

In-water Surveys of Marine Turtles at Glover's Reef Marine Reserve April 2009

Report compiled by:
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PROJECT BACKGROUND:

In 2007, the Wildlife Conservation Society (WCS), in partnership with the Belize Fisheries Department, initiated a long term in-water sea turtle monitoring program at Glover's Reef Atoll, the first of its kind in Belize. The project focuses on building the capacity of stakeholders to collect accurate, reliable, and standardized data that decision makers can use to better understand the status and threats to sea turtles in Belize and make informed decisions regarding their conservation and management needs.

OBJECTIVES:

The main objectives of the in-water sea turtle monitoring program at Glover's Reef Atoll are to: (1) determine relative population abundance and long-term population trends; (2) increase our knowledge of sea turtle movements and habitat use at Glover's Reef; (3) assess genetic stock of foraging sea turtles at Glover's Reef; and (4) study growth rates of sea turtles at Glover's Reef.

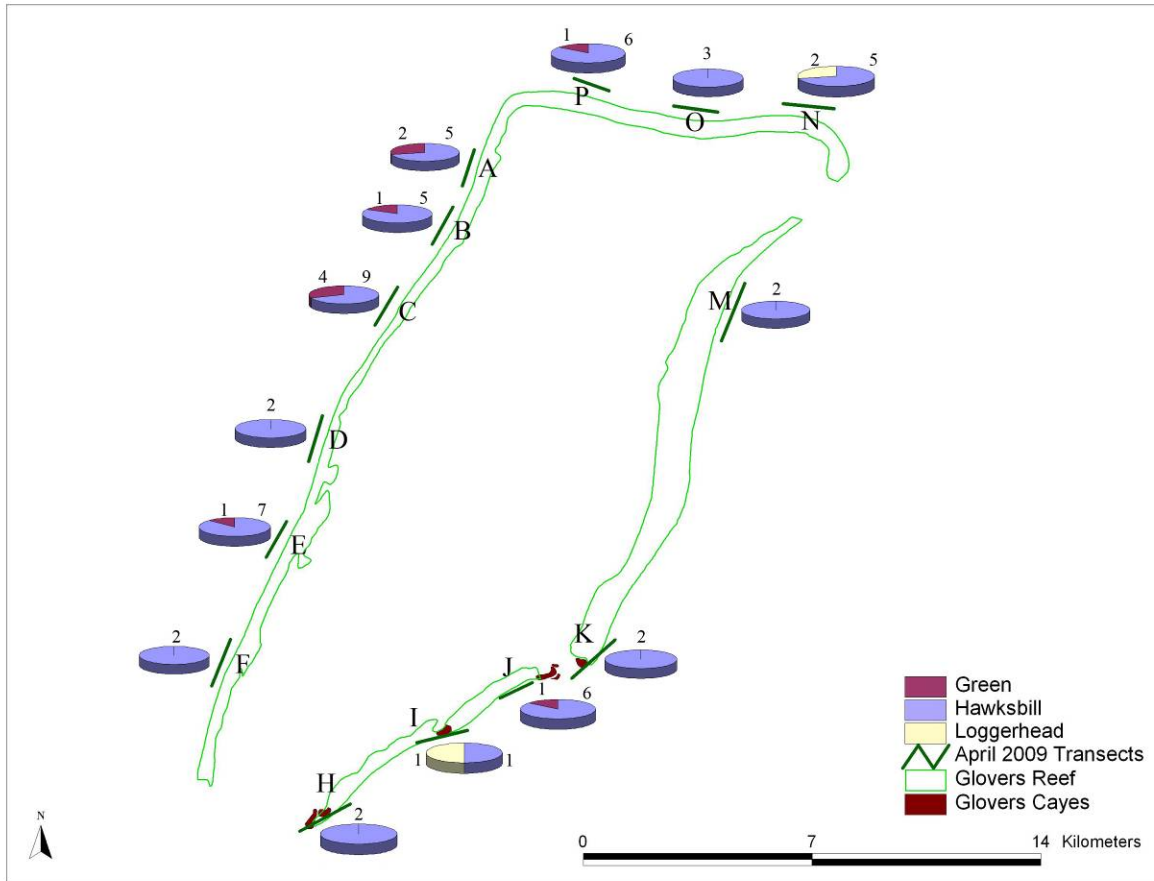
APRIL 2009 IN-WATER SURVEYS

Surveys were conducted from 25th to 29th April, 2009. Previous surveys were conducted in April and September of 2007 and April, July and November of 2008. The survey team for April included staff from Glover's Reef Marine Reserve (GRMR), Wildlife Conservation Society, Caye Caulker Marine Reserve, Southern Environmental Association (SEA) and one representative from the Hopkins Fisherman Association (HFA) (see list of team members at the end of the report). Dr. Samantha Strindberg, a statistician with the WCS Living Landscape Program, also participated in the surveys to primarily improve the method for estimating abundance of sea turtles and make recommendations to improve the scientific rigor of the data collection and analyses.

The survey team covered a total of 14 in-water transects on the forereef areas of the Atoll (Figure 1). Each transect was surveyed in approximately 60 minutes. Sea conditions during the April surveys were choppy with poor visibility at times. Transect depths ranged from 2.0 m to 24.0 m. A total of 13.9 hours of surveys were

conducted. Transect lengths varied from 1.2 km to 2.4 km and a total of 22 km of in-water habitat were surveyed for sea turtles (Table 1).

Figure 1. Map of Glover’s Reef Marine Reserve with transects (green lines) and sightings of sea turtles (Hawksbill, Green and Loggerhead) during in-water surveys for the period 25th – 29th April, 2009.



SEA TURTLE SIGHTINGS

A total of 70 turtles were sighted with an overall sighting rate of 5.0 turtles/hr or 3.2 turtles/km. Of the 70 turtles sighted, 57 (81.4%) were hawksbills (*Eretmochelys imbricata*), 10 (14.3%) were green turtles (*Chelonia mydas*) and 3 (4.3%) were loggerheads (*Caretta caretta*). The greatest number of turtles sighted occurred at South of Fisherman Camp 2 (transect C) located on the west side of the atoll with 13 turtles sighted during the 1.38 km survey (Figure 1, Table 1).

Table 1. In-water survey results for 14 surveys conducted at Glover's Reef Marine Reserve from 25th to 29th April, 2009. Abbreviations are the same as in Figure 1.

Date	Location	No. of snorkelers	Duration	Survey	Ei Sighted	Cc Sighted	Cm Sighted	Total Sighted	No. Captured
			(min)	Length (km)					
25-Apr-09	North of Fisherman Camp 1 (A)	7	60	1.19	5	0	2	7	2
25-Apr-09	South of Fisherman Camp 1 (B)	7	62	1.35	5	0	1	6	1
25-Apr-09	South of Fisherman Camp 2 (C)	7	62	1.38	9	0	4	13	1
26-Apr-09	North of Baking Swash (D)	7	54	1.50	2	0	0	2	2
26-Apr-09	Baking Swash (E)	7	63	1.29	7	0	1	8	2
26-Apr-09	South of Fisherman's Cut (F)	7	56	1.57	2	0	0	2	2
27-Apr-09	North of South West Caye (H)	6	60	1.80	2	0	0	2	0
27-Apr-09	North of Middle Caye (I)	6	60	1.63	1	1	0	2	1
27-Apr-09	South of Long Caye (J)	6	60	2.35	6	0	1	7	3
29-Apr-09	North of NorthEast Caye (K)	6	60	1.83	2	0	0	2	1
29-Apr-09	South of Northeast Point (M)	6	60	1.94	3	0	0	2	0
28-Apr-09	North East Elbow (N of Lighthouse Area) (N)	8	60	1.62	5	2	0	7	0
28-Apr-09	Midpoint (Northwest and Northeast Elbow)(O)	7	58	1.40	3	0	0	3	1
28-Apr-09	East of Northwest Elbow (P)	7	59	1.17	6	0	1	7	3
Total			834 (13.9hrs)	22.02	58	3	10	70	19

SEA TURTLE CAPTURES

The in-water survey team captured 19 of the 70 turtles sighted by hand. Sixteen were hawksbills, two were greens and one was a loggerhead. Turtles captured for the first time were measured, weighed and tagged. Recaptured turtles were remeasured and reweighed. Mean size for captured hawksbills was 40.4 cm minimum straight carapace length (SCL), (standard deviation (SD) = 7.9 cm, range = 27.3 – 56.6 cm, n = 16); for greens, was 36.7 cm SCL (SD = 6.1 cm, range = 32.4 to 41.0 cm, n = 2). The loggerhead was 94.5 cm SCL. Genetic tissue samples were collected from all turtles except recaptured turtles. Methods for collecting biometric data are described in the field report for the April 2007 monitoring surveys.

ASSESSING MOVEMENT PATTERNS OF SEA TURTLES

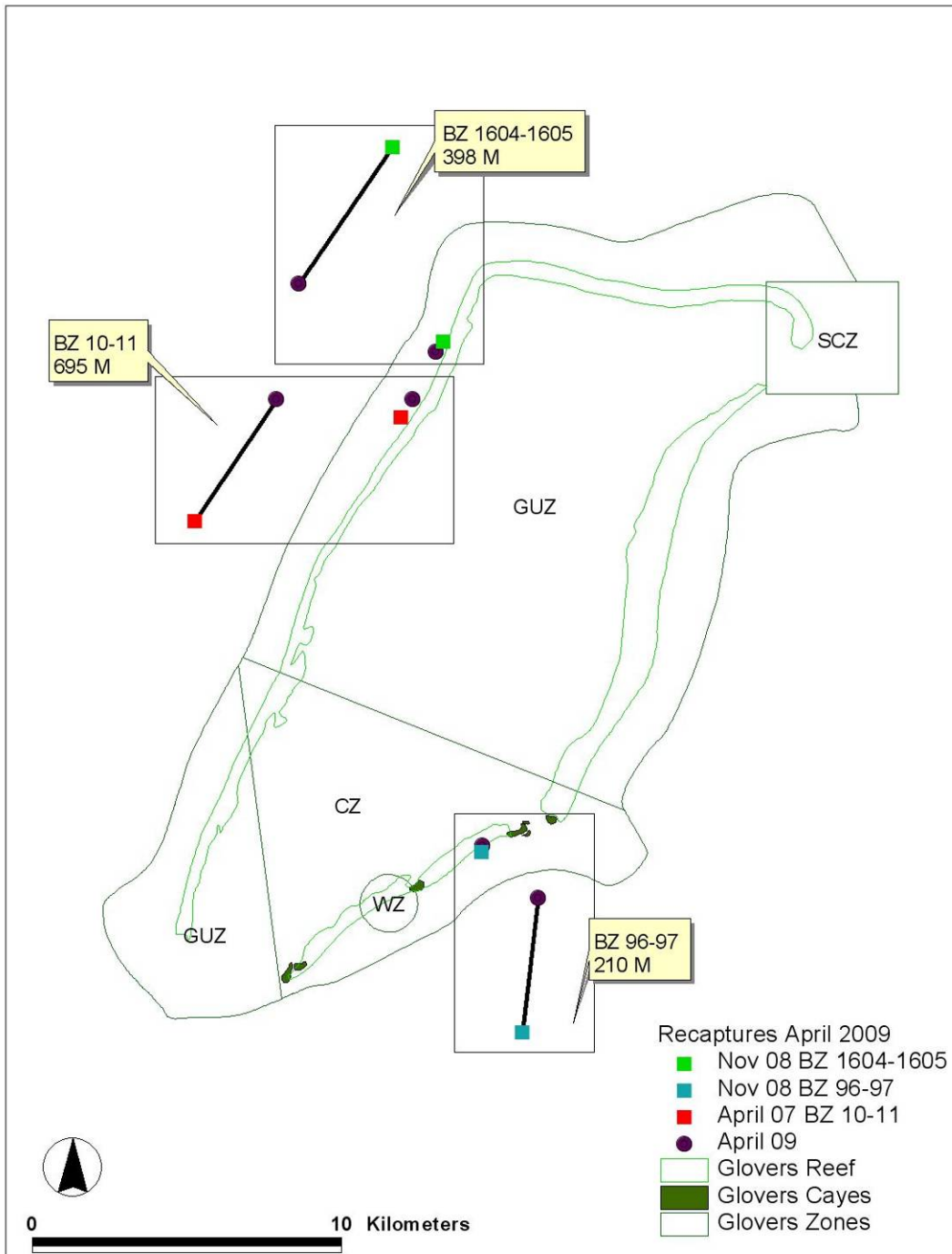
SEA TURTLE MARK-RECAPTURES

Three hawksbill turtles tagged during previous surveys were recaptured during the April 2009 surveys (Table 2). The distance between the first sighting location and the April sighting location for the three recaptured turtles ranged from 210 m to 695 m (Table 2, Figure 2).

Table 2. Distance comparisons between the sighting locations of three sea turtles recaptured during the April 2009 surveys and the first sighting locations for each sea turtle.

Species	Turtle ID	Recapture Date	Date First Captured	Distance between first sighting and April, 2009 sighting locations (m)
Ei	BZ 1604 - BZ 1605	25 April, 2009	24 Nov., 2008	398
Ei	BZ 10 -BZ 11	25 April, 2009	26 April, 2007	695
Ei	BZ 96 - BZ 97	27 April, 2009	25 Nov., 2008	210

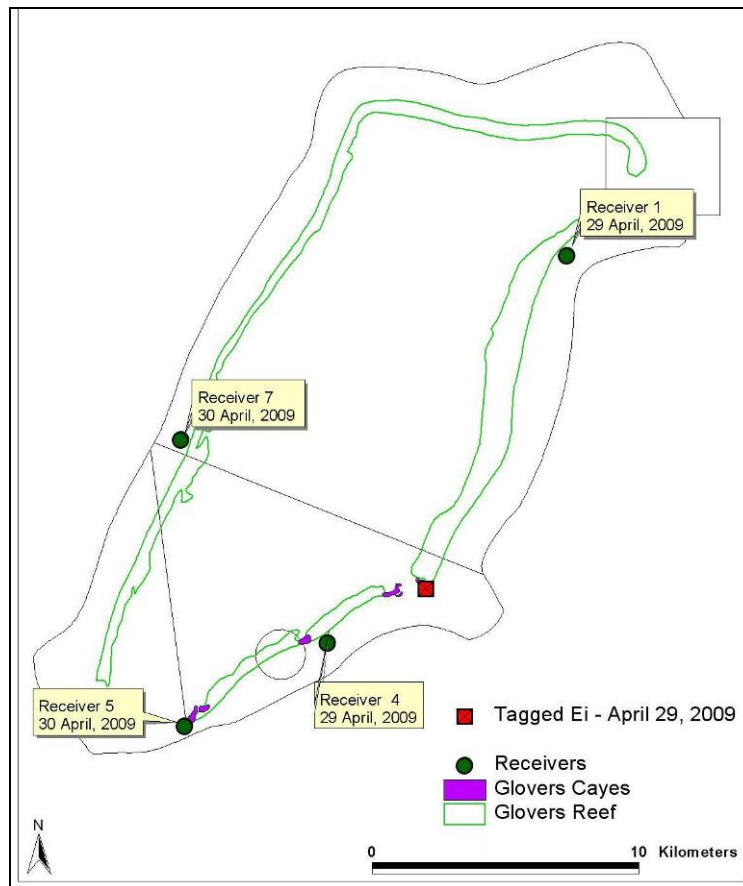
Figure 2. Sighting locations of three sea turtles recaptured during the April 2009 surveys (purple circle) in relation to the first sighting location for each sea turtle.



ACOUSTIC TRANSMITTERS TAGGING

A coded acoustic transmitter (V13, Vemco Ltd) was attached to the lower left carapace of a juvenile hawksbill (SCL 48.3 cm) with flipper tags BZ 1115 (Right) and BZ 1116 (Left) on 29 April, 2009. The turtle was released at the same location captured on the eastern forereef south of North East Caye near the channel (Figure 3). The turtle was released after one hour to allow for the acoustic transmitter, which was attached to a rectangular shaped plastic, to bond to the carapace. In order to track the movements of the turtle, three omnidirectional hydrophone VR-2 receivers (Vemco Ltd) were placed on the eastern forereef and one receiver was placed on the western forereef (Figure 3). The receivers were placed in sand among the coral reef habitat in depths of 10-15 m. They were fastened to a rope with shackles and plastic cable-ties and its position secured by three cement blocks bound together. Buoys were used to keep the receivers in an upright position. The receivers record the date, time and identification number of the turtle as it passes through the detection range of the unit (~ 500 m). A GPS was used to record the location of each receiver. The receivers will be retrieved every three months to download data and ensure that it is operational.

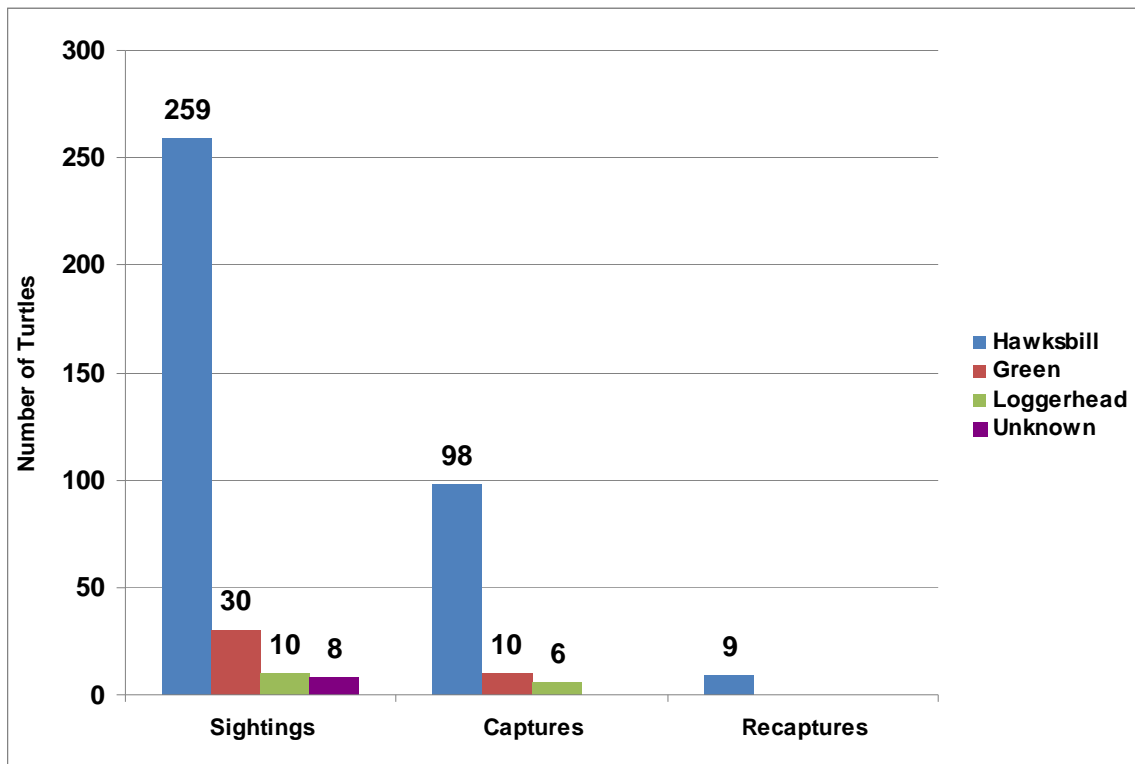
Figure 3. Location of VR-2 receivers on the forereef areas of the atoll and release location of turtle with coded acoustic transmitter.



TOTAL SIGHTINGS, CAPTURES AND RECAPTURES FOR SIX SURVEY PERIODS FROM APRIL 2007 TO APRIL 2009.

The total number of sea turtles sighted since the start of the in-water monitoring program in April 2007 is 307 sea turtles (Figure 4). The majority of these sightings are hawksbills (84.4%). A total of 114 sea turtles were captured of which 98 (86.0%) were hawksbills. A total of nine sea turtles have been recaptured to date.

Figure 4. Summary of Sightings, Captures and Recaptures for the six monitoring periods: April, 2007 – April, 2009.



SIZE CLASS DISTRIBUTION OF TURTLES

The size class distribution data for captured hawksbills for all six sampling periods showed that hawksbills averaged 40.1 cm SCL (SD = 7.7 cm, range = 26.4 – 58.9 cm, n = 97) (Figure 5). The average SCL for greens was lower than hawksbills at 32.7 cm SCL (SD = 5.6 cm, range = 22.2 – 41.3 cm, n = 10) (Figure 6). The loggerheads captured were subadults to adults averaging 84.4 cm SCL (SD = 8.7 cm, range = 70.0 – 94.5 cm, n = 6) (Figure 7).

Figure 5. Size class distribution of hawksbill turtles captured during surveys at Glover’s Reef Marine Reserve between April 2007 and April 2009, showing frequency of 5 cm size classes for each sampling period.

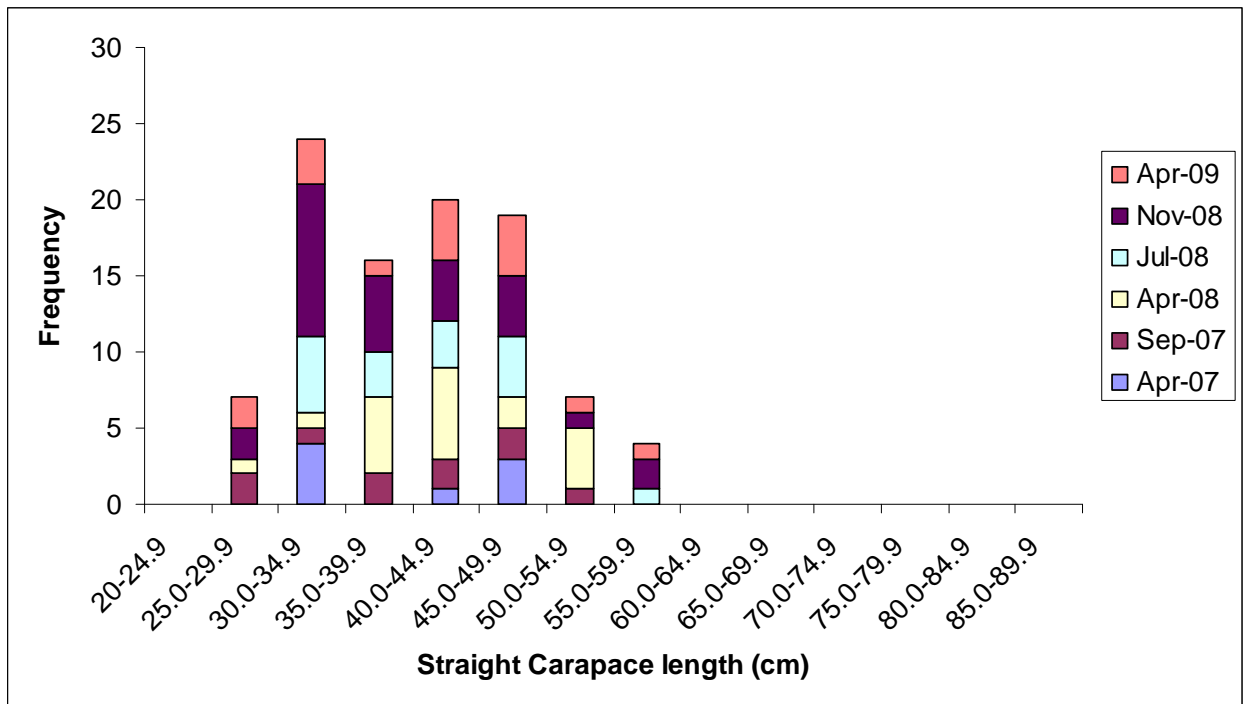


Figure 6. Size class distribution of green turtles captured during surveys at Glover’s Reef Marine Reserve between April 2007 and April 2009, showing frequency of 5 cm size classes for each sampling period.

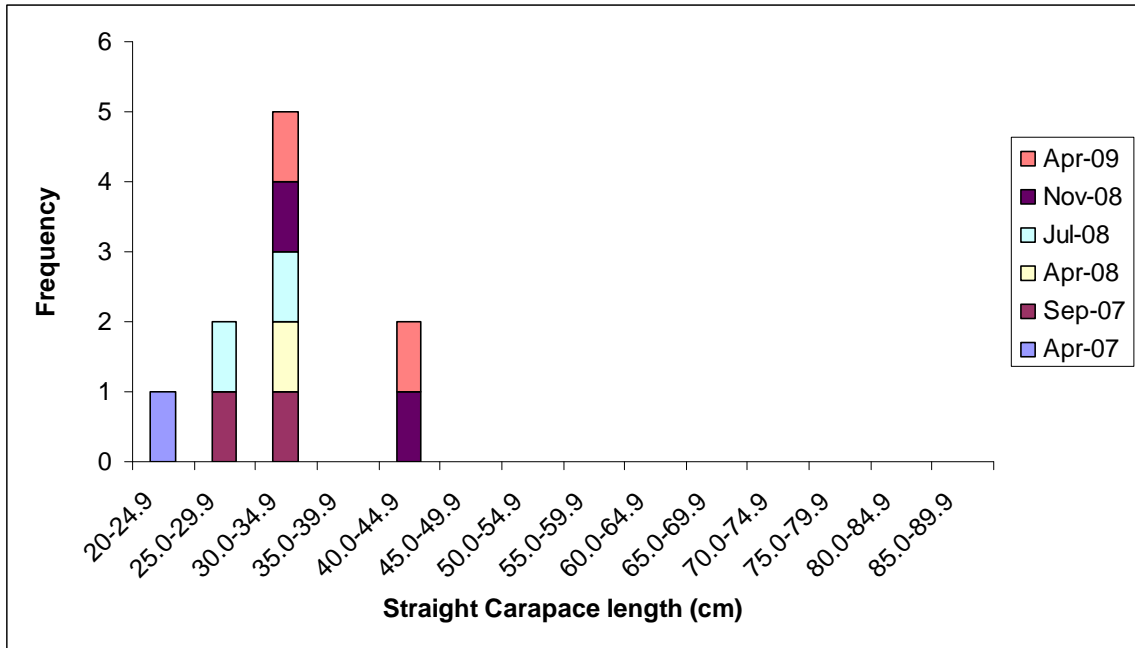
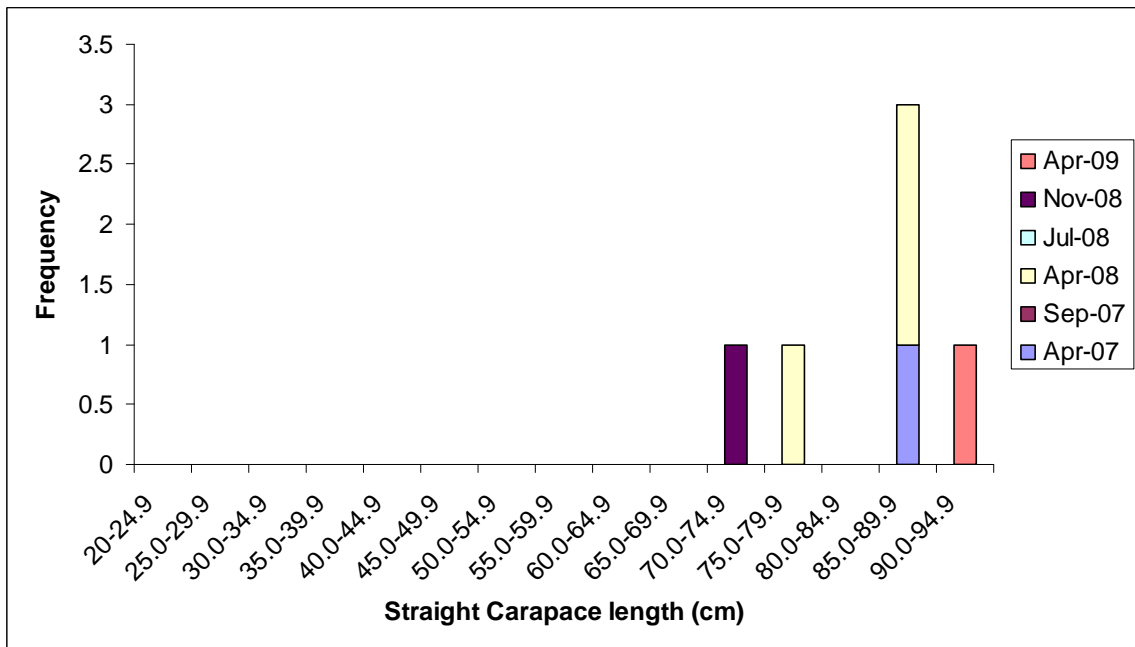


Figure 7. Size class distribution of loggerhead turtles captured during surveys at Glover’s Reef Marine Reserve between April 2007 and April 2009, showing frequency of 5 cm size classes for each sampling period.



INDEX OF SEA TURTLE RELATIVE ABUNDANCE

MEAN SIGHTING PER SURVEY PERSON HOUR (SPH)

The mean SPH can be used as an indicator of relative turtle abundance for each monitoring period, and is based on the average of the number of sightings per survey person hour for each survey in a monitoring period. A summary of turtle sightings and effort of the six monitoring periods conducted thus far is shown in Table 3. The highest mean SPH thus far, is for the November, 2008 monitoring period with a rate of 0.821.

Table 3: Turtle sightings and sighting effort for six monitoring periods at Glover’s Reef Marine Reserve, including the sighting rate for each period.
(CI = 95% Confidence Interval, SD = Standard Deviation).

Monitoring Period	Total Turtle Sightings	Sightings / Hour Surveyed	Mean SPH (Sightings/Survey Person Hour)
22-26 Apr '07	38	3.30	0.518 (CI=0.194, SD=0.390)
24-27 Sept '07	26	2.48	0.304 (CI=0.158, SD=0.273)
21-15 April '08	49	3.84	0.554 (CI=2.279,SD=0.484)
26-31 July '08	54	4.03	0.512 (CI=0.123, SD=0.214)
24–27 Nov, '08	70	5.96	0.821 (CI=0.253, SD=0.398)
25–29 April, '09	70	5.04	0.727 (CI=0.263, SD=0.456)

DISTANCE SAMPLING

The mean SPH as an index of relative abundance is difficult to interpret over time as it is influenced by 1) observer effort (i.e. amount of time actually spent looking for turtles rather than attempting capture); 2) observer sighting ability (although there is a core set of people comprising the “turtle survey team,” the survey team does change over time and in addition observers have varying experience and competence); 3) visibility that changes between surveys, and 4) other environmental variables (e.g. wave height and current that influence the ease with which the snorkelers can complete the sample counts).

In an effort to obtain a more robust absolute index of turtle abundance, Dr. Samantha Strindberg, suggested distance sampling be tested during the April 2009 surveys. Distance sampling allows one to estimate detection probability and requires the observers to estimate the perpendicular distance between the line transect and the animal they observe. To familiarize the team members with the concept, Dr. Strindberg gave a brief presentation on distance sampling and the key assumptions underlying this technique for estimating density and abundance (see Glover's workshop _introductionDistance_April2009.pdf). Participants also conducted an exercise involving estimating distances to "turtles" of varying degrees of visibility marked on either side of a line in the sand on Middle Caye and they compared their results to the measured perpendicular distances to reinforce some of the key concepts, and also to let people improve their measurement accuracy.

Based on the initial results, Dr. Strindberg is optimistic that distance sampling can be used to estimate hawksbill (and possibly also green) turtle density and abundance in the forereef habitat of the Atoll. The encounter rates are high enough that it should be possible to obtain sufficient precision to permit trend detection over time.

DISCUSSION AND SUMMARY

Compared to previous surveys, the April 2009 surveys yielded the second highest sighting rate. The mean SPH in April 2009 (0.738) was also the highest recorded for the April surveys conducted thus far – April 2007 (0.518) and April 2008 (0.554). This difference may be due in part to the increasing level of experience of the in-water survey team, the majority of whom had participated in most or all of the previous five surveys and therefore were adept at sighting turtles. The "observer sighting ability" can be controlled for with distance sampling, which will continue to be tested and adapted to the surveys.

Consistent with previous surveys, the majority of turtles sighted during the April 2009 surveys were juvenile hawksbills. The mean SCL for hawksbills captured in April 2009 (40.1 cm) was also similar to the mean SCL for hawksbills captured in April 2007 (39.9 cm), September 2007 (39.0 cm), April 2008 (41.9 cm), July 2008 (40.4 cm) and November 2008 (39.1 cm), suggesting that juvenile hawksbills remain at the atoll throughout the year. Three juvenile hawksbills were captured during the April 2009 surveys that had been first sighted in surveys conducted in April 2007 and November 2008, suggesting that juvenile hawksbill may utilize the atoll for more than 24 months. Furthermore, the preliminary recapture data suggest that each juvenile hawksbill may reside in a particular area of the atoll and not travel long distances on the atoll. To better understand the movement patterns of hawksbills at Glover's, a pilot study was initiated during the April 2009 surveys. The pilot study involved attaching a coded acoustic transmitter to a juvenile hawksbill and deploying four receivers at various locations in the forereef areas of the atoll to track the turtle's movements.

Ten green turtles were sighted during the April 2009 surveys, the highest number compared to the April 2007 (2 green turtles) and the April 2008 (3 green turtles). A total of ten green turtles were also sighted in November 2008. Only male subadult to adult loggerheads continue to be sighted during the surveys. Three loggerheads were sighted during the April 2009 survey, one of which measured 94.5 cm SCL, the largest to date. The loggerheads' distribution on the atoll seem to be limited to the northern and eastern forereef areas only, unlike the hawksbills and the greens which displayed a general distribution.

NEXT STEPS

- Analyse tissue samples collected to date (Collaborators: Ximena Velez-Zuazo, University of Puerto Rico – genetic analyses; and Sea Turtle Laboratory - National Marine Fisheries Service in California – long term storage and archiving).
- Explore possibility of adding two transects to eastern forereef to fill gap in sampling design
- Explore further distance sampling as a means to determine turtle abundance and density
- In May 2009, place two more receivers on forereef areas of the Atoll
- Secure funding for at least three more coded acoustic transmitters to be affixed to hawksbills during the November 2009 surveys
- Complete the in-water protocol for the in-water monitoring study, including development of a schedule for the surveys
- Develop sea turtle Access database; archive and manage turtle capture data in Access
- Calculate growth rate based on data from recaptured turtles
- Explore options for investigating sea turtle movement patterns in different habitats at GRMR such as sea grass flats and patch reefs within the lagoon
- Explore possibility of estimating sex ratio in the turtle population; most studies collect blood samples and test the level of testosterone using radioimmunoassay performed in a laboratory
- Explore possibility of studying the foraging ecology (i.e. sponge diet) of hawksbills in more detail

APRIL 2009 SEA TURTLE IN-WATER MONITORING TEAM

Belize Fisheries Department:

Glover's Reef Marine Reserve

Alicia Eck

Elias Cantun

Carlos Martinez

Luis Novelo

Caye Caulker Marine Reserve

Ali Cansino

Wildlife Conservation Society

Virginia Burns

Robin Coleman

Faygon Villanueva

Samantha Strindberg (New York)

Alex Tilley

Danny Wesby

Hopkins Fisherman Association Representative

Mervyn Nunez

Southern Environmental Association

Christina Garcia

PHOTOGRAPHS



Photo 1: Ali Cansino and Elias Cantun measuring juvenile hawksbill (*Eretmochelys imbricata*) captured during April 2009 in-water surveys at GRMR; Robin Coleman recording the data. Photo: V Burns/WCS



Photo 2: Elias Cantun, Alex Tilley, Luis Novelo and Mervyn Nunez releasing a male loggerhead (*Caretta caretta*) captured during April 2009 in-water surveys at GRMR. Photo: A. Cansino/Belize Fisheries Department



Photo 3: Carlos Martinez releasing a juvenile hawksbill (*Eretmochelys imbricata*) captured during April 2009 in-water surveys at GRMR. Photo: V. Burns/WCS



Photo 4: April 2009 in-water survey team - (back row) Elias Cantun and Samantha Strindberg; (middle row) Christina Garcia, Virginia Burns, Mervyn Nunez, Alicia Eck and Luis Novelo holding juvenile hawksbill (*Eretmochelys imbricata*) (front row) Robin Coleman and Faygon Villanueva. Photo: D. Wesby/WCS