Current conch fishers utilize less sites and cover more ground than the fisherman who stopped conching in the last 10 years. Some of the older men who still harvest conch expressed that they used to harvest in more areas and that conch are not found in some of the areas they used previously. Excepting commercial harvesters, fishermen typically take an average of a dozen conch at a time, which is enough for a couple meals or to share with friends (Hope Town Primary reports that 47% of Hope Town locals collect 6-10 conch per time, n=34). This could be a form of self-policing if fishermen see the value of leaving

conch in the sea to reproduce. Also, conch is often eaten raw for conch salad so fishermen would prefer to have a fresh catch straight from the sea, rather than frozen.

There are some concerns about the use of local knowledge for science and the integration of the two (Chalmers & Fabricius, 2007). However, because this study focused on fisherman behaviour versus ecological knowledge the content is appropriate. This study (and that of Hope Town Primary) highlights the value of local knowledge to conservation and serves as a reminder that the community should be an integral part of conservation initiatives, especially when species as iconic and cultural as the queen conch are involved. Information gathered from these studies can be used to identify gaps in community knowledge and set priorities for awareness initiatives. For example, the Hope Town Primary survey revealed that 100% of locals were able to correctly identify a juvenile conch, yet only 75% of visitors could. 94.1% of local/recreational fishermen believe that conch are being overfished in The Bahamas (n=34), while only 66.7% of local/commercial fishermen do (n=6). What are the reasons for this difference in belief? There are more answers to be found in the local knowledge of Elbow Cay.

Results for this study seem to indicate that it is becoming harder to find conch and that they occur in less areas than historically. Further repetition of the mapping interview could help confirm that trend, which has also

been anecdotally observed. If the interview process were repeated additional questions could be added to ask fishermen how long they have been (or had been fishing for), or what age they were when they started conching. A more detailed survey could also tease out whether the conching practices of each fisherman had changed over the years. Information about the average time spent to gather conch could help determine a catch per unit effort, which is one way to monitor the sustainability of a harvest (Maunder *et. al.*, 2006). This could be ground-truthed through in-situ surveys of conch and their habitat. Pairing the results of this study with ecological and environmental data about the harvest areas could help determine why some areas seem to be more sustainable than others.

Next steps for this study, and for FRIENDS, will be to build on the partnership with the Bahamas' National Conchervation Campaign, Community Conch and others involved in current initiatives to work towards a sustainable queen conch fishery. FRIENDS will be partnering with Community Conch and The Bahamas National Trust to implement the My Science My Conch project (Community Conch, 2013) on Abaco in January 2014. The author is also developing some graphic ads for social media which promote the ecological consequences of breaking the laws that protect queen conch (Appendix F).

Acknowledgements

Thank you to all the Hope Town residents who agreed to be interviewed and who offered extra information about their conching practices and to my Facebook friends for sharing photos and videos relevant to conching for my research. Thank you to the

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Appendix A - Interview Questions

The purpose of this research is to illustrate past and current use of Queen conch harvesting areas in The Sea of Abaco and is being conducted as part of Olivia Patterson’s work in a Master’s program at Miami University. Participation in the interview is voluntary and you may stop at any time. Confidentiality and anonymity of responses will be maintained to the highest degree possible. If you have any questions you can contact Olivia Patterson at Olivia@friendsoftheenvironment.org. If you have questions or concerns about the rights of research subjects, you may contact the Research Compliance Office at Miami University at (513) 529-3600 or humansubjects@miamioh.edu.”

1. Please select your age bracket

- | | | |
|----------------------------------|----------------------------------|--------------------------------------|
| <input type="checkbox"/> 18 - 19 | <input type="checkbox"/> 40 - 44 | <input type="checkbox"/> 65 - 69 |
| <input type="checkbox"/> 20 - 24 | <input type="checkbox"/> 45 - 49 | <input type="checkbox"/> 70 - 74 |
| <input type="checkbox"/> 25 - 29 | <input type="checkbox"/> 50 - 54 | <input type="checkbox"/> 75 and over |
| <input type="checkbox"/> 30 - 34 | <input type="checkbox"/> 55 - 59 | |
| <input type="checkbox"/> 35 - 39 | <input type="checkbox"/> 60 - 64 | |

2. How many people are there in your household (including yourself)?

3. Who in your household eats conch currently? Please include yourself and give ages and genders only (no names).

	Gender (male or female)	Age		Gender (male or female)	Age
#1			#4		
#2			#5		
#3			#6		

4. Has anyone in your household chosen not to eat conch? If yes, why?

5. When did/do you go conching?

- I currently fish for conch
- I stopped in the last five years
- I stopped in the last ten years
- I have not collected conch for more than a decade

6. To the best of your knowledge, please list the number of family members (not including yourself) that fall into the following categories:

- _____ Currently collect conch
- _____ Stopped conching in the last five years
- _____ Stopped conching in the last ten years
- _____ Have not collected conch in more than a decade
- _____ Have not collected conch for 20 years or more

7. List or explain the type of gear you use(d) for conching (including boat type, hook, snorkel gear, conch breaker etc)

8. How many conch would you typically harvest in a day?

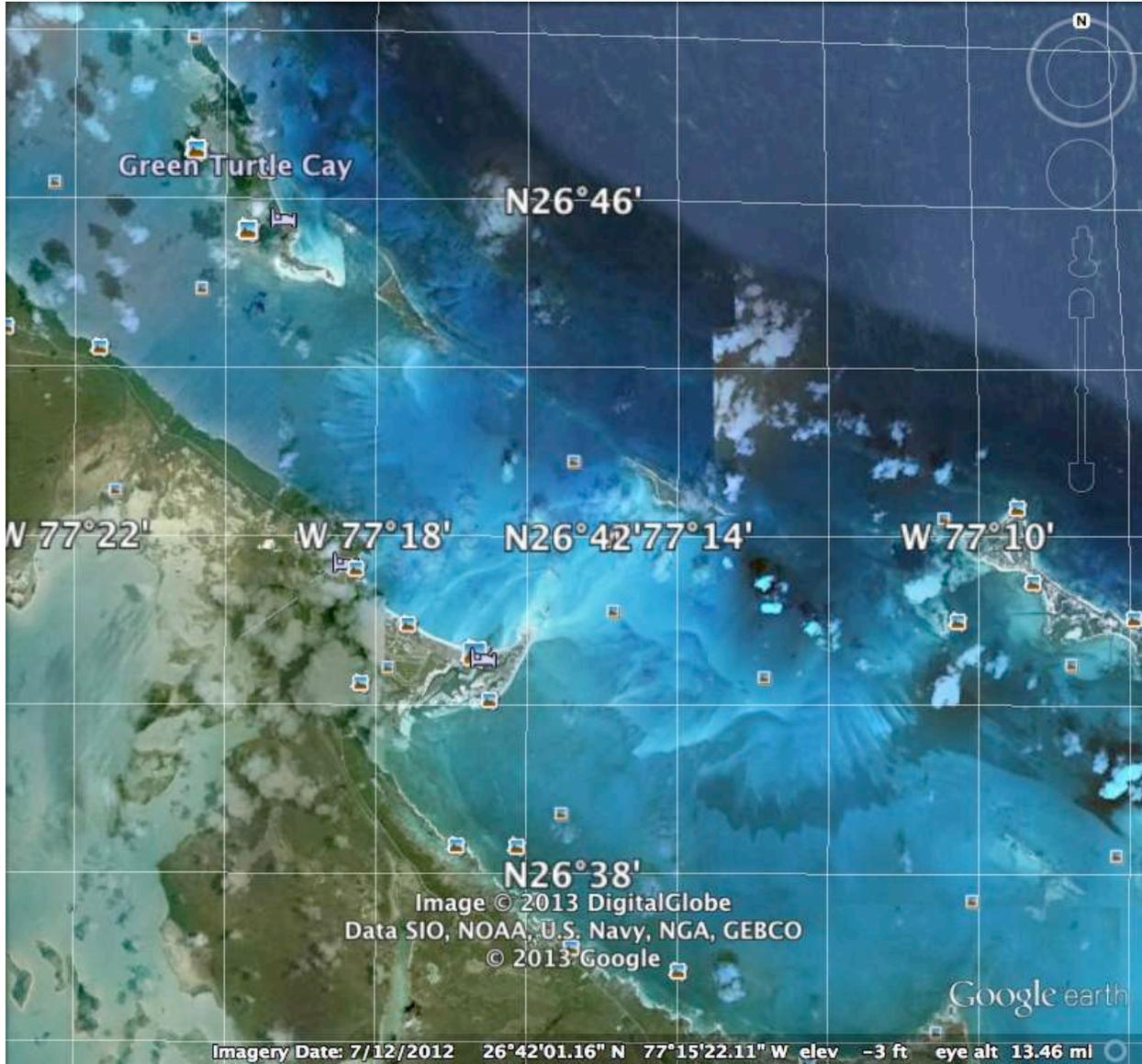
9. Approximately how many times per year do/did you go conching?

10. What percentage of the conch was for recreational/personal _____ or commercial _____ use?

11. Are there any comments you wish to make about conch, or conching?

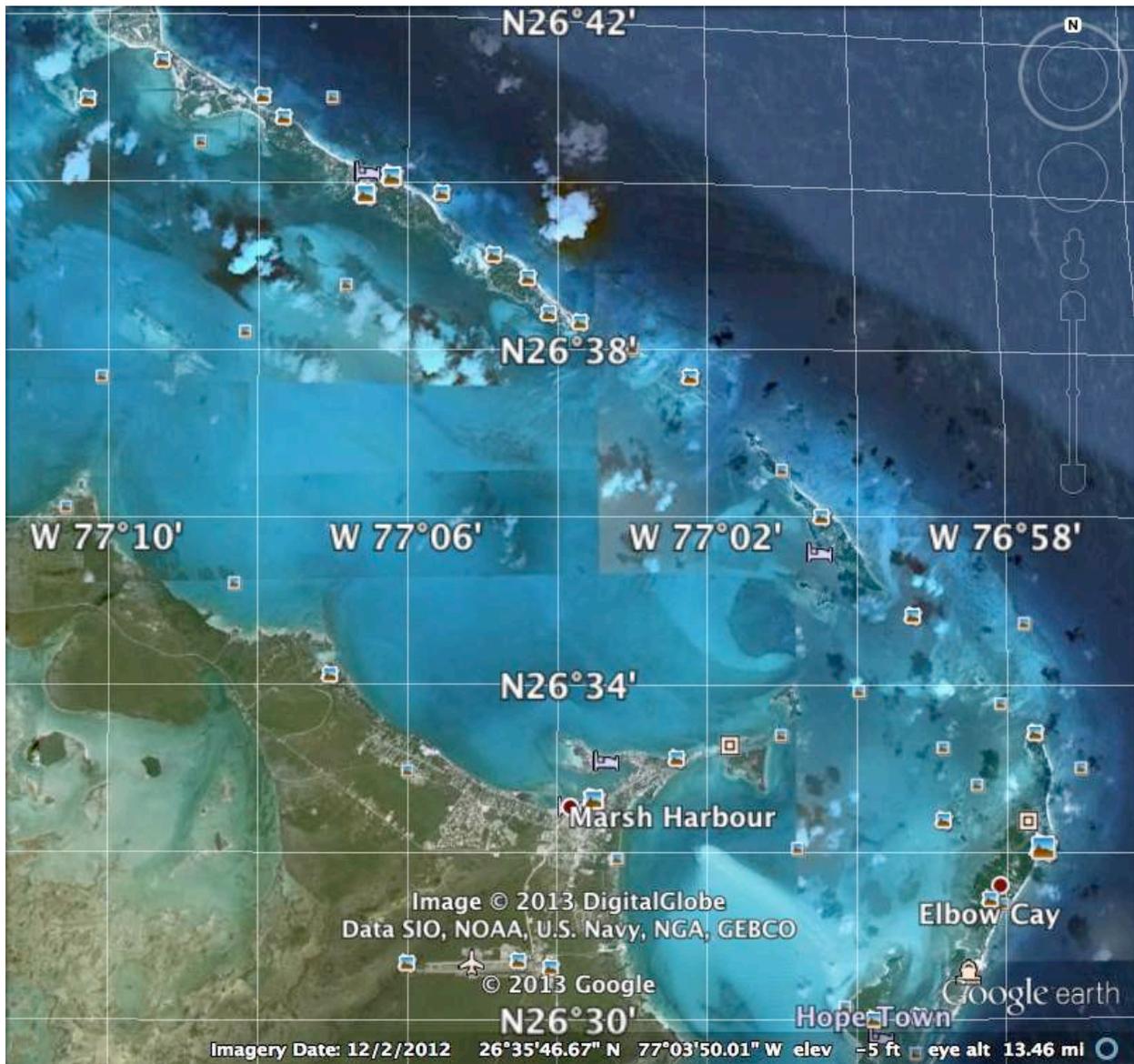
Appendix B - Google Earth maps for interviews

Sea of Abaco - Map A

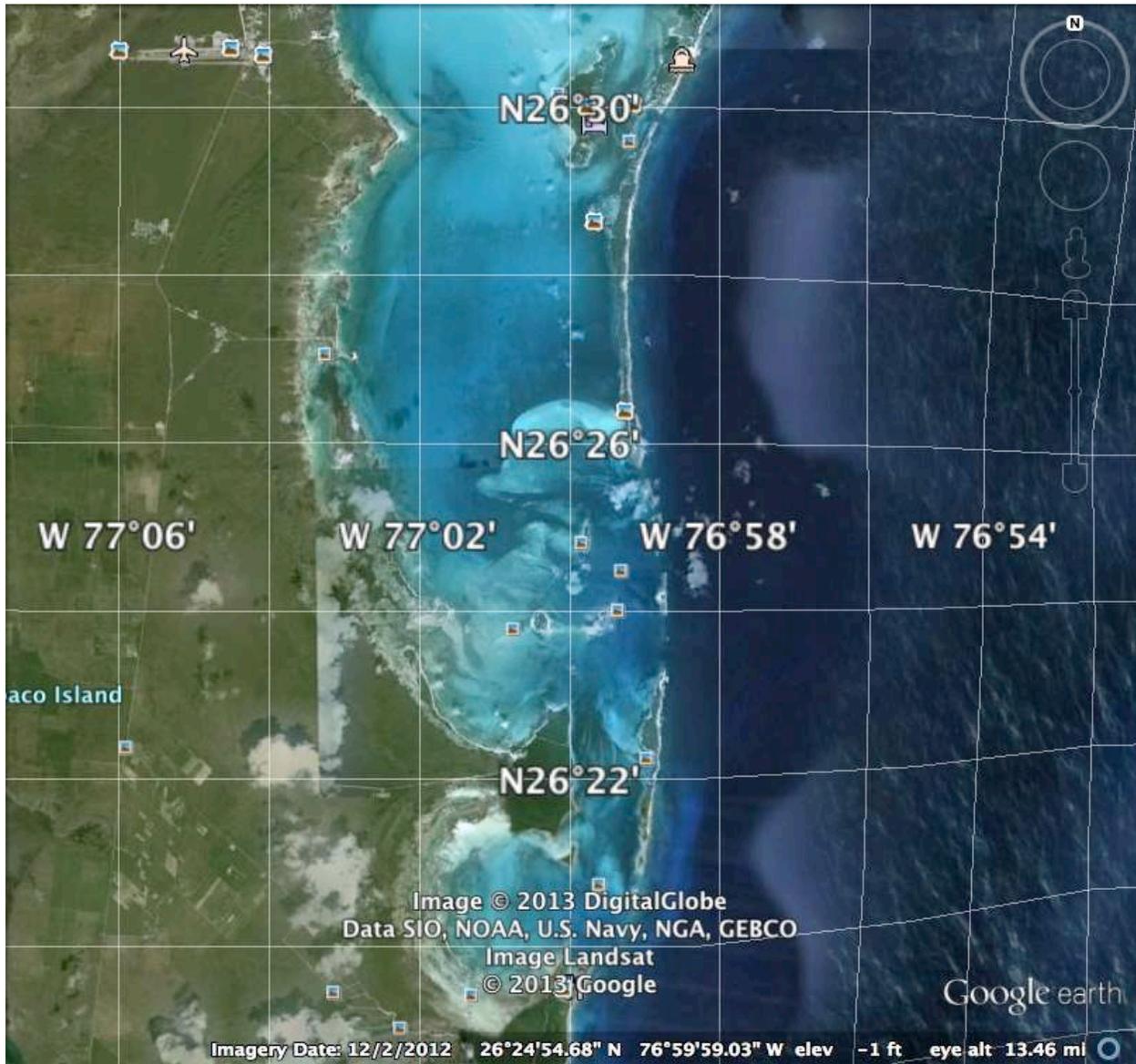


26deg42'01.16"N 77deg15'22.11"W elevation -3ft, eye altitude 13.46mi

Sea of Abaco - Map B



Sea of Abaco - Map C



Appendix C

Polls for Facebook

Question: When was the last time you went conching?

Responses:

Answer	# Votes	Percentage
I currently fish for conch (for personal or commercial use)	21	48
I stopped conching in the last five years	5	11
I stopped conching in the last ten years	1	2
I have not collected conch for more than a decade	2	5
I have not collected conch for 20 years or more	3	7
I have never been conching	12	27

Appendix D

Responses to Interview Question 11: “Are there any comments you wish to make about conch, or conching?”

Respondent	Comments about conch, or conching?
1	There should be commercial limits. Conching for me has always been a Bahamian family and cultural experience. I hope it is still possible for my grandkids. (NB: Has observed people using a conch hook, but never did so personally).
2	There should be a conch season
3	There should be more action on conch. More protection is needed because it is disappearing. Suggested actions include having a closed season, enforcing existing regulations, addressing foreign poaching and locals taking undersized conch, revise regulations to adjust the legal size of conch. Government and NGO's (FRIENDS, BNT, Save the Bays) should be more involved.
4	There aren't many conch left, so many people don't go conching anymore. Some of the conch areas are inactive (no conch left).
5	People are catching undersized conch - especially tourists and repeat visitors. Most know the rules, but they still catch them. I used to go conching almost everyday, weather permitting, when I was younger and worked for a local restaurant. I have seen an aggregation of conch near Johnny's Cay - there were 100's of conch with lips - it was amazing!. Have also seen hundreds of rollers (in the past). NB: Rollers are conchs without a fully flared lip on the shell.
6	Conch is good to eat. It is a fun experience to go conching with family and friends. Conch is an easy meal.
7	Conching is fun. It's a good experience to be able to catch your own food.
8	There should be further restrictions for Bahamians and foreigners, and more enforcement.
9	Found no conch pearls in the last 5 years! It's not my favourite activity, but customers like conch salad - it's very popular. Numbers are dwindling. People are breaking out conch on conch grounds. Sizes still pretty steady (still see flared lip conch). Still see some conch in deep water.
10	Never found a pearl! When I was younger i used to get more conch [each time] so that I would have some to sell [now only collects for personal use]. There needs to be more conservation efforts in The Bahamas. People need to learn not to get small conch and fish one area too heavily. Started conching around the age of 12.

Appendix E

Queen Conch (photo by Olivia Patterson)



Appendix F

Draft “Conchsequences” Social Media Ad

(What are the ecological consequences of harvesting a juvenile queen conch?)

The Conchservation campaign coordinator has agreed to partner on this initiative. The official “Conchservation” logo will go on the ad. More ideas are in the works!



Appendix G

Hope Town Primary School Science Fair Project Survey (page 1)

Hope Town Primary Conch Survey

Please help us gather data about people's understanding of conch in Hope Town by completing this survey. Thank you!

1. Are you a local or visitor? Circle one local visitor
2. Are you a commercial fisher? Circle one yes no
3. Do you catch conch? Circle one yes no
4. If you answered yes to question 3, how often? Circle one
Every day once a week a few times a month a few times a year
5. If you answered yes to question 3, about how many do you get each time? Circle one
1-5 6-10 11-15 16-20 more than 20
6. Do you think conch are an endangered species? Circle one yes no
7. Do you think conch are being overfished in The Bahamas? Circle one yes no
8. Circle the picture of a juvenile conch.


9. Have you ever caught a juvenile conch? Circle one yes no
10. Have you ever conched in a protected area? Circle one yes no
11. Have you ever seen people catch juvenile conch? Circle one yes no
12. Have you ever seen people conching in a protected area? Circle one yes no
13. Have you ever seen people poaching conch? Circle one yes no

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14. Circle all the regulations you think currently exist to protect conch in The Bahamas.

Conch must have a well formed lip	you need a permit to catch conch	you can only catch conch during their open season
the lip must be 15mm thick	visitors are limited to number they can get	you must have a permit to catch conch with air compressors
you must have a permit to catch conch with SCUBA	exporting conch is banned	the amount exported is limited

15. Circle all the regulations you think should exist in The Bahamas.

Conch must have a well formed lip	you need a permit to catch conch	you can only catch conch during their open season
the lip must be 15mm thick	visitors are limited to number they can get	you must have a permit to catch conch with air compressors
you must have a permit to catch conch with SCUBA	exporting conch is banned	the amount exported is limited

16. Do you feel the regulations are well enforced? Circle one yes no

17. Which do you feel are the possible consequences for illegal fishing?

Fine prison time confiscation of catch confiscation of boat

18. Do you think that illegal conching methods and actions lead to over-conching in The Bahamas?

Circle one yes no

19. Do you think that over conching is a serious problem in The Bahamas? Circle one yes no

20. Any comments or concerns?
