

POST HURRICANE FEEDING BEHAVIOR AND PREFERENCE OF STROMBUS GIGAS IN
GREATER LAMSHUR BAY, ST JOHN USVI.

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ABSTRACT

Observations of feeding behavior and preference were conducted and compared to data taken before Hurricane Hugo to see if it had any effect on feeding habits. The hurricane had no noticeable effect on feeding preference but a change in feeding behavior is evident. Whether this change is hurricane related is unknown.

INTRODUCTION

On September 17 and 18, 1989 Hurricane Hugo passed over the United States Virgin Islands. High winds of up to 130 miles per hour and turbulent waters caused extensive damage to both the marine and terrestrial environments. One of the marine ecosystems damaged was the seagrass beds, where large hurricane scars are found (Martino, 1989 pers comm). These scars altered the sea grass beds which is the home of many marine organisms including the Queen conch, Strombus gigas.

Strombus gigas is a large herbivorous marine gastropod that lives on the sandy ocean floor of the Caribbean waters (Wormke and Abbot, 1961 in Webb, 1988). They can survive in depths up to 77 meters but are usually found in water 33 meters or shallower where light is abundant enough not to restrict the growth of seagrasses and macroalgae (Randall, 1964 in Silin, 1988). Conch use their extendable proboscis to graze on epiphytes which grow on vascular sea plants including Thalassia testudinum and Cymodocea filiforme and the macroalgae, which include Halimeda, Penicillus, Udotea, and Avrainvillia (Young 1932 in Silin 1988). Epiphytes are also found growing on detritus and sand. (pers. obs.). Many epiphytic species including both brown and red algae can be found on the surface of seagrass species (Round, 1981).

Earlier studies have been done on S. gigas feeding habits in Greater Lamshur Bay. In Hwang's 1987 report, queen conch were proven to move more and farther in sparser substrate, and dense substrate was their predominant habitat ($p < .05$). Later studies show that S. gigas juveniles have significant difference ($p < .001$) of feeding preference (Webb, 1988). In a study that extended Webb's, juveniles had a significant preference for T. testudinum when grass abundance was calculated (Silin, 1988). Adult conch clearly prefer macroalgae (Baldwin, 1988).

The purpose of this study is to compare the feeding preference of Strombus gigas pre hurricane to post hurricane. Using data obtained by (Silin 1988) and comparing with data taken within two months after the hurricane it will be determined if the hurricane caused a significant change in feeding preference of the Queen conch. The first null hypothesis states that there is no significant difference in the time spent by S. gigas in the consumption of plant epiphytes from time 1 (pre hurricane) to time 2 (post hurricane). Also data collected by Webb in 1988 will be compared with current data to distinguish between

changes in feeding behavior. The second null hypothesis states that the hurricane had no effect on feeding behavior.

METHODS

The study was conducted in the grass beds off of Donkey Bight, where the juvenile bed is located, in Greater Lamshur Bay, St John U.S.V.I. using SCUBA. Twenty-five conch were observed for fifteen minutes at fifteen second intervals. The predominant activity during each fifteen second period was recorded to examine feeding patterns. Movement and no activity was also noted to understand the full realm of conch feeding behavior. At the end of each fifteen minute observation period, the length of the conch was recorded.

At this point a one half meter quadrat was placed around the conch encompassing the feeding area and all species of seagrass and macroalgae were counted. This was done to account for frequency of plant distribution available to the conch. The post and present data is then placed in graphs where it was compared and analyzed. (NOTE: This procedure was taken from Silin's 1988 study.)

RESULTS

Table 1 and 2 represent the number of observations of feeding on a particular substrate over a fifteen minute period. Table 1 represents data taken in October and November 1989 and Table 2 is data from July 1988 (Silin 1988). Time spent on feeding on the different seagrasses and macroalgae from time 1 (July 1988) to time 2 (Oct. and Nov. 1989) is compared in Graph 1.

Macroalgae and seagrass counts taken from $1/2m^2$ quadrats is shown in Tables 3 and 4 (October and November 1989 and July 1988 (Silin 1988) respectively). The comparison of seagrass and macroalgae counts is represented in Graph 2.

Table 5 and 6 show the percentage of time during a fifteen minute period spent on feeding, sand grazing, and no activity. Also included is the number of moves recorded within that fifteen minute period. Table 5 is data taken in October and November 1989 and Table 6 represents data from April 1988 (Webb 1988). The third graph distinguishes between time 1 (April 1988) and time 2 (Oct. and Nov. 1989) the changes in feeding behavior. Finally Graph 4 compares the average number of movements pre hurricane to post hurricane.

DISCUSSION

Looking at Graph 1, one can see that Strombus gigas on average spent more time feeding in July 1988 than in October and November 1989. Taking a closer look at the numbers the difference is not incredibly significant. In the Silin's 1988 data the conch was observed feeding 39.70 times to 34.32 times in 1989 during the fifteen minute observation period. This is only a difference of 5.38 fifteen seconds observations or approximately 81 seconds. The trends within the observations in Time 1 (July 1988) and Time 2 (Oct. and Nov. 1989) are similar. In both cases the conch ate mostly the epiphytes that live on Thalassia testudinum. The survey in July 1988 shows that conch ate significantly more from Cymodocea filiforme than from the other macroalgae in the seagrass

community. In contrast those surveyed in the fall of 1989 ate almost equally from C. filiforme, Halimeda and the other macroalgae.

Graph 2 basically shows the differences in seagrass and macroalgae abundance from Time 1 (July 1988) and Time 2 (Oct. and Nov. 1989). The seagrasses T. testudinum and C. filiforme were on average more abundant in the summer of 1988 than in the fall of 1989. The macroalgae populations are constant between the two surveys. A possible explanation for the lower numbers in seagrasses is the habitat disruption caused by Hurricane Hugo. Unknown factors caused by the hurricane may have resulted in large hurricane scars (Martino pers. comm.), as well as other minor destruction. All though macroalgae may have been effected by the hurricane, lower populations may have resulted in less significant damage. Also since macroalgae are on a lower sere in the succession chain than seagrasses, they may have been able to regenerate more quickly than the seagrasses (Williams, lec.).

In a 1988 study it was proven that Strombus gigas show a significant preference for feeding on T. testudinum when grass abundance was calculated ($\chi^2 = 89.272$, $df = 52$, $p < .001$) (Silin 1988). Looking at the similar trends in the pre hurricane and the post hurricane studies it can be concluded that the hurricane had no effect on the feeding preference of S. gigas in relation to the density of seagrasses.

Comparing feeding behavior data from Webb's April 1988 study to the October and November 1989 study a change is evident. It shows that conch spend a larger percentage of time feeding on seagrasses and macroalgae post hurricane to pre hurricane. Possible reasons could include the hurricane, seasonal change in eating habits or just an overall change in substrate consumption. Further research needs to be done to reach an explanation for this trend. Conch also tend to graze more often on sand post hurricane to pre hurricane. This could be the result of an increase of detritus on the ocean floor due to seagrass destruction caused by the hurricane. The conch thus feed on the epiphytes that grow on the detritus as well as those found on the sand.

Finally data shows that conch seem to be moving on average more times per fifteen minute period in post hurricane data to pre hurricane data. One suggestion for this may be the fact that seagrasses are more sparse due to the hurricane and therefore the conch has to move more often to have a substrate to feed on. This is also supported by Hwang's 1987 study which prove that conch move more when seagrasses are sparse.

From the comparison of the data collected pre hurricane to post hurricane it can be concluded that the hurricane had no major effect on Strombus gigas feeding preference. The hurricane did effect trends in feeding behavior in a minor way. For instance the fact that conch graze on sand a larger percentage defends this conclusion. With time the decline in detritus may result in a possible return to pre hurricane habits. Continued research needs to be done to determine the extent of the changes in behavior caused by the hurricane and whether time will return behavior back to normal.

ACKNOWLEDGEMENTS

Thanks to: Gary and Hans for teaching me all about the marine world; Matt, Nick, and Kathy for watching the little guys for me, I know its a drag; Dani and Heinz for taking me to the grass beds; Darryl and Heinz keep those BC's on; Alex for trying to teach me stats, WHERE IS PETE WHEN WE NEED HIM!; Hey conch people no more yea!!! Louise do you really think they will miss me? Cecily and Lauren thanks for just being great friends and to everybody else thanks for dealing with my stress fits.

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- Hwang, M. 1987. Feeding Behavior of S. gigas and S. costatus, School for Field Studies, Greater Lamshur Bay, St. John, USVI.
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Conch Feeding

TABLE 1

RAW OBSERVED CONCH FEEDING DATA, GLB, USVI.

Numbers of observations of feeding on the following
species substrate, Oct. & Nov. 1989

CONCH #	SIZE	THAL.	CYM.	HAL.	ALG.	TOTAL
1	16cm	26	14	10	0	50
2	20cm	53	5	0	0	58
3	19cm	16	11	26	0	52
4	18cm	44	0	1	4	49
5	27cm	36	13	0	6	56
6	18cm	2	7	0	30	39
7	20cm	12	3	18	0	43
8	11cm	11	0	0	10	21
9	9cm	2	0	11	0	13
10	9cm	10	0	11	27	48
11	18cm	17	2	0	0	19
12	17cm	23	2	0	0	25
13	24cm	23	12	0	6	41
14	18cm	34	3	0	6	43
15	21cm	25	11	0	6	42
16	18cm	44	3	0	0	47
17	23cm	19	3	2	13	37
18	19cm	37	1	0	10	48
19	11cm	3	0	2	0	5
20	11cm	2	0	10	2	14
21	11cm	17	23	0	0	40
22	9cm	0	0	0	0	0
23	10.5cm	2	1	0	0	3
24	10cm	30	7	0	0	37
25	9cm	28	0	0	0	28
MEAN		20.64	4.84	3.64	4.8	34.32

THAL. -- *Thalassia testudinum*

CYM. --- *Cymodocea filiforme*

HAL. --- *Halimeda*

ALG. --- Other Algae

TABLE 2

RAW OBSERVED CONCH FEEDING DATA, GLB, USVI.

Numbers of observations of feeding on the following
species substrate, July 1988

CONCH #	SIZE	THAL.	CYM.	HAL.	ALG.	TOTAL
1	23cm	23	20	1	4	48
2	24cm	31	14	2	3	50
3	21cm	23	29	0	0	52
4	18cm	16	27	1	1	45
5	24cm	29	6	0	6	41
6	25cm	20	8	0	1	29
7	19cm	36	12	0	0	48
8	17.5cm	25	5	0	8	38
9	19cm	16	12	0	3	31
10	24cm	47	0	0	0	47
11	16cm	32	5	0	0	37
12	17cm	26	3	0	0	29
13	24cm	20	2	0	0	22
14	22cm	37	6	2	0	45
15	19.5cm	56	2	0	0	58
16	20cm	11	11	10	4	36
17	21cm	39	12	0	0	51
18	21cm	14	1	0	0	15
19	18.5cm	33	11	0	0	44
20	21cm	14	12	2	0	28
MEAN		27.4	9.9	.9	1.5	39.7

THAL -- Thalissia testudinum

CYM --- Cymodocea filiforme

HAL --- Halimeda

ALG --- Other Macroalgae

(SILIN 1988)

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TABLE 3

SEAGRASS & MACROALGAE COUNT ABUNDANCE

Counts taken from a $1/2m^2$ quadrat, Oct. and Nov. 1989 GLB, USV

CONCH #	# T	# C	# H	#A	TOTAL #
1	4	95	9	6	114
2	219	43	1	5	268
3	59	95	5	9	168
4	179	72	5	14	270
5	107	94	3	8	212
6	93	79	8	14	194
7	65	59	10	17	151
8	149	82	13	2	246
9	20	3	6	0	29
10	120	44	15	10	189
11	246	118	6	7	377
12	204	64	7	8	283
13	120	150	5	15	290
14	290	137	3	16	446
15	315	151	2	10	478
16	171	51	5	23	250
17	126	74	9	9	218
18	121	57	4	24	206
19	13	7	7	4	31
20	72	23	19	6	120
21	128	27	0	0	155
22	0	0	0	0	310
23	1	1	0	0	2
24	341	151	23	0	515
25	362	103	4	0	469
MEAN	141	71.2	6.76	8.28	239.64

T - *Thalassia testudinum*
C - *Cymodocea filiforme*
H - *Halimeda*
A - Other Macroalgae

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TABLE 4

GRASS COUNT ABUNDANCE

Count taken from a 1/2m² quadrat, July 1988 GLB, USVI.

CONCH #	#T	#C	#H	#A	TOTAL #
1	155	184	17	9	365
2	205	175	1	6	387
3	79	332	0	0	411
4	180	323	1	4	508
5	134	196	7	28	365
6	85	158	4	2	249
7	160	135	0	2	297
8	160	133	2	19	314
9	142	139	1	42	314
10	263	112	0	0	375
11	212	121	1	4	338
12	201	182	4	7	294
13	116	163	0	5	284
14	264	192	5	9	470
15	213	123	4	3	363
16	76	146	24	5	251
17	112	159	0	0	271
18	91	209	2	10	312
19	184	231	5	8	428
20	98	77	7	2	184
MEAN	156.5	174.5	4.25	8.25	339

T - *Thalassia testudinum*
C - *Cymodocea filiforme*
H - *Halimeda*
A - Other Macroalgae

(SILIN. 1988)

TABLE 5

OBSERVED BEHAVIOR DATA, GLB; USVI.

Percentage of time spent on feeding, sand grazing, and no activity as well as # of moves with in a 15 minute period. Oct. & Nov. 1989

CONCH #	% FEED	% SAND	% NA	# MOVE
1	83.33	.00	.00	9
2	96.67	.00	.00	2
3	86.67	.00	.00	7
4	81.67	.00	.00	9
5	93.33	.00	.00	4
6	65.00	6.67	20.00	4
7	71.67	33.33	3.33	5
8	35.00	45.00	.00	11
9	21.67	40.00	15.00	16
10	80.00	11.67	6.67	1
11	31.67	16.67	45.00	4
12	41.67	1.67	53.33	0
13	68.33	5.00	13.33	6
14	71.67	18.33	5.00	1
15	70.00	20.00	1.67	3
16	78.33	.00	15.00	3
17	61.67	11.67	3.33	16
18	80.00	10.00	5.00	3
19	8.33	30.00	33.33	9
20	23.33	26.67	35.00	10
21	66.67	21.67	.00	7
22	.00	80.00	20.00	0
23	5.00	66.67	20.00	5
24	61.67	23.33	10.00	4
25	46.67	26.67	21.67	2
MEAN	57.20	19.80	13.07	5.64

(NOTE: Percentages for each conch do not add up to 100% because time was not added for each move)

TABLE 6

OBSERVED BEHAVIOR DATA, GLB, USVI.

Percentage of time spent on feeding, sand grazing, and no activity as well as # of moves with in a 15 minute period. April 1988.

CONCH #	% FEED	% SAND	% NA	# MOVE
1	51.11	.00	44.44	2
2	15.56	.00	84.44	0
3	95.56	.00	2.22	0
4	24.44	.00	28.89	0
5	33.33	4.44	60.00	2
6	46.67	55.56	8.89	1
7	11.11	11.11	42.22	0
8	55.56	2.22	86.67	0
9	73.33	2.22	33.33	4
10	84.44	4.44	17.78	0
11	77.78	8.89	4.44	1
12	44.44	.00	8.89	6
13	13.33	11.11	75.56	0
14	42.22	.00	51.11	3
15	22.22	6.67	66.67	2
16	24.44	35.56	11.11	0
17	66.67	13.33	20.00	0
18	71.11	8.89	17.78	1
19	35.56	8.89	42.22	6
20	28.89	11.11	53.33	3
21	33.33	51.11	8.89	3
22	82.22	4.44	8.89	2
23	53.33	8.89	17.78	0
24	20.00	4.44	71.11	2
25	57.78	8.89	20.00	6
26	57.78	6.67	26.67	4
27	20.00	.00	75.56	2
28	22.22	.00	15.56	6
29	57.78	.00	31.11	5
30	37.78	4.44	51.11	3
31	51.11	4.44	40.00	2
32	64.44	6.67	.00	12
33	68.89	2.22	28.89	0
34	71.11	4.44	20.00	2
35	31.11	.00	68.89	0
36	73.33	4.44	42.22	1
37	66.67	8.89	24.44	0
38	55.56	2.22	24.44	8
MEAN	48.48	8.07	35.15	2.34

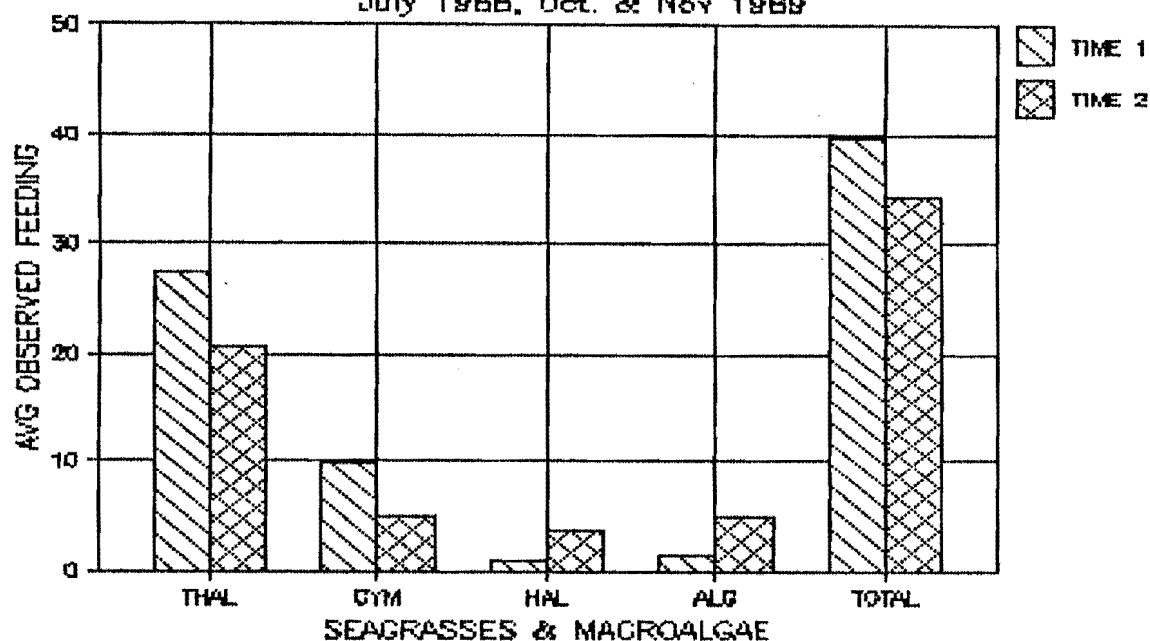
(NOTE: Percentages for each conch do not add up to 100% because time was not added for each move)

(WEBB 1988)

Graph 1

COMPARISON OF AVERAGE OBSERVED FEEDING

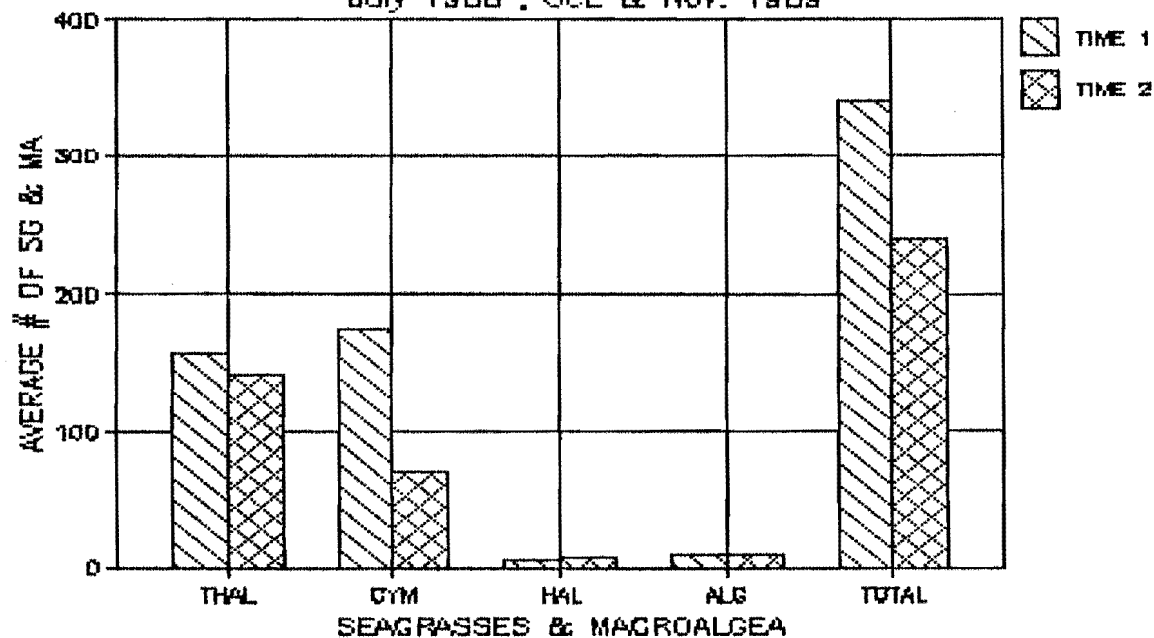
July 1988, Oct. & Nov 1989



Graph 2

COMPARISON OF AVERAGE GRASS ABUNDANCE

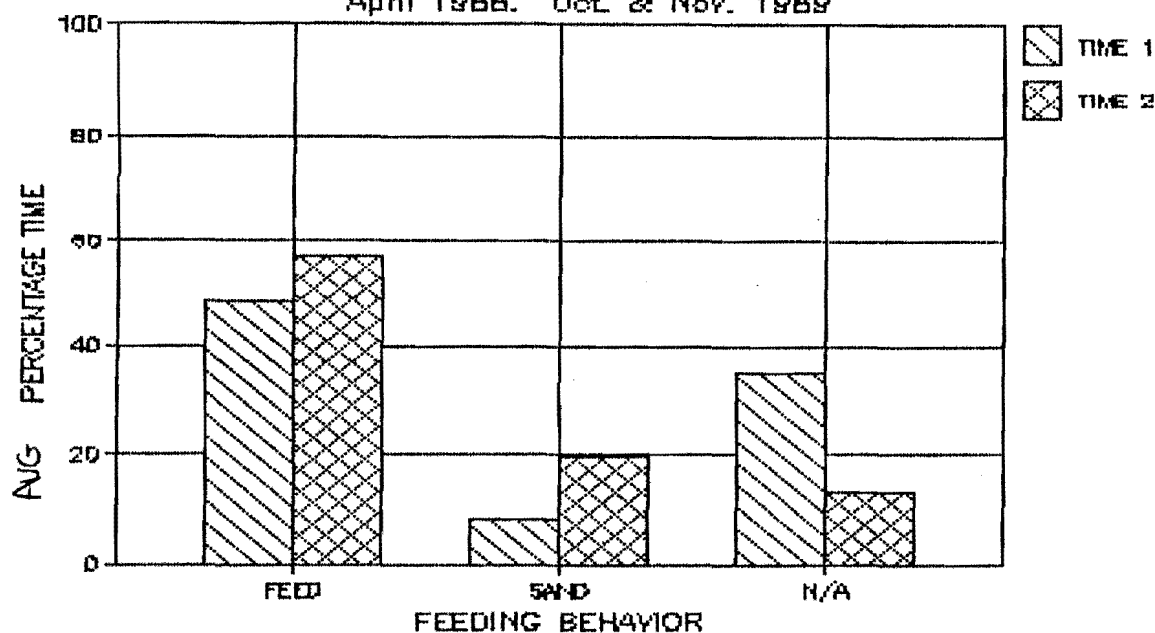
July 1988, Oct. & Nov. 1989



Graph 3

COMPARISON OF FEEDING BEHAVIOR

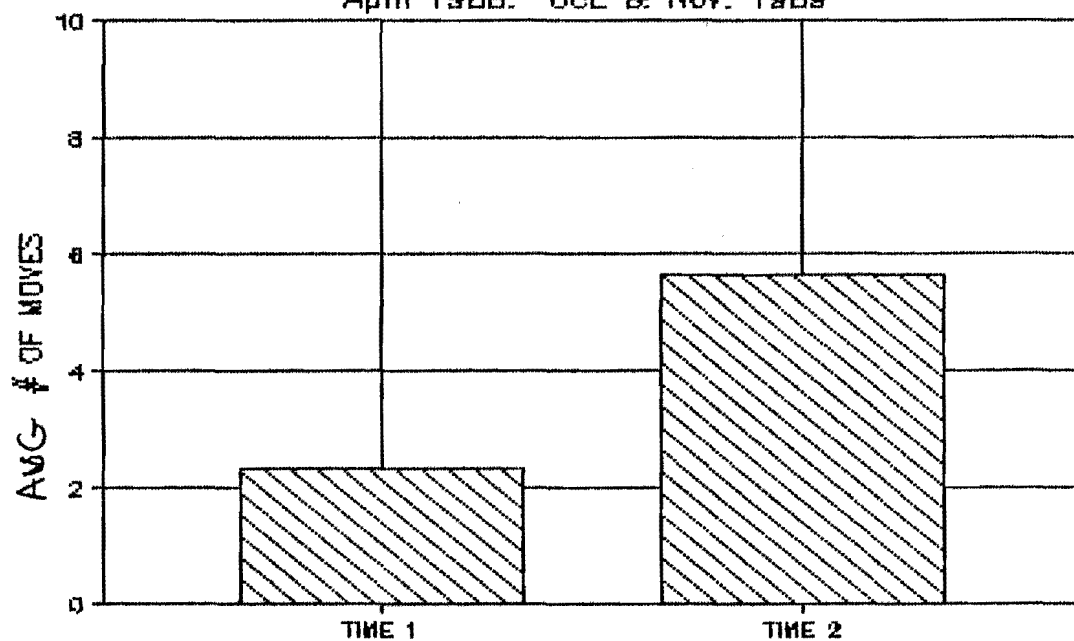
April 1988. Oct. & Nov. 1989



Graph 4

COMPARISON OF # OF MOVEMENTS

April 1988. Oct. & Nov. 1989



The School for Field Studies

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Beverly, Massachusetts 01915
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December 4, 1987

Dear Caroline,

Attached is a student paper, by Janice Brickell, which documents the current size of the queen conch population in Lameshur Bay. She did an excellent job and I am confident of the quality assurance of the data. I have also attached maps from a paper done last spring by Jenifer Beeh, which shows the conch population at that time. Janice compared the current size distribution with that of last April and last November.

It is apparant from these data that about 500 conch are missing. The are gone from the previously dense area to the south of the rocks we call "Donkey Bight." This was the area we saw the boat operating in early October. One of the two piles of conch shells was found in this area. The other pile was around the Tektite point, to the south. Together, we counted about 70 clean shelled.

Although about 500 conch are missing, we cannot simply conclude that 500 were poached. Brickell's Table 1, page 10, shows the size frequency distribution over the last year. There is a clear trend towards increase in the average size of a conch in the population, but I might expect there to be more larger conch by now. The 16-19 cm conch from April should be 21-25 cm adults by now. She found a couple of large adults, but not the 50-60 (representing an estimated population of 250-300) we might expect based on the earlier surveys, nor can we assume that natural mortality is likely to run over 90%. Migration is possible, but we have done an extensive amount of swimming in waters off Tektite and farther out, and see no major influx to that population. Another telling fact is that the densest bed is now at the northern edge of the bed, where formerly the population was low. I assume that this increase is due to natural population increases (the Bay was almost devoid of conch 3 years ago, according to Don Levitan), which didn't occur in the poached area.

Although circumstantial, I think we can make a clear case for a size specific mortality in the conch population off Donkey Bight due to poaching. The actual number of animals taken was between 70 and 500. The lower value is the number of observed cleaned shells, and the upper value assumes that all the missing conch were taken by poachers. This value of loss, although high, is lower than my earlier fears indicated, because we hadn't located the bed to the north at that time.

Sincerely,

Robert Singer, Ph.D
Caribbean Director