Reproduction, Spawning Potential Ratio and Larval Abundance of Queen Conch Off La Parguera, Puerto Rico

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INTRODUCTION

The queen conch, *Strombus gigas,* resource represents one of the most important in the U.S. Caribbean and elsewhere in the region. Recent studies in Puerto Rico have indicated that the resource is overfished; in the U.S Virgin Islands noticeable declines in landings led to a 5-year moratorium on conch harvest around St. Thomas - St. John and the implementation of management regulations for conch harvest is St. Croix.

There is concern that, for a variety of reasons, queen conch may be particularly susceptible to recruitment overfishing. First, queen conch have a number *of* life-history traits that put them at risk. They are long-lived and spawn repeatedly during and among years. This spawning strategy has often been viewed as an adaptation for spreading out reproductive effort when the probability *of* recruitment success is low. Indeed, conch recruitment has been shown to be quite variable over time and space. Intensive fishing lowers the mean longevity substantially, and this reduces the probability that spawners will survive long enough to encounter the conditions under which their larvae will successfully recruit. Second, conch fishing tends to be facilitated during the spawning season; deeper water conch will migrate to shallower water to spawn, where they will be more accessible, and spawning takes place in open sand areas, where conch are more visible to divers. Third, by depleting aggregations, conch fishing reduces density; aggregations for spawning and mating are not quickly restored because conch are slow moving. This may reduce spawning potential. Forth, a growing amount of data indicate that there is a direct correlation between successful recruitment and the number of larvae in the water, indicating a strong stock-recruitment relationship is operating. Lastly, fringe areas (e.g. Florida, Bermuda) have not shown significant increases in conch abundance following closure *of* the fishery over many years.

The purpose of the work reported here was to conduct data analysis and field sampling on questions relative to reproduction and stock assessment of the queen conch. Specifically, the objectives were the following:

1) To determine the fecundity of queen conch,

2) To determine *if* there exists a relationship between conch size and fecundity,

3) To determine *if* there exists a relationship between conch age and fecundity,

4) To use the above information, in conjunction with previously published studies, to calculate spawning potential ratios as a function of fishing intensity for a variety of management options,

5) To determine the abundance of conch larvae in the waters off La Parguera, PR, and

6) To determine the age-structure *of* conch larvae in the waters off La Parguera, PR.

METHODS

Reproduction

Data for fecundity were taken from a field experiment conducted off of La Parguera, PR. In that experiment, large enclosures were constructed in a natural spawning site of queen conch. These enclosures were then stocked with adult conch at various densities. Prior to stocking, all conch were measured for siphonal length and shell-lip thickness, and weighed whole. Spawning activity was monitored each day over the season, and all egg masses produced were recorded as to spawning female and subsequently removed to the laboratory where the number of eggs were counted. After terminating the experiment, *all conch were reweighed and measured as above; they were then sacrificed and weighed to obtain measures of shell weight and tissue weight.

For the analyses conducted here, data were taken from the two treatments wherein a sufficient number of females spawned. The first contained 20 females and 20 males at a density of 1/5m'; the second had 10 females and 1 male at a density of 1/70m^2. Because of obvious density effects (see Results), conch from these treatments were analyzed separately. Calculations were made of the total number of egg masses and total number of eggs spawned over the reproductive season.

To examine the existence of a size-fecundity relationship, a linear regression was made on log-transformed data of fecundity over several measures of size (length, total weight, meat weight). To examine the existence of an age-fecundity relationship, a linear regression was made on log-transformed data of fecundity versus age, with age calculated from shell-lip thickness using the relationship of Appeldoorn (1988a).

Spawning Potential Ratio

Calculations of spawning potential ratio (SPR) were made using the La Parguera population as a model. Calculations were based on the formula of Goodyear (1989):

$$SPR = P_{fished}/P_{unfished}$$

where P is potential fecundity. Potential fecundity is the number of eggs potentially produced by an average recruit in the absence of density dependence. Mathematically, P is expressed as follows:

$$P = \sum_{i=t_r}^{n} X_i \; L_i \prod_{j=0}^{i-1} \exp[-(F_{ij}+M_{ij})]$$

where t_r is the age at recruitment, X_i is the mean fecundity at age i, L_i is the fraction of age i females that are mature, F_{ij} is the fishing mortality rate for females by age, and M_{ij} is the natural mortality rate for females by age. The SPR was determined by calculating the value of P in the absence of fishing (i.e. F=0) and with fishing (i.e. F>0).

The analysis of SPR was conducted for age = t_r to 30 yr, the maximum known age of queen conch (Berg & Glazer, pers. comm.) The age at recruitment was estimated from the size of juveniles when they first appear (i.e. are unburied) in abundance in the La Parguera population: t_r = 1.4 yr.

The fraction of mature females per age was determined by converting the relationship of proportion mature of both sexes against shell lip-thickness (see results of reproductive experiment, below) to age using the formula of Appeldoorn (1988a)

$$LT\ (mm) = 54.9\ (1 - e^{-0.706T})$$

where LT is lip thickness and T is adult age (i.e. age since the onset of maturation). To determine total age, T was added to 3.2 yr, the mean age at maturation (Appeldoorn 1988a). The above equation could then be substituted into the equation expressing proportion mature as a function of lip thickness:

$$\text{Proportion Mature} = 1 - e^{-0.14(LT-1.9)}$$

The reproductive experiment (see results below) showed evidence of a relationship between fecundity and age, but the data were too variable and ranged over too few years to precisely model this relationship. To determine a relationship, it was assumed that fecundity was proportional to tissue wet. Under this assumption, it was possible to use as a guide the Gompertz equation given by Appeldoorn (1992a) predicting weight from age for the average adult in the La Parguera population. The upper portion of this function approximates a decreasing exponential function of a form analogous to the von Bertalanffy equation, such that, in terms of fecunity, the following equation can be developed:

$$E_t = E_{max}\ (1-e^{-k(t-3.2)})$$

where E_t is fecunity at age t, E_{max} is the average maximum fecundity for an individual, k is the instantaneous growth constant, and 3.2 is the age (yr) at the onset of maturation. From the tissue growth equation it was determined that 95 % of the adult growth occurs by age 6, or 2.8 years after the onset of maturation. The parameter k can then be estimated from $t_{.95} = 3/K$, or k = 1.07. Estimation of E_{max} is not necessary for calculation of SPR; because SPR is a ratio, maximum fecundity, as a constant, can set to equal 1.

The relationship between selection and age was determined as follows, with size converted to age using the growth equation for juveniles presented in Appeldoorn (1990). The age at first capture was determined from the size of the smallest individual observed in the La Parguera area to have been fished (i.e. with a hole cut in the shell spire): t_c = 1.6 yr. The size at full capture is not precisely known, but was estimated to be between 170 and 185 mm; for this analysis, the latter was used to estimate age at full capture = 2.3 yr (185 mm). The selectivity curve was then taken to be a straight line from F = 0 at 1.6 yr to F = 100% at F = 2.3 yr. In the analysis, SPR was calculated for a range of F-values, extending from F=0 to F=2.0.

Calculation of M was made using the data of M against age as given in Appeldoorn (1988b) with the following two modifications. First, the data point representing the youngest juveniles was omitted. This point represented a stage prior to recruitment (i.e. prior to becoming epibenthic and potentially available to the fishery). Second, the estimate of adult mortality presented in Appeldoorn (1988a) was added. The inverse model of Caddy (in press) was used in preference to the Weibull model used by Appeldoorn (1988b) because in the former the extrapolated survival rates for old individuals were more consistant with the known life span of conch. The final form of the equation was

$$M, = -0.242 + 4.330/t$$

where t is age. Calculation of the mean value of M between any two ages in the iterative model was by the following equation:

$$M_{mean} = \frac{4.330}{(t_2 - t_1)} \ln \; (t_2/t_1) - 0.242$$

Nevertheless, even the Caddy model resulted in negative values of M at older ages. Thus, the SPR analysis restricted M to a minimum of 0.1, i.e. the Caddy model was used until M was reduced to 0.1, M then stayed constant at this value as age increased.

The SPR analysis was conducted under three management scenarios. The first was with -no management (the current situation). The second was with the implementation of a minimum size limit of 9 inches (230 mm) total shell length as currently specified under the Draft Queen Conch Fishery Management Plan of the Caribbean Fishery Management Council; for La Parguera, this size is reached at age 3.0 yr. The third scenario was the implementation of a minimum size limit of 5 mm shell lip-thickness as argued for by Appeldoorn (1993); for La Parguera, this size is reached at age 3.6 yr.

Conch Larval Abundance

Starting the beginning of May, conch larvae were sample twice monthly off La Parguera, PR along a transect extending from the shoreline out to 12.5 km. Stations were located at the shore line along mangrove channels (3 sites), behind an inner reef (1 site: Enrique), in front of the outer reefs (3 sites: Laurel, Media Luna and Turrumote), the shelf edge (1 site) and 3.5 km off the shelf edge (1 site) (see Figure 1). At those stations represented by one site, three replicate five-minute tows were made. At the three mangrove and three outer reef sites only one tow was made.

Tows were made at the surface, using a half-meter net with mesh of 202 μm. The net was equipped with a flow meter to calculate volume filtered.

In the lab, samples were preserved in buffered formalin and total sample volume was measured. Gastropods were sorted from the samples and all individuals of *Strombus* were identified and measured for shell length with an ocular micrometer.

RESULTS

Reproduction

A high proportion of individual male and female conch, previously thought to be mature on the basis of lip-thickness, where not observed to be reproductively active, and upon dissection at the end of the experiment were found to be still immature. Table 1 shows the number mature and immature by size (lip thickness) category. These data were then used to develop a relationship between lip-thickness (LT) and proportion mature (PM). A three parameter, decreasing (toward an upper asymptote) exponential model was fit to the data:

$$PM = a\ (1-e^{-b(LT-c)})$$

where a, b and c are the model parameters. For this analysis, the data for size classes 5-8 and classes 24-25 were pooled because of low within-class sample size. Parameter estimation was made by non-linear regression using the FISHPARM procedure of FSAS (Saila et al., 1988). Table 2 presents the results of the regression. Given these results, the model was simplified to the following form:

$$PM = 1 - e^{-0.14\ (LT-1.9)}$$

Thus, 100% maturation is not achieved until over one year after the start of shell lip formation.

Clear differences between the two density treatments were evident (Table 3), and these were probably related to food supply. In the low density treatment, macroalgae were maintained within the enclosure throughout the duration of the experiment. In contrast, in the high density treatment all macroalgae were quickly consumed, and algal supplies were supplimented frequently. In the high density treatment only 10 females (= half) produced eggs; in the low density treatment all females (10) laid egg masses. Of those females that spawned, those in the high density treatment produced an average of 6.7 egg masses and 3.36 million eggs for an average of 500,000 eggs per mass, while those in the low density treatment produced an average of 13.6 egg masses and 10.2 million eggs for an average of 750,000 eggs per mass.

Much individual variability occurred within treatment (Table 3), with some females being highly productive in all respects. For example, female 4F1 produced the most egg masses (25), the most eggs (22 million), the largest single egg mass (1.48 million), and had the longest reproductive season, spawning both the first and the last egg masses during the season.

Total fecundity was examined to see if there were size or age differences. Regressions of fecundity against tissue weight using log-transformed data showed no statistical significance for either density treatment. The results for the regression of fecundity against shell lip-thickness using log-transformed data are given in Table 4. Both regressions give similar results, but only that for conch in the low density treatment was statistically significant. This was because the regression for this treatment extended over a broader range of fecundities and lip sizes. Considering that some density-dependent effect was operating in the high density treatment, analyses relative to estimating fecundity should be restricted to data from the low density treatment, as this treatment more closely approximates the natural situation. Table 4 shows that within the range of data considered, fecundity increases with the square of lip thickness. This indicates that, with lip-thickness a function of age, fecundity increases with age. However, because (1) growth in lip thickness decreases with age, (2) that data exist for only 10 individuals, (3) that only a narrow range of lip-sizes are represented in the data, and (4) that lip thickness is only a rough indicator of age, the nature of the relationship between fecundity and age cannot be determined on the basis of these data alone (see Methods).

In the experimental enclosures, the spawning season ran from June 4 to October 21 (Figure 2). Spawning began earlier and finished later in the low density treatment. The amount and timing of spawning appeared to be related to temperature (Figure 3). Maximum spawning occurred during early August, when temperatures were near maximum. Over this general seasonal trend, there existed variations also related to temperature; sudden declines or increases in temperature were associated with corresponding decreases or increases in spawning rate. Total egg production over the reproductive season followed the same general pattern as shown by spawning rate.

Generally, there was no evidence of a decline in percent hatch toward the end of the reproductive season, although this did occur in the last egg mass for a few isolated individuals. For example, for the most productive female mentioned above, the last egg mass was much smaller than normal and only 50% of the eggs hatched, but similar behavior could not be attributed to the majority of females.

Spawning Potential Ratio

The results of the analyses of SPR are shown in Figure 4, where SPR is plotted against fishing mortality (F) for the three management scenarios. Under no management, SPR rapidly declines with increasing fishing pressure, dropping below a value of 0.2 at F = 0.7. Use of the 9-inch size limit resulted in slower rate of decline in SPR, with the value of SPR remaining above 0.2 until fishing pressure was extremely high (F = 2.0). Under the 5-mm lip-thickness limit the SPR remained above 0.4 even at high fishing pressure.

Conch Larval Abundance

Larvae for queen conch *(Strombus gigas)* and milk conch (S. *costatus)* were found in the plankton samples (Table 5). The first sample on 21 May contained several queen conch larvae ranging up to 900 μm in size. Abundances remained low, however, throughout most of the sampling period ($\leq$6/100m^3). In August, abundances increased slightly for queen conch and markedly for milk conch. Generally, almost all larvae were were caught at the stations located at Enrique or the outer reefs. However, the low number of individual larvae caught per station on any given date does not allow a more detailed picture of distribution over space and time to be determined at this time.

Sampling for larvae will continue through the month of October and into November if larvae are still encountered. One goal of this study, the ageing of larvae, will be conducted after all sampling has been completed.

DISCUSSION

The reproductive season observed in the experiment began later that observed in nature during previous years; the earliest spawning reported off La Parguera was early May. The later onset of spawning during the experiment may have been due to natural variation, or stress due to handling and confinement in tanks prior to the onset of the experiment may have delayed the onset of reproduction.

In general, the length of the reproductive season, the average rate of reproduction and the small-scale variations in spawning activity all appeared to be related to temperature. There was no basis for considering daylength as a controlling factor as hypothesized by Stoner et al. (1992).

Mariculturists have expressed concern as to the sustained viability of eggs over the course *of* the reproductive season. In this experiment, there was no evidence to suggest such a general decline in viability. The few isolated cases where a decline occurred were only for the last egg mass laid; in these cases this may have resulted from lack of sperm available for fertilization, especially considering that in one treatment only one male was present, and his reproductive season may have ended earlier than some females who then had to rely on stored sperm.

With respect to population dynamics, the most important result from the reproductive experiment was the finding of a relationship between fecundity and lip-thickness, and hence age. This is typical for most fishes and bivalve mollusks, but these organisms have indeterminate growth. Conch have determinate growth with respect to shell length and, hence, volume within the shell. In fact, with subsequent thickening of the shell, volume decreases over time. Randall (1965) felt that this limited the growth potential of the organism. Indeed, Appeldoorn (1992a), in modeling biomass growth, showed that growth declined more rapidly after sexual maturation than expected on the basis of extrapolated juvenile growth. The results *of* the present experiment indicate that much *of* that potential goes into egg production. Unfortunately, from the reproductive data available, it is impossible to determine the precise nature *o*f the relationship between fecundity and age. This would require conducting a second, similar experiment and insuring that a broad range *of* adult ages from the same population were included. This condition is likely to be met only were unfished populations occur.

The occurrence *of* larvae off of La Parguera correlates well with the rate *of* spawning observed during the experiment, even though these represent two different years worth *of* data. This would indicate that the observed spawning season was fairly typical. It would also indicate that the abundance *of* larvae is directly related to spawning activity. This is somewhat counter to what was observed by Stoner et al. (1992) in the Bahamas, who observed high larval densities in association with only a portion *of* the peak reproductive season. Based on work in the Bahamas and Florida (Stoner, pers. comm.), the abundance of larvae appears to be correlated to the recruitment of juveniles. In that respect, the larval densities observed were discouraging because they were two orders of magnitude lower than the maximum values reported from protected areas in the Bahamas and an order of magnitude below those observe in areas unprotected but showing some sustained recruitment. While the relationship between larval abundance and recruitment is still tentative, the present results further support the concern that the local stocks are recruitment overfished (see also below).

Goodyear (1989; unpubl. ms) has developed empirical and theoretical arguements for considering a SPR-value of <0.2 as indicative of a population where the threat of stock collapse is high. This value has generally been adopted within the U.S. for management within Federal waters (EEZ), although exceptions of either higher (e.g. Sadovy 1993) or lower (e.g. Bohnsack et al., 1991) values of SPR have been suggested where justified. Justification has usually come in the form of a history of stock decline despite a high SPR or stock stability despite a low SPR. At present, such a historical perspective is not available for queen conch, and an acceptance of the 0.2 SPR limit would seem appropriate.

The SPR analyses conducted indicated that without management, the conch stock can be expected to decline to a point were the SPR declines below 0.2. Appeldoorn (1987;

1992b) estimated fishing pressure off of La Parguera during the mid-1980's at about F=1.14. At this level of fishing, the SPR value is about 0.09, or way below the recommended value of 0.2. It is noted that estimated landings declined dramatically (80%) at this time. For the La Parguera population, application of the proposed 9-inch minimum size limit would maintain the population above a SPR of 0.2 at reasonable levels of fishing. The La Parguera population consists of relatively large individuals (Appeldoorn, in press); thus a lower percentage of individuals would be protected under the 9-inch size limit than in other areas. This would indicate that for the Puerto Rican stock as a whole, the 9-inch size limit may adequately conserve spawning stock according to the 0.2 criterium. The management strategy based on lip-thickness was the most conservative with respect to SPR, with values never approaching critical levels. The results of both this and the 9-inch size limit analysis indicate the substantial effect that fishing of juveniles is having on the future reproductive potential of the population.

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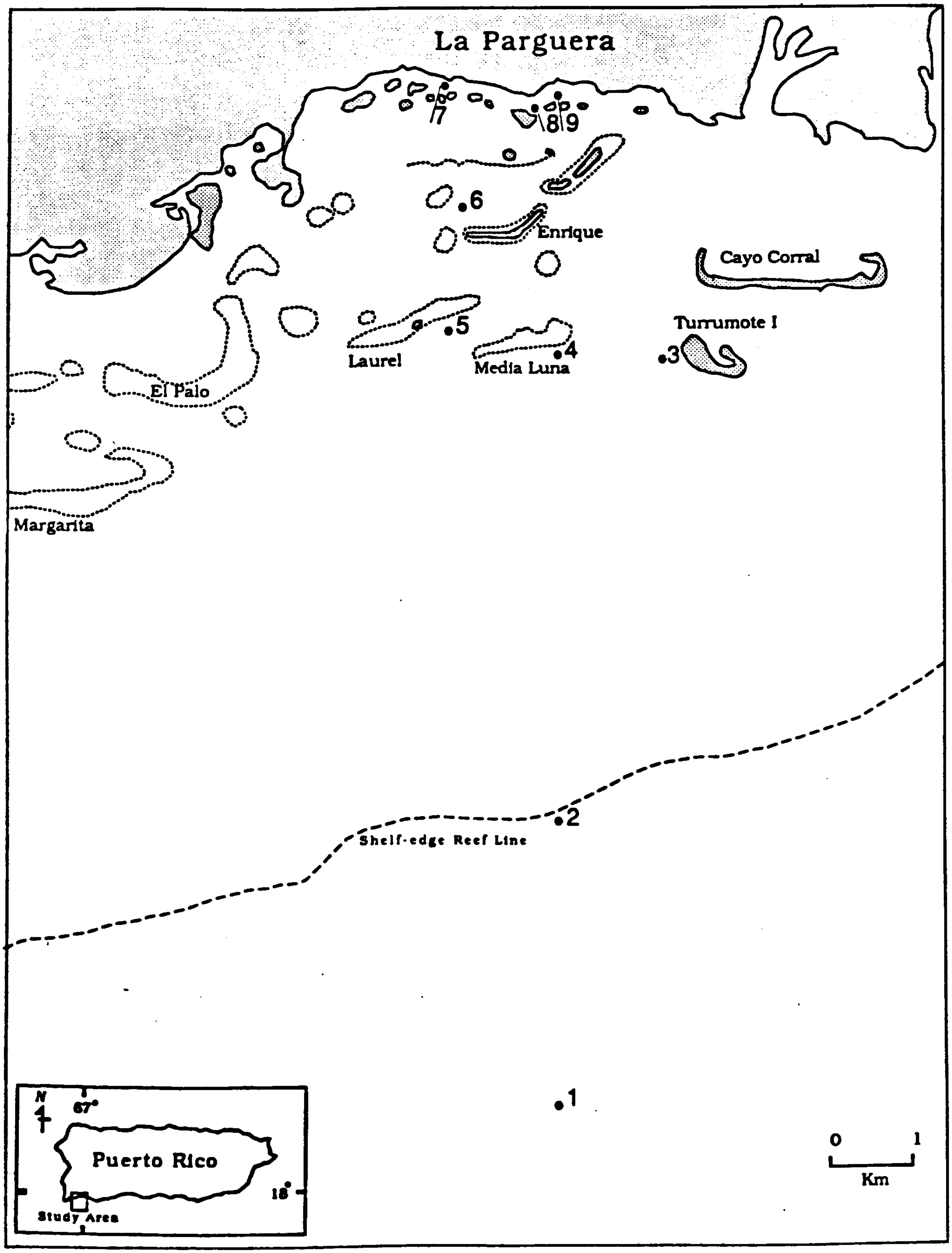
LIST OF FIGURES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8
9
6
Enrique
Cayo Corral
5
Turrumote I
4
3
Laurel
Media Luna
El Palo
Margarita
2
Shelf-edge Reef Line
1
N
67°
Puerto Rico
18°
Study Area
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1
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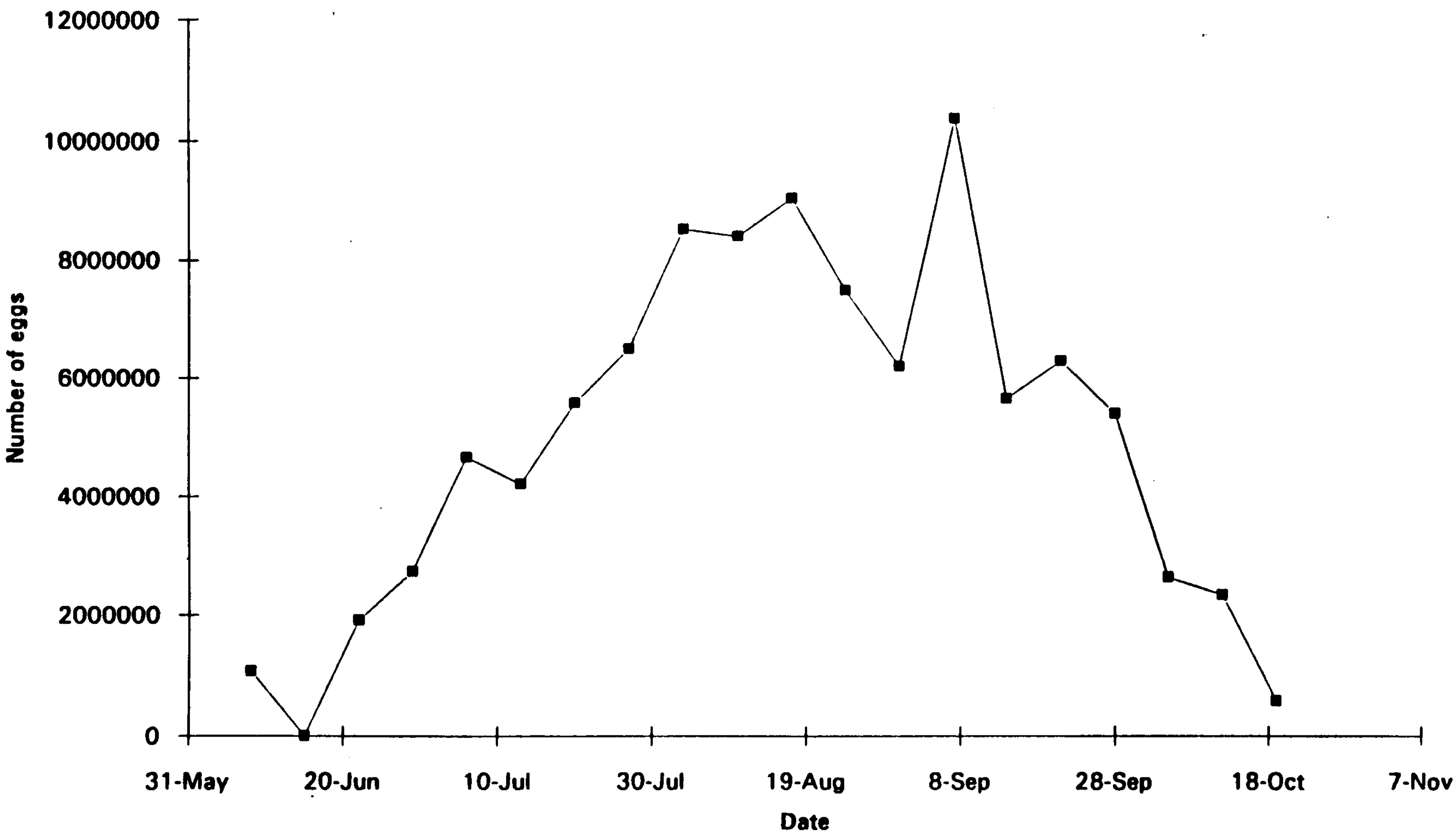

12000000
10000000
8000000
6000000
4000000
2000000
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Number of eggs
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20-Jun
10-Jul
30-Jul
19-Aug
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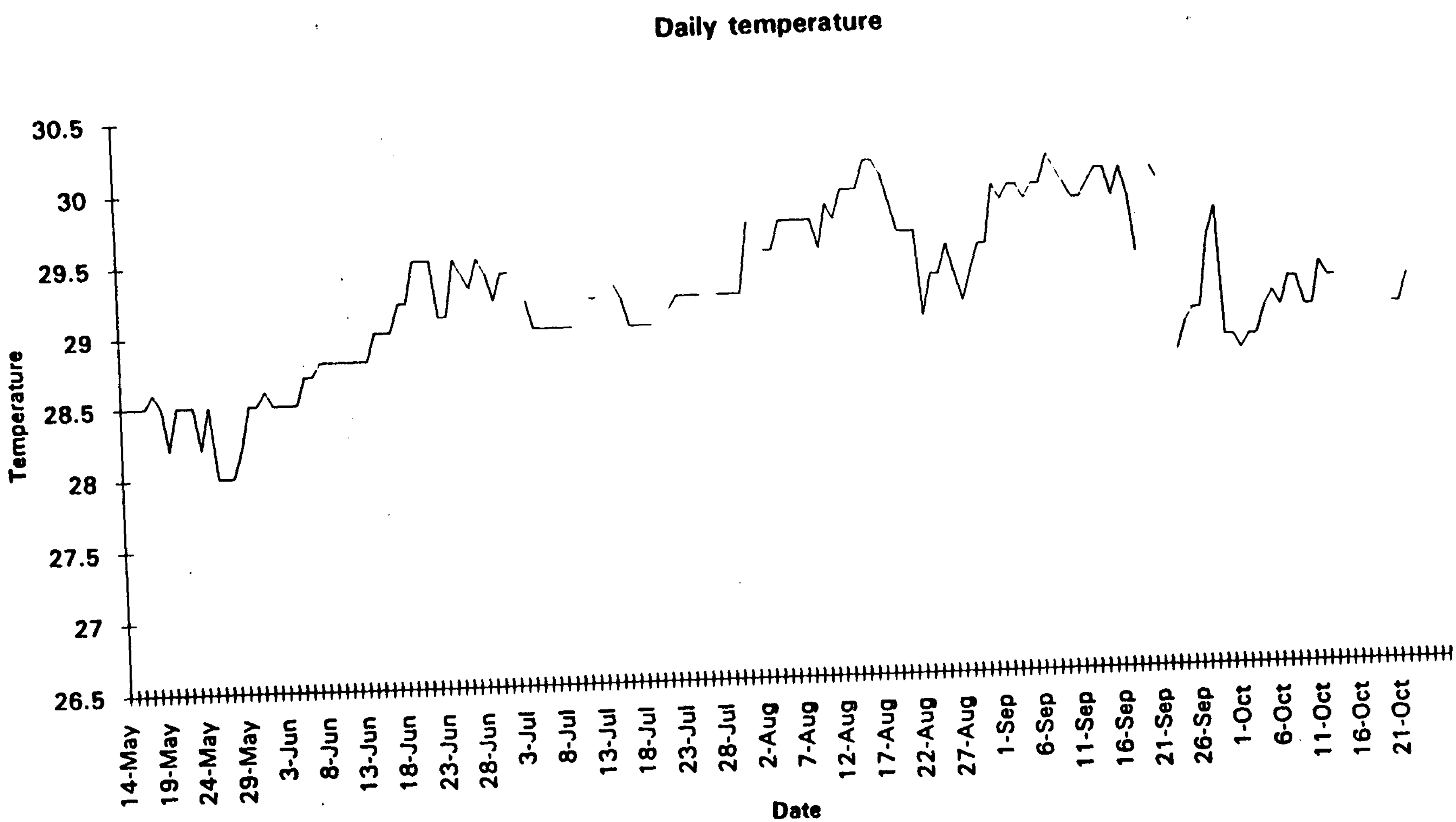
18-Oct
7-Nov
Date



Daily temperature
Temperature
30.5
30
29.5
29
28.5
28
27.5
27
26.5
14-May
19-May
24-May
29-May
3-Jun
8-Jun
13-Jun
18-Jun
23-Jun
28-Jun
3-Jul
8-Jul
13-Jul
18-Jul
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21-Oct
Date

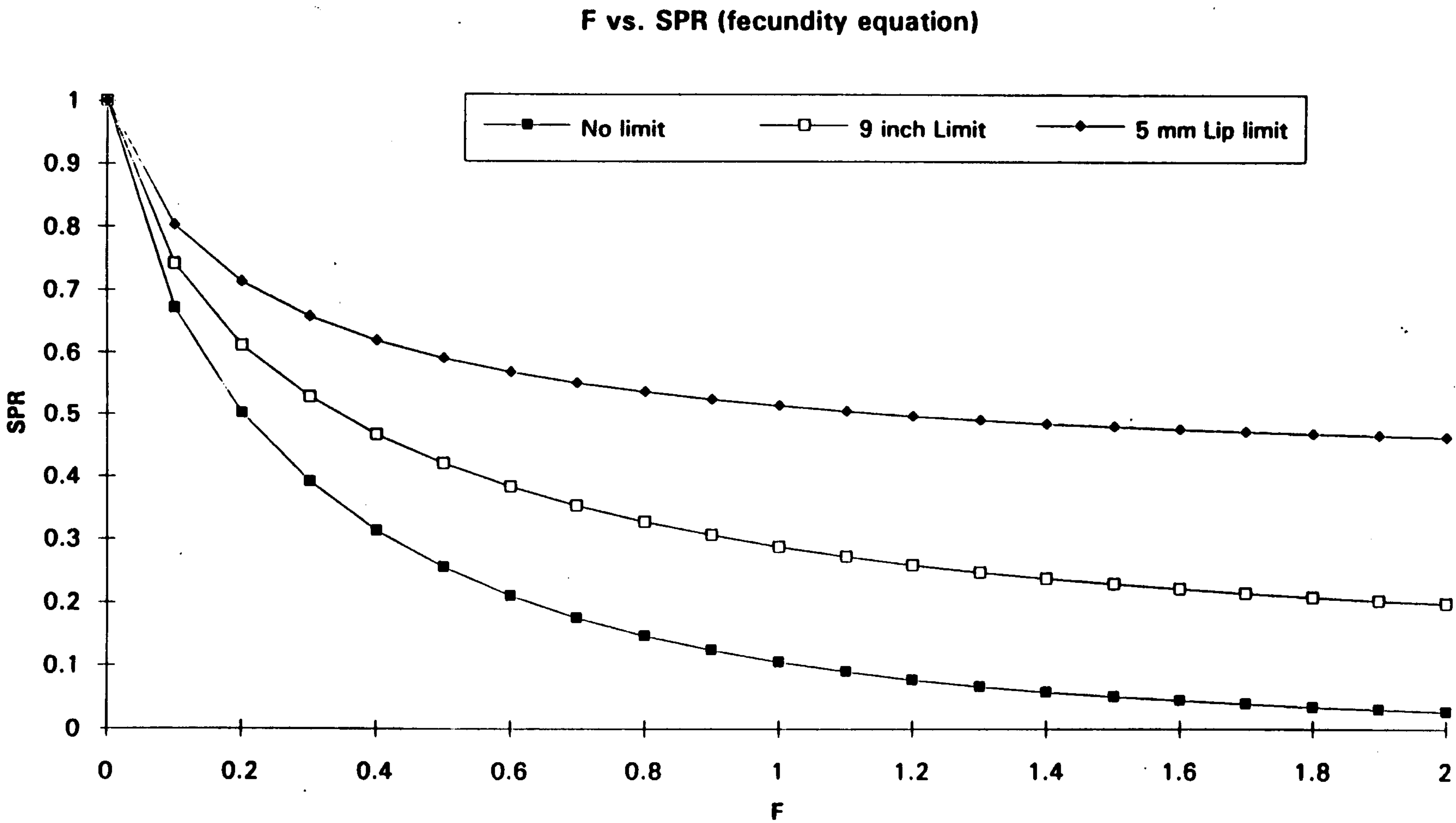
F vs. SPR (fecundity equation)
No limit
9 inch Limit
5 mm Lip limit
SPR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
F

Table 1. Number of males and females mature and immature by siz
(lip thickness) class. Total number = 210.

Lip Thickness (mm)	Males Mature	Males Immature	Females Mature	Females Immature	Tota
4	0	3	1	4	8
5	0	0	1	0	1
6	0	1	1	0	2
7	0	1	0	0	1
8	0	1	1	0	1
9	2	1	3	0	6
10	2	0	1	1	4
11	5	2	1	1	9
12	8	4	3	2	17
13	3	0	1	3	7
14	8	3	3	1	15
15	12	0	4	1	17
16	10	2	7	1	20
17	11	2	6	2	21
18	7	1	9	2	19
19	9	2	7	0	18
20	8	0	9	0	17
21	3	1	5	0	9
22	3	0	3	0	6
23	4	0	2	0	6
24	2	0	0	0	2
25	3	0	1	0	4

Table 2. Parameters estimated for the equation of proportion mature (PM) as a function of lip-thickness (LT): $PM = a \{1 - \exp[-b(LT - c)]\}$. For the regression $r^2 = 0.74$.

Paramter	Estimate	Standard Error
a	1.0	0.10
b	1.4	0.057
c	1.9	1.5

Table 3. Length, lip thickness at start of the experiment, wet tissue weight at the end of the experiment, total number of egg masses produced, total fecundity (x 10^6), and total eggs hatched (x 10^6) for each female in two density treatments (code numbers 2 [high density] & 4 [low density]). * indicates broken shell.

Female	Length (cm)	Lip (mm)	Weight (g)	Egg Masses	Fecundity	Eggs Hatched
2F1	25.9	15	504	11	7.162	7.156
2F2	26.1	15	452	8	3.454	3.454
2F5	24.7	13	390	4	1.592	1.294
2F8	27.4	17	464	8	3.715	3.690
2F10	24.8	14	366	2	1.270	1.270
2F13	23.4	11	364	3	1.604	1.604
2F15	24.5	13	438	3	1.926	1.926
2F16	23.5*	13	398	17	7.902	7.900
2F18	23.4	11	342	5	1.857	1.852
2F19	25.9	15	472	6	2.799	2.785
4F1	24.6	14	430	25	22.298	22.031
4F2	24.1	14	424	5	4.282	3.781
4F3	24.8	10	412	9	4.811	4.790
4F4	25.0	16	442	20	14.303	14.013
4F5	24.6	5	468	2	0.853	0.477
4F6	23.3	17	398	19	15.843	15.834
4F7	24.4	18	534	13	7.629	7.545
4F8	24.5	11	542	16	8.631	8.572
4F9	27.9	14	670	21	19.613	19.613
4F10	27.0	11	676	6	3.581	3.580

Table 4. Results of the regression of Log_{10}(fecundity) as a function of Log_{10}(age) for queen conch from two density treatments.

Density Treatment	Intercept	Slope	r^2	p
High	4.157 (1.638)	2.012 (1.444)	0.195	.201
Low	4.475 (0.596)	2.187 (0.541)	0.672	.004

Table 5. Results of surface plankton tows (202 μm mesh) for *Strombus* larvae during May, June, July, and August, 1993. Site locations are given in Figure 1. R= Number of replicates, Sg = *S. gigas*, Sc = *S. costatus*, Tot = Total *Strombus*, ns= no sample. Zooplankton Volume is in ml/tow and abundance is in ml/100m^3.

			Strombus Conc. (No./100 m^3)			Number of *Strombus*			Zooplankton		
Site	Date	R	Sg	Sc	Tot	Sg	Sc	Tot	Abund	Vol	Tow Volume (m^3)
1	5/21/93	3	0.00	0.00	0.00	0	0	0	16.96	36	212.26
2	"	3	0.00	0.00	0.00	0	0	0	16.34	33	201.95
3-5	"	3	2.15	0.00	2.15	4	0	4	10.73	20	186.37
6	"	3	0.00	0.00	0.00	0	0	0	11.34	19	167.55
7-9	"	3	0.00	0.00	0.00	0	0	0	15.29	30	196.18
1	6/4/93	3	0.00	1.13	1.13	0	2	2	18.12	32	176.58
2	"	3	0.00	0.85	0.85	0	1	1	36.72	43	177.09
3-5	"	3	4.65	0.00	4.65	8	0	8	26.77	46	171.86
6	"	3	6.81	0.00	6.81	8	0	3	37.44	44	117.53
7-9	ns										
1	6/18/93	3	0.00	0.00	0.00	0	0	0	11.14	22	192.92
2	"	3	0.00	0.00	0.00	0	0	0	17.50	24	137.22
3-5	"	3	0.00	0.00	0.00	0	0	0	5.28	10	189.57
6	"	3	0.00	0.00	0.00	0	0	0	12.40	16	128.96
7-9	6/28/93	3	0.00	0.00	0.00	0	0	0	7.71	12	155.61
1	7/9/93	3	0.00	0.00	0.00	0	0	0	10.76	22	204.52
2	"	3	0.00	0.00	0.00	0	0	0	16.17	30	185.58
3-5	"	3	0.00	0.00	0.00	0	0	0	19.56	26	132.90
6	"	3	0.00	0.00	0.00	0	0	0	18.06	24	132.89
7-9	7/15/93	3	0.00	0.00	0.00	0	0	0	17.94	25	139.38
1	ns										
2	ns										
3-5	7/23/93	3	1.26	1.26	2.52	2	2	4	12.57	20	159.08
6	"	3	0.00	1.93	1.93	0	3	3	28.27	44	155.64
7-9	ns										
1	8/6/93	3	0.00	0.00	0.00	0	0	0	17.08	30	175.68
2	"	3	0.62	0.00	0.62	1	0	1	14.77	24	162.46
3-5	"	3	0.60	0.00	0.60	1	0	1	10.86	18	165.65
6	"	3	2.54	6.77	9.31	3	8	11	18.62	22	118.18
7-9	8/3/93	3	0.00	0.00	0.00	0	0	0	11.10	20	180.17
1	8/20/93	3	0.00	0.00	0.00	0	0	0	24.87	34	136.72
2	"	3	0.63	0.00	0.63	1	0	1	18.94	30	158.40
3-5	"	3	3.79	8.52	12.31	4	9	13	6.63	7	105.63
6	"	3	1.93	18.30	20.23	2	19	21	15.41	16	103.82
7-9	8/18/93	3	0.00	0.00	0.00	0	0	0	7.59	14	184.40