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INITIAL OBSERVATIONS ON A NEW FISHERY FOR THE SUNRAY VENUS CLAM, MACROCALLISTA NIMBOSA (SOLANDER)

by
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PREFACE

Florida, with its thousands of square miles of shallow estuarine areas, would appear to have ideal habitats for many species of clams and, consequently, a potentially vigorous clam industry. Many areas throughout the State are already known to have several species of clams in relatively high abundance. Yet the total State production in 1966 was slightly over 5,000 pounds of meats valued at about $2,000.

The present method of harvesting is one major reason for this apparent disregard for a natural resource and the subsequent loss to the State of a potentially rich industry. In major clam producing areas, such as Chesapeake Bay, the most efficient production is accomplished through the use of mechanical harvesters.

In Florida, these harvesters are very unpopular in certain areas and are not used. Consequently, Florida clams have traditionally been harvested by hand, a method not conducive to mass production.

The effects of a mechanical harvester on the extensive grass flats and rich bottom habitats of southern estuaries are virtually unknown. Approximately 75% of Florida's commercial species of fishes and invertebrates spend at least a portion of their life cycle in these shallow estuarine areas. Consequently, mechanical harvesting, especially on large scale commercial operation, should be restricted until sufficient research can be performed to determine whether such harvesters should be allowed in Florida and what restrictions, if any, should be applied.

It would certainly not be in the interests of good management to jeopardize the established commercial efforts in an attempt to initiate production on an unproven resource, no matter how great its potential.

INITIAL OBSERVATIONS ON A NEW FISHERY FOR THE SUNRAY VENUS CLAM, *MACROCALLISTA NIMBOSA* (SOLANDER)

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INTRODUCTION

The data and results presented in this paper were obtained through a cooperative effort of Mr. George M. Kirvin, owner of *Quality Seafoods* of Apalachicola, Florida, and the Florida Board of Conservation. Mr. Kirvin applied for a special permit to use a commercial hydraulic Nantucket dredge to harvest clams. Since the area to be worked was loose quartz sand, almost barren of vegetation, the permit was granted, providing a marine biologist from the Board of Conservation was present during the harvesting operations of the first few months.

This provided an excellent opportunity to observe a new fishery from its inception, to make observations on the effect of this type of mechanical harvester on the bottom habitats sampled, and to broaden our data on the abundance of these clams. This fishery was also different in that it did not utilize the southern quahog (*Mercenaria campechiensis*) which had previously dominated Florida's clam production. The new fishery was based on the sunray venus clam *Macrocallista nimbosa* (Solander).

M. nimbosa (Figure 1) is four to seven inches in length, elongate, compressed and glossy-smooth with a thin, varnish-like periostracum. The exterior is dull salmon to mauve with broken radial bands of darker color. The interior is dull white with a blush of red over the central area. The species is known to occur from South Carolina to Florida and the Gulf states (Abbott, 1958). This attractive shell is popular with shell collectors and tourists. It is relatively common throughout its range and the local shells may be collected from the beaches or taken alive in shallow water.

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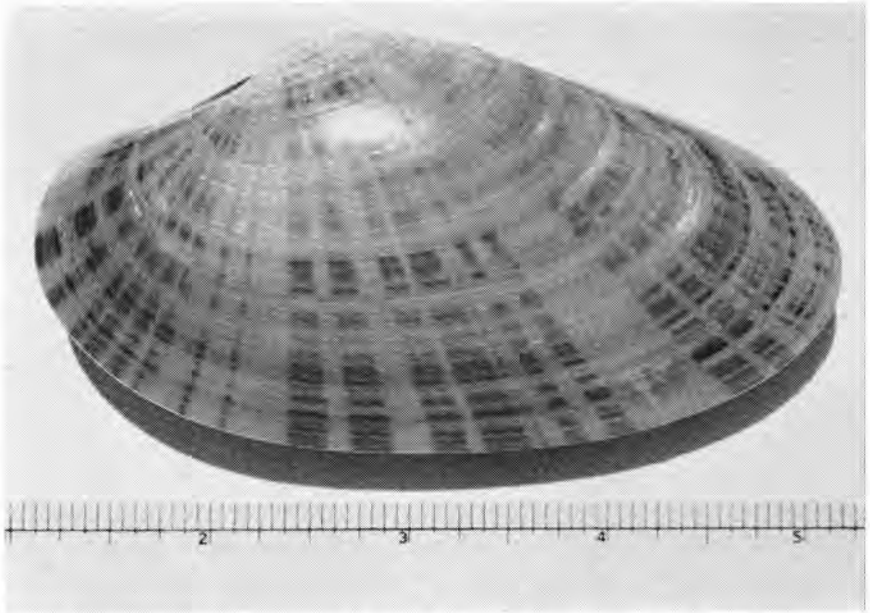

Figure 1. The sunray venus clam *Macrocallista nimbosa* (Solander).

A previous study indicated that this species was present in commercial quantities in the Alligator Harbor area of Franklin County, Florida (Akin and Humm, 1959). However, as of this writing, no commercial production has been achieved in that area.

Mr. Kirvin became interested in the potential of the sunray venus through inadvertent encounters with large numbers of clams in shallow water areas. Local fishing boats occasionally became grounded while working these areas and when power was applied to free the vessel, large numbers of clams were dislodged by the wake. With this information available, and a potential market beckoning, Mr. Kirvin applied for, and received, his clam harvesting permit.

ACKNOWLEDGMENTS

Our sincerest thanks go to Mr. George Kirvin whose interest and assistance in our research was far beyond that required by a permit. We also wish to thank the employees of *Quality Seafoods*

in Apalachicola for their assistance in the handling of specimens and collection of data.

METHODS AND MATERIALS

Gear

All harvesting was accomplished from the slightly modified 65-foot shrimp trawler *Little John* based at Port St. Joe, Florida and powered by a 671 GM diesel. This vessel had been equipped with an "A" frame (Figure 2) which was used to raise and lower the dredge over the stern.

A 27-inch "Nantucket" dredge (Figures 3 and 4) was used throughout the study period. The major components of the dredge used on the *Little John* during this study period were as follows: 1) a 27-inch welded steel dredge head with cutting blade, water pressure manifold, steel sled runners (to prevent the unit from

Figure 2. The modified shrimp trawler *Little John*, showing the "A" frame construction and the Nantucket dredge being lowered.

Figure 3. The 27-inch Nantucket dredge.

digging into the bottom) and a steel frame box to retain the catch; 2) a 365 horsepower Chrysler marine deck engine powering a 1,000-gallon-per-minute (125 lb. pressure per sq. in.) water pump; 3) sufficient high pressure four-inch-diameter water hose to connect the pump to the dredge head.

Basically, this harvester utilizes water pressure to dig the clams which are then forced back into the container by the forward motion of the dredge (Figures 5a and 5b). The entire unit is then lifted on deck, emptied, and returned overboard to continue fishing.

During the early commercial operation, the dredge remained on the bottom for varying lengths of time. However, it soon became apparent that a fishing time of 10 to 15 minutes was preferable. This short towing time prevented overfilling of the dredge and undue breakage of clams. It also allowed the crew

Figure 4. Nantucket dredge, showing manifold and water jets.

Figure 5a. Nantucket dredge on bottom and working. Note the sunray clam being cut from the substrate by the digging action of the water jets.

Figure 5b. Top view of the Nantucket dredge working. Note the clams being forced over the collecting blade and into the catch retainer.

sufficient time for sorting and bagging the catch prior to the next emptying of the dredge.

Yield per unit of effort calculations were based on 10 minutes of towing time, although actual tows may have been of varying duration. To determine the yield per unit of effort for any particular day, the total number of towing minutes (bottom time) were divided by 10 to arrive at the number of drags. The total number of bushels produced that day was then divided by the number of 10-minute drags to determine yield per 10-minute tow.

The first commercial harvest was made on February 8, 1967 after two or three trial samplings were used to check on clam populations and to test gear operation. Harvesting has continued since that time with only minor interruptions for repairs and gear modifications.

The data presented in this report cover only those harvesting trips when the biologist was actually on board. The study period ran from February 13 through June 26, 1967 and a total of 50 trips were analyzed.

All major harvesting throughout the study period occurred in the area known locally as Bell Shoal. This is about an eight-square-mile area located four miles northwest of St. Joseph Point in St. Joseph Bay, Gulf County, Florida (Figure 6). The depth of the shoal ranges from 16 to 25 feet and the bottom is composed of loose, shifting quartz sand, barren of vegetation. Occasional sampling was attempted in other areas when weather prevented the vessel from working Bell Shoal.

All catch data were recorded on specially prepared field data sheets and one of these forms was prepared for each drag. The drag was given a number and the location, date, time of drag, bottom type, and depth were recorded. A check list of species was also included on the data sheets and each time a species was taken it was checked on the list and the number recorded. The number of bushels of *M. nimbosa* taken in each drag were counted or estimated and recorded.

Hydrographic data were recorded periodically during each day's activities. The large number of drags prevented this data from being obtained each time the dredge was overboard. Consequently, surface and bottom water temperatures and salinities

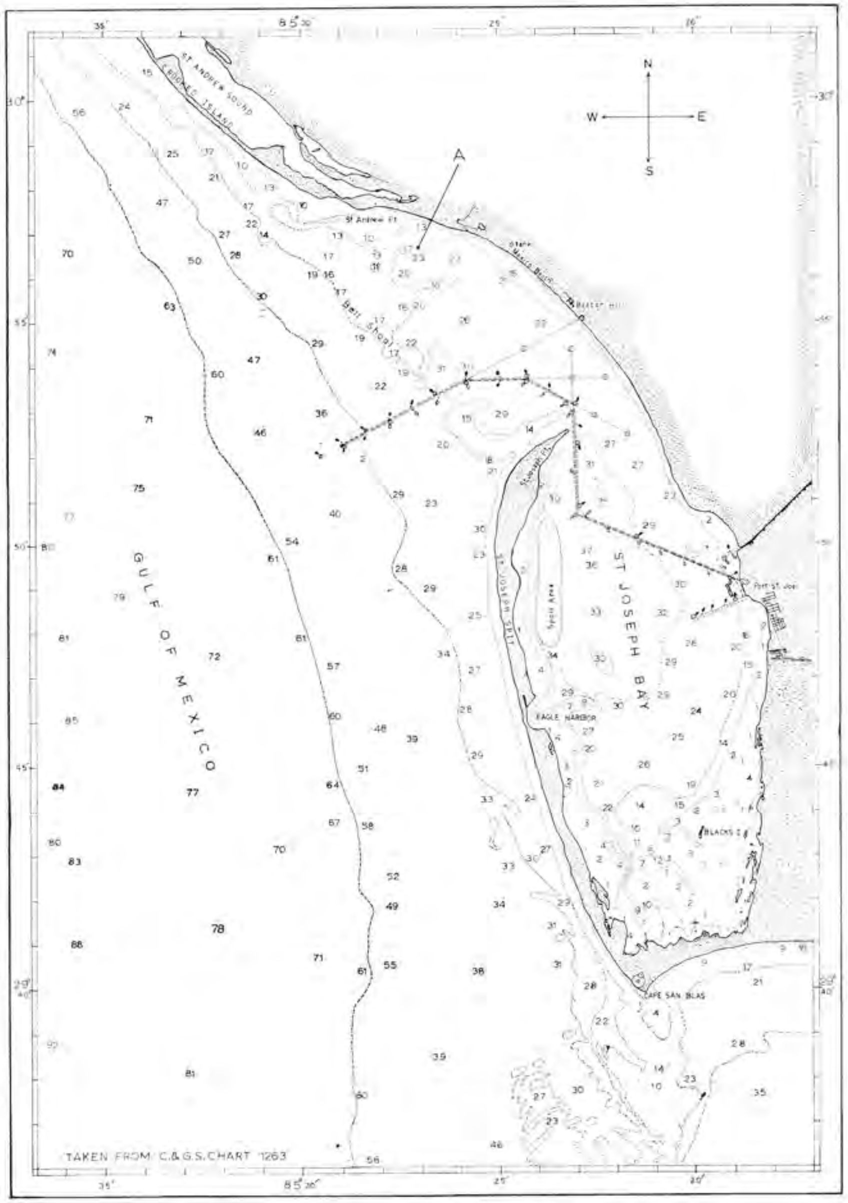

Figure 6. Map of St. Joseph Bay and the Bell Shoal area.

were recorded approximately four times during the work day. Temperatures were taken with a centigrade immersion thermometer and salinities were determined with a standard salinity hydrometer. Additional data including water condition, weather, and wind velocity and direction were also recorded along with any other pertinent information.

A marking experiment was conducted to obtain information on growth rates. Approximately 200 small clams 35 to 55 mm long were collected, marked, and replanted on June 9, 1967 in an area where later reharvesting would be facilitated. A triangular file was used to make a notch which extended to the edge of the shell (Figure 7). Later growth was then easily measurable as that area of unmarked shell extending beyond the outer edge of the filed notch. As many of the replanted clams as could be found were reharvested and re-marked on July 27, 1967, September 15, 1967, February 6, 1968, April 4, 1968, and June 8, 1968. Although not all of the marked clams were relocated at each digging, sufficient numbers were recovered to provide an indication of growth rates. In addition, comparative analysis of the varying amounts of

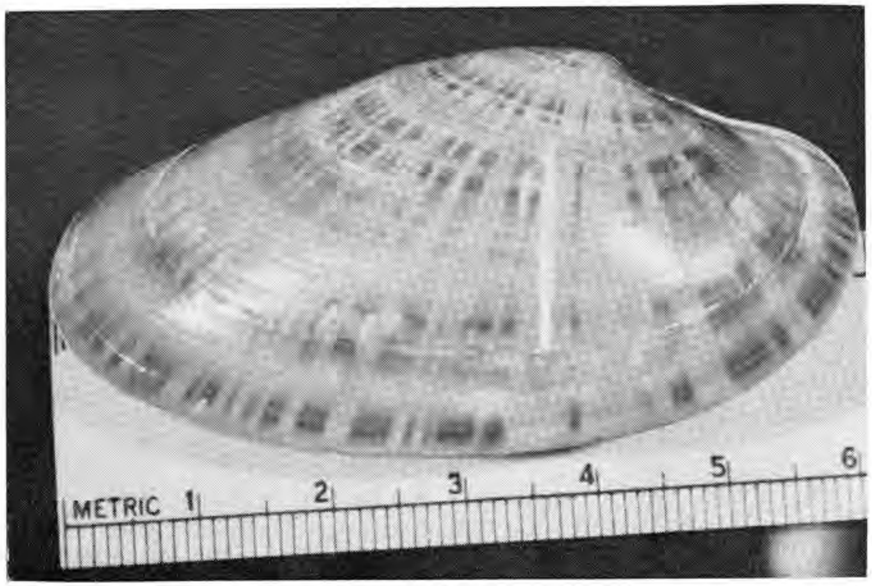

Figure 7. Sunray clam showing the mark used in growth studies. The area of unmarked shell beyond the lower end of the notch represents the new growth.

growth between marks on those clams which were recovered each time provide data on the seasonality of growth.

Observations were also made on the methods and problems of shucking and clam meat handling. Since this clam was completely new to the market many problems arose in the preparation of the product prior to sale. Several procedures were tried and later discarded before the most successful method was developed.

RESULTS AND CONCLUSIONS

Total Production

Total production by date is presented in Table 1. An additional summary of landings and trips made per month is given in Table 2. Trips in which a biologist was aboard are also summarized in Table 2 and a discussion of these 50 trips is provided in the section below.

Yield Per Unit of Effort and Other Technical Observations

A biologist made four trips in February when clams were harvested on the east-northeast sloping edge of Bell Shoal (see arrow marked *A*, Figure 6). This edge is about 150 yards wide and one-half mile long, rising from the mud bottom (depth 25 ft.) to its shallowest portion (depth 18 ft.). The average yield per unit of effort for this month (8.7 bushels per 10-minute drag) was the highest obtained during our study. Figure 8 presents yield per unit of effort and average daily catches for the months of observation.

In March, biological information was obtained for 10 trips which were also spent in the area described for February. The largest total catch for a single day recorded during our entire study (approximately 570 bushels) was made on March 1st. Fishing was generally good even though the catch per 10-minute tow declined slightly to 8.5 bushels.

In April, water temperatures began to rise and fishing along the edge became less productive. Trips were then made to the higher portions of the Shoal and the yield, although not as good as it had been on the edge, was much higher than it had been in previous tests. Twelve trips were observed during the month and an average of 4.5 bushels per 10-minute tow was obtained. Al-

TABLE 1. PRELIMINARY AND UNOFFICIAL CATCH DATA GATHERED BY THE BUREAU OF COMMERCIAL FISHERIES OF THE U. S. FISH AND WILDLIFE SERVICE
(In Bushels)

Date	Feb.	March	April	May	June	July	Aug.	Sept.
1		570						310
2					63			
3		350	289		185			
4			285		228		1,671*	
5			328	210				170
6					220			271
7			495		205		357	
8	150	455		91	203		306	380
9				101	214		327	
10		428	130	81	185	179	247	
11			270			242		261
12			305		157	310		306
13	222				200			271
14		451	28		151	165		200
15			175			300		231
16		270		152	190			
17		500	305			310		
18			305	182		250		230
19			263			200		260
20	184				150	180	1,920*	138
21		307				402		215
22	414	560		75	154			
23	EH 18			200	99		300	
24		491	181	150	100	354	323	
25				250			352	375
26			81				272	210
27	290				208	185		285
28					309	272	307	220
29		149		35	352		250	185
30		141		185	348		333	
31				178		300	291	
Total	1,278	4,632	3,440	1,890	3,921	5,149	7,256	4,518

*These figures represent several days' production.
EH—landings derived from Eagle Harbor.

TABLE 2. PRODUCTION AND YIELD PER UNIT OF EFFORT DATA

Month	Total Trips: Trips Made	Total Trips: Total Production[x] (Bushels)	Total Trips: Total Meats*	Trips with Biologist Aboard: Trips	Trips with Biologist Aboard: Bushels	Trips with Biologist Aboard: Average No. Bushels/Day	Trips with Biologist Aboard: Average No. Bushels/10-Min. Tow
Feb.	6	1,278	12,428	4	1,182	295	8.7
March	12	4,632	44,251	10	3,315	331	8.5
April	14	3,440	32,952	12	2,597	216	4.5
May	13	1,890	21,103	13	1,428	109	2.5
June	20	3,921	8,725+	11	1,725	157	3.5
July	14	5,149	NDA	End of biological observations			
Aug.	14	7,256	NDA				
Sept.	18	4,518	NDA				

x—includes amounts listed for trips with biologist on board.
*—figures are not exactly comparable to bushels produced. Clams brought in during last few days of each month may not have been shucked and sold until first part of following month.
+—covers only first eight days of month.
NDA—no data available.

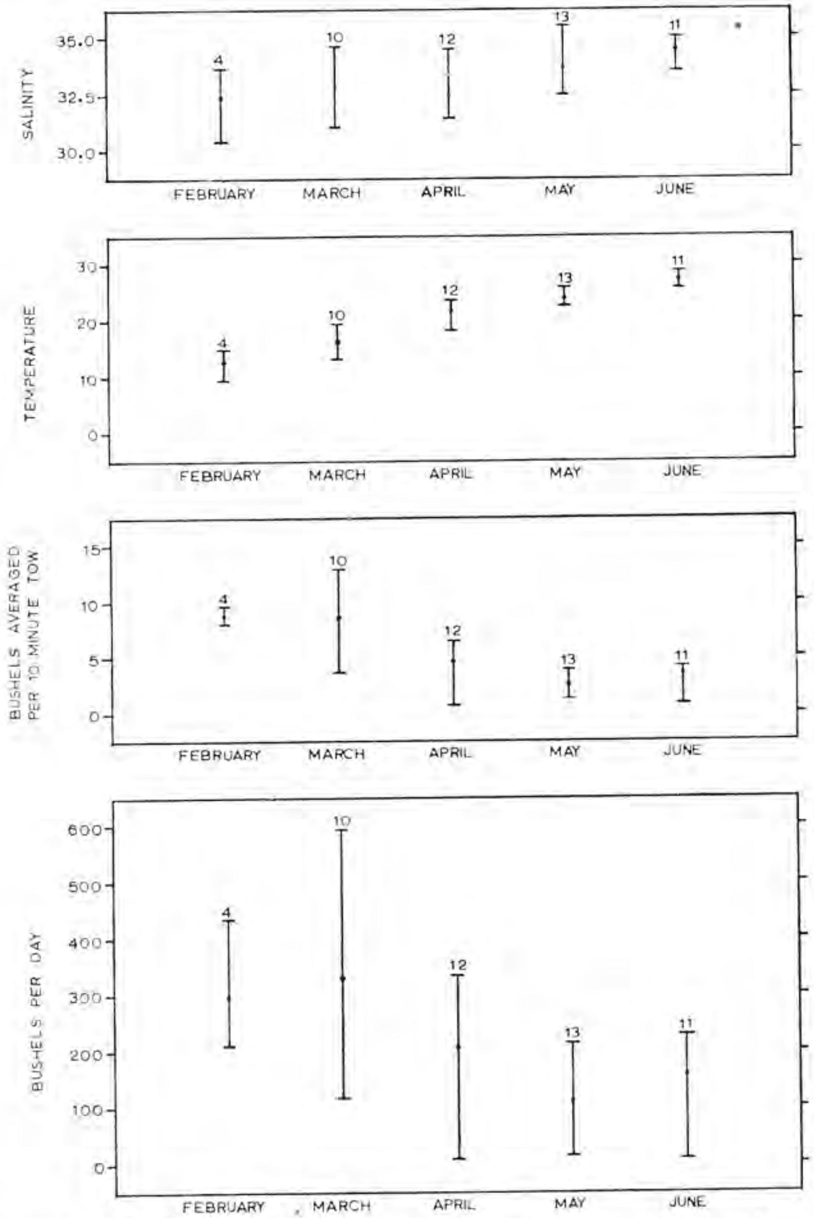

Figure 8. Observed ranges and means (based on the number of trips observed, top of column) for temperature, salinity, yield per unit effort, and daily catches by month throughout the study period.

though statistical and biological verification is not presently available, day-to-day observations indicate that the clams had spread from the highly concentrated condition on the edge to the more extensive, higher and open flats.

Production in May, as in April, was carried out on the higher portions of the Shoal. However, harvest was seriously reduced through loss of possible working time. Equipment began to break down. It was not unusual to arrive on the harvesting site, work a few hours and be forced to return to dock because of broken gear or deck unit malfunctions. Even when we were not forced to return for repairs, the catching efficiency of the worn equipment was reduced. As a result of these poor conditions, May's average production (13 trips) of 2.5 bushels per 10-minute drag was the lowest obtained for any month.

Time consuming and inefficient conditions finally forced the complete repair of worn equipment and June's average production (11 trips) increased to 3.5 bushels per 10-minute tow. Trips for June were also made to the more elevated areas of the Shoal.

Weather appeared to affect the harvesting of sunray venus clams. It was observed that our average catch was reduced during prolonged periods of rough, stormy weather. Also, various degrees of light intensity appeared to have a direct effect on our yield per drag. On clear, calm days, while a buoyed area was worked, yield per drag was high during the morning hours. As the sun neared its zenith, yield per drag dropped and remained low until the altitude of the sun decreased sufficiently to allow a decrease in light intensity. Yield per drag would then increase and remain good until several hours after darkness. It would appear from this observation that a portion of the clams burrow deeper into the substrate during periods of high light intensity. This hypothesis is strengthened by other studies.

Crude experiments in the laboratory showed that clam activity (determined by siphon count) is greatest when light intensity is 330 foot candles and diminishes if intensity is raised or lowered. It has previously been established that this animal may be found buried as much as two feet in the substrate (Akin and Humm, 1959).

Production was sufficient to make the operation commercially feasible in spite of the reduced yield caused by: 1) dispersal of clams from a concentration on the edge to the open and extensive flats; 2) loss of work time and reduced catching efficiency due to worn equipment; 3) tendency of this clam to burrow deeper into the substrate during prolonged rough weather or periods of high light intensity.

From February 13 to June 26, 1967, we participated in 50 of the harvesting trips. These trips yielded approximately 10,300 bushels of clams produced at an overall average of five bushels per 10-minute drag. The clams harvested were uniform in size (average length, 130 mm) and averaged 150 clams per 85-pound bushel.

Associated Fauna

Table 3 presents a check list of the species collected on Bell Shoal. The predominant species were monitored and are ar-

TABLE 3. SPECIES FOUND IN ASSOCIATION WITH THE SUNRAY CLAM (*Macrocallista nimbosa*)

	Scientific Name	Common Name	Percent Composition by Number of Individuals
Species Harvested Regularly and in Quantity	*Theelothuria princeps*	Sea cucumber	36.5
	Luidia alternata	Starfish	24.5
	Dinocardium robustum	Heart cockle	18.2
	Astropecten articulatus	Starfish	6.5
	Albunea gibbesii	Sand flea	5.2
	Luidia clathrata	Starfish	2.3
	Calappa flammea	Flame crab	0.9
	Limulus polyphemus	Horseshoe crab	0.8
	Polinices duplicatus	Moonsnail	0.8
	Spisula solidissima similis	Surf clam	0.6
	Cancellaria reticulata	Nutmeg shell	0.6
	Busycon contrarium	Left-handed whelk	0.6
	Busycon spiratum	Pear whelk	0.5
	Oliva sayana	Lettered olive	0.4
	Hepatus epheliticus	Liver crab	0.4
	Encope michelini	Purple sand dollar	0.3
	Moira atropos	Heart urchin	0.3
	Phalium granulatum	Scotch bonnet	0.2
	Ovalipes quadulpensis	Swimming crab	0.2
	Dosinia discus	Disc shell	0.1
	Pleuroploca gigantea	Horse conch	0.1

TABLE 3. (Continued)

Species Harvested Regularly but not in Quantity	*Chilomycterus schoepfi*	Burr fish	—
	Narcine brasiliensis	Shock ray	—
	Galeichthys felis	Catfish	—
	Hemipteronotus novacula	Pearly razor fish	—
	Carapus bermudensis	Pearl fish	—
	Kathetostoma albigutta	Stargazer	—
	Ancylopsetta quadrocellata	Four-eyed flounder	—
	Letharchus velifer	Sailfin eel	—
	Branchiostoma	Amphioxus	—
	Macrocallista maculata	Checkerboard clam	—
	Mercenaria campechiensis	Quahog	—
	Chione cancellata	Dog clam	—
	Trachycardium egmontianum	Prickly cockle	—
	Laevicardium laevigatum	Egg cockle	—
	Lucina sp.		—
	Tellina magna	Great tellin	—
	Strombus pugilis alatus	Florida fighting conch	—
	Cassis madagascariensis spinella	Helmet conch	—
	Sinum perspectivum	Baby's ear	—
	Mellita quinquiesperforata	Brown sand dollar	—
	Callinectes sapidus	Blue crab	—
	Arenaeus cribrarius	Speckled sand crab	—
	Libinia dubia	Spider crab	—
	Pinnaxodes floridensis	Commensal crab in *Theelothuria princeps*	—
	Portunus gibbesii	Swimming crab	—
	Arenicol acristata	Lug worm	—

ranged in order of declining percentage. Species collected, but not in sufficient numbers to permit a percentage comparison, are listed.

Macrocallista nimbosa was by far the most predominant animal taken in our collections. A drag yielding 15 bushels of clams would normally have a bushel or less of other species. The most numerous of the associated species were sea cucumbers (*Theelothuria princeps*), starfish (*Luidia alternata*), and heart cockles (*Dinocardium robustum*).

Some of these species might be of commercial value if they could be harvested in sufficient quantity. The heart cockle was harvested at a rough average of one or two individuals per bushel of *Macrocallista nimbosa*. The ratio was constant throughout our observations and heavy concentrations were not encountered. Occasionally, small surf clams (*Spisula solidissima similis*), approximately 80 mm long, and southern quahogs (*Mercenaria campechiensis*), approximately 140 mm long, were harvested. Two near relatives of these clams, the Atlantic surf clam (*Spisula solidissima*) and northern quahog (*Mercenaria mercenaria*) support large commercial operations along the New Jersey and New York coasts.

Observations were made concerning the catch of some species taken in association with sunray clams. The starfishes *Luidia alternata* and *Astropecten articulatus* were usually caught on shoal areas of sand composition while *Luidia clathrata* was taken from mud bottom areas. Two gastropods, the Scotch bonnet (*Phalium granulatum*) and lettered olive (*Oliva sayana*), did not appear in our catches until the end of April, after which they were taken regularly.

Hydraulic dredges utilize powerful jets of water to churn the substrate and free the clams. This method of harvesting breaks some of the shells which are left exposed with other burrowing invertebrates on the surface of the substrate. Because of this, fish are attracted to the operating dredge. During summer months, large schools of catfish (*Galeichthys felis*) followed the dredge as it worked. These schools would darken the relatively clear water for approximately 100 yards in back of the dredge. Other fish were also attracted to the site and individuals trolling their boats near the harvesting area usually enjoyed good fishing.

Physical and Chemical Data

Salinity of Bell Shoal remained fairly constant throughout the period of study. Lowest salinity recorded was 30.5 ‰ taken on February 20, 1967, while the highest (35.5 ‰) was noted May 18 through 30, 1967. February, March, and April had an average salinity of 32.6 ‰ which was somewhat lower than the averages for May and June (34.3‰). A mean salinity of 33.5 ‰ was obtained for the entire period of study (Figure 8).

Water temperature increased from a low of 9.5°C recorded February 28, 1967 to a high of 28.5°C recorded June 19, 1967. Mean temperatures for February, March, April, May, and June were: 12.8°C (55.4°F); 16.5°C (62.6°F); 21.9°C (71.6°F); 23.7°C (75.2°F); and 27.0°C (80.6°F) respectively (Figure 8). Observations indicate that the temperature change for April was the most significant in that it apparently affected the dispersal of clams from the edge to the Shoal proper.

Growth

The clams on Bell Shoal were large (130 mm long) and uniform in size. Small clams, 25 to 80 mm long (see Figure 9 for length-height relationship) were rarely, if ever, harvested in this area. However, when it was too rough to work on Bell Shoal we occasionally worked in the protected locations of St. Joseph Bay. In this area, clams ranged from 25 to 130 mm in length. The large ones were kept for processing and the smaller ones were thrown overboard.

On June 9, 1967, we collected approximately 200 small specimens (18 to 48 mm in height). These were notched on the right valve and planted in a selected area that could be easily located on future visits. In 1967, the marked clams were checked on July 27 and September 15. In 1968 they were checked on February 6, April 4, and June 8. On each visit, measurements were taken and the clams renotched so that the mark, and the measurement date it represented, could be distinguished from previous marks. When measurements and markings were completed, the clams were returned to the experimental plot. Some individuals were collected, measured, and re-marked as many as four times.

Table 4A presents the basic growth data obtained throughout the marking experiments. As the clams were recaptured the original size at release was recorded, along with the new growth. These original sizes were then grouped into 3 mm increments for easier analysis. Table 4B was constructed in the same manner, except that the 3 mm increment groups were based on the sizes of the September recaptures. This table gives an indication of the difference in seasonal growth of *Macrocallista nimbosa*. Figure 10 presents observed growth curves based on Tables 4A and 4B. These figures indicate that sunray clams may attain a growth of approximately three inches in length by the end of their first year. A hypothetical growth curve, based on a projection of these rates, was constructed (Figure 11). This curve suggests that the commercial-sized animals (130 mm long) are probably four to five years of age.

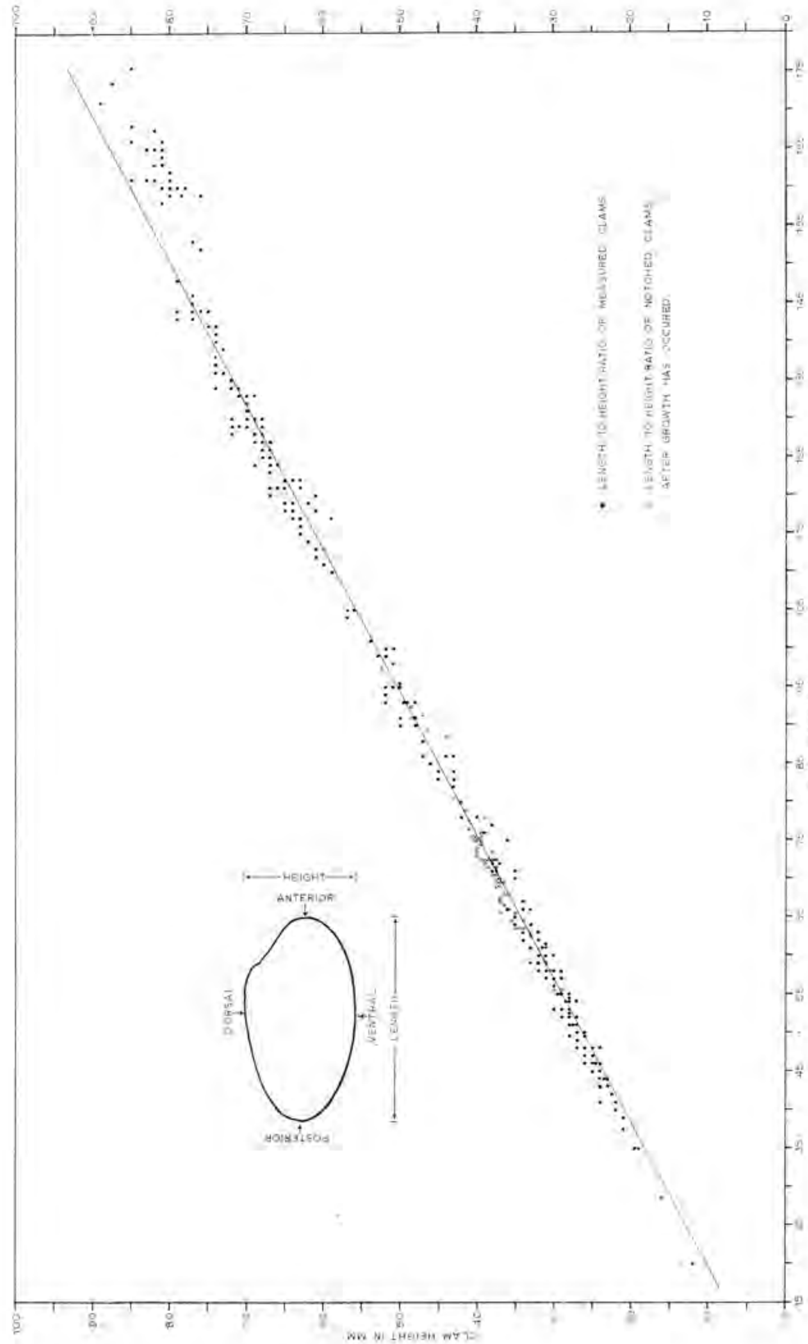

Figure 9. Length to height ratio of *Macrocallista nimbosa*.

TABLE 4A. BASIC GROWTH DATA (IN MM) OBTAINED FROM MARKING EXPERIMENTS

(Clams were grouped in 3 mm size increments for ease in presentation)

Size Range	June 1967		July 1967				September 1967			
	Average Size at June Capture	Total Number of Marked Clams Recaptured During Study	Average Size	Number of Clams	Average Growth	Range of Growth	Average Size	Number of Clams	Average Growth	Range of Growth
16-19		1								
19-22	19.3	1					29.1	1	9.8	9.8
22-25	23.1	11	30.0	1	6.1	6.1	35.9	3	12.5	10.6-13.8
25-28	25.6	43					37.1	8	11.5	8.5-13.5
28-31	28.2	61	34.0	8	5.8	3.0-7.4	38.5	23	10.0	7.5-12.6
31-34	31.4	27	37.3	6	6.2	5.4-6.6	39.6	8	8.2	7.6- 9.5
34-37	34.1	8	39.2	1	5.0	5.0	41.6	5	7.7	3.2-10.8
37-40										
40-43										
43-46	43.4	4	46.8	2	3.6	2.6-4.5				
46-49	46.9	4					49.0	3	2.8	2.5- 3.0
49-52	49.4	3					52.7	1	2.6	2.6
52-55										
55-58										
58-61										
61-64	62.4	2								

TABLE 4A. BASIC GROWTH DATA (IN MM) OBTAINED FROM MARKING EXPERIMENTS (continued)

(Clams were grouped in 3 mm size increments for ease in presentation)

Size Range	February 1968				April 1968				June 1968			
	Average Size	Number of Clams	Average Growth	Range of Growth	Average Size	Number of Clams	Average Growth	Range of Growth	Average Size	Number of Clams	Average Growth	Range of Growth
16-19									40.0	1	23.0	23.0
19-22												
22-25	42.7	2	20.4	19.6-21.2	44.4	3	21.6	20.1-23.2	45.7	2	24.0	24.0
25-28	43.7	8	18.0	10.0-21.4	44.8	14	19.3	11.6-22.8	47.4	13	22.3	13.2-28.0
28-31	43.6	7	15.7	10.1-19.8	45.3	15	17.2	11.0-21.4	46.0	8	18.2	11.0-22.0
31-34	43.8	4	12.4	7.8-15.0	46.1	5	14.7	9.6-18.5	48.0	4	16.6	15.0-18.5
34-37					41.6	1	7.4	7.4	43.0	1	9.0	9.0
37-40												
40-43												
43-46					50.3	1	6.9	6.9	51.0	1	7.5	7.5
46-49					51.3	1	3.8	3.8				
49-52					54.0	1	5.4	5.4	55.0	1	6.0	6.0
52-55												
55-58												
58-61												
61-64	68.9	1	6.5	6.5	69.9	1	7.5	7.5				

TABLE 4-B. SEPTEMBER TO APRIL GROWTH DATA (IN MM) OBTAINED FROM MARKING EXPERIMENTS

Size Range	September 1967		February 1968				April 1968			
	Average Size at September Capture	Total Number of Marked Clams Recaptured in Feb. & April	Average Size	Number of Clams	Average Growth	Range of Growth	Average Size	Number of Clams	Average Growth	Range of Growth
16-19										
19-22										
22-25										
25-28	26.8	2	33.7	1	6.9	6.9	36.4	1	9.6	9.6
28-31										
31-34										
34-37	34.9	11	41.4	4	6.6	1.6-9.6	44.0	7	8.9	3.4-11.6
37-40	37.6	32	43.9	12	6.2	2.1-9.4	44.8	20	7.3	3.0-10.1
40-43	40.6	6	46.1	2	5.4	4.9-5.9	47.0	4	6.9	6.5- 7.6
43-46	42.4	1					43.5	1	1.1	1.1
46-49										
49-52	49.8	1					51.3	1	1.5	1.5
52-55	52.5	2	54.6	1	2.1	2.1	55.5	1	3.0	3.0
55-58	56.3	1					59.7	1	3.4	3.4
58-61										
61-64										

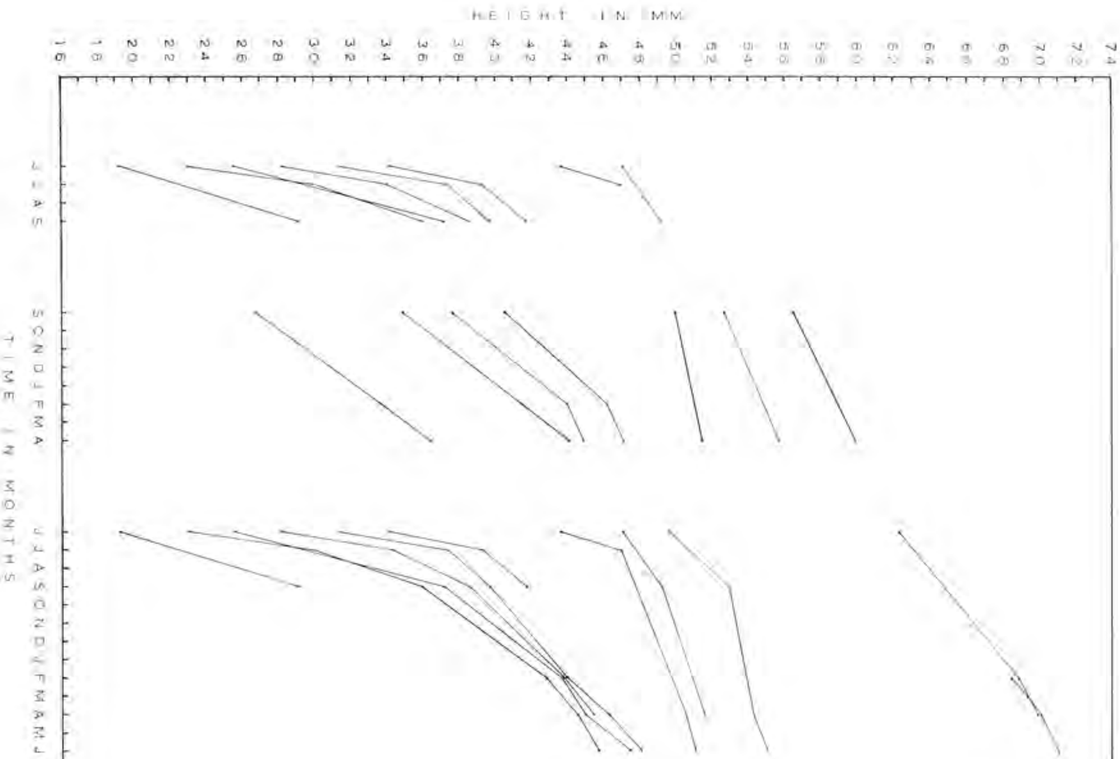

Figure 10. Seasonal and annual growth curves of different size ranges of *Macrocallista nimbosa*.

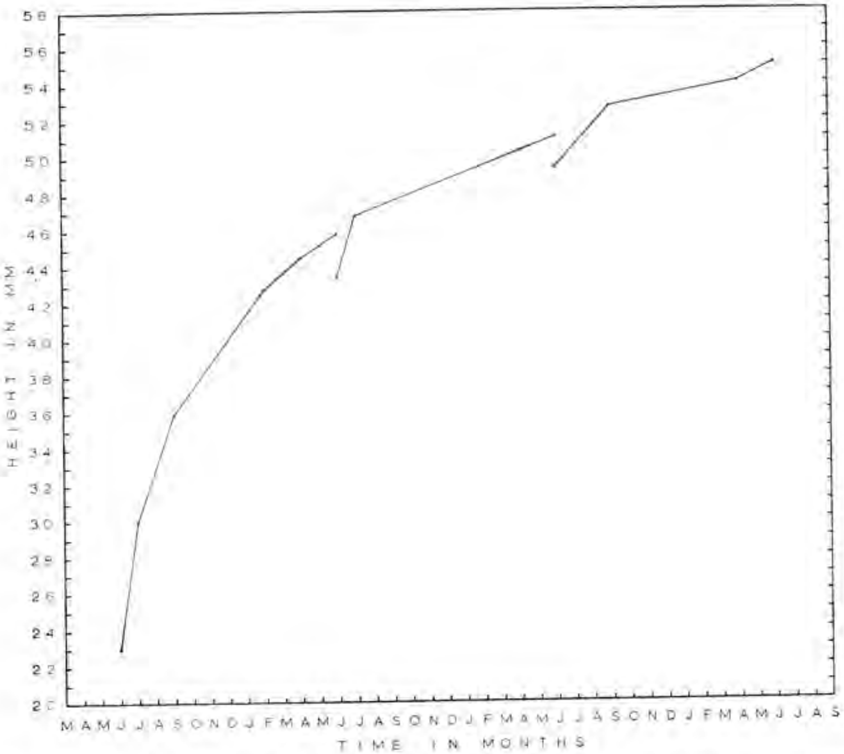

Figure 11. Projected hypothetical growth curve for *Macrocallista nimbosa*.

Handling and Processing

In any new fishery, new and/or modified methods of handling and processing must be developed which take into consideration the different characteristics of the new product being harvested. The following describes the procedures which have been developed to handle the sunray clams.

The harvesting differs from the New Jersey surf clam operations in that an "A" frame lifts the dredge over the stern rather than over the side of the boat. Contents of the dredge are dumped on a slanted metal rack that allows broken shell and trash to fall through. Clams slide down the rack onto the deck and, as they are shoveled into the measure, remaining shells or broken clams

are picked out by hand. The half-bushel measure is emptied twice into a burlap bag and the filled bags are stacked on deck. The catch is landed in Port St. Joe the same day it is harvested and is then loaded directly onto a truck and transported to the shucking plant at Apalachicola.

If the clams are to be processed the following day they remain in the truck overnight. If not, they are iced, or placed in a refrigerated room until time for processing. Once refrigerated, clams maintain good closure and can be kept for a week, if necessary. Care is taken not to handle or move the bags of clams any more than necessary as the shell is brittle and easily broken. In processing, the clams are spread on a conveyor belt that dips them through a bath of hot, fresh water. This dip does not cause the clams to "gape" but it does enable the shucking knife to be inserted more easily. Shucked clam meats are hand cleaned by cutting out the gonad and visceral mass, leaving the siphons, mantle strap, and foot. An 85-pound bushel yields an average of 10 to 12 pounds of cleaned meats, which are washed in cold fresh water to remove any remaining sand or crushed shell. Washed meats are packed in five-gallon pots and delivered to the packing house where they may be ground, sliced into strips, minced (quarter-inch pieces), chopped (half-inch pieces), or packaged whole, depending upon the product desired.

Some problems connected with the processing of this clam are:

1. A dark, granular mass is located around the siphon retractor muscle. This gritty body is present throughout the year and special care in cleaning must be taken to insure its complete removal.

2. The gonad and visceral mass is very soft and cannot be cleaned satisfactorily by squeezing (the method used on the surf clam). A knife is necessary to remove the unwanted portion and this reduces yield and slows production.

3. Some of the people who work in the clam house develop a severe and painful rash, presumably caused by continued exposure to clam juice. Physicians have been consulted and preventive measures taken but the rash continues to occur. Extremely severe cases have forced employees to leave the plant.

4. Complete training of inexperienced personnel is expensive, yet mandatory, since this is the first clam plant established in the area.

Changes in procedure and development of skill have enabled 16 to 20 people to process as many clams as were originally processed by 40 to 50.

CONCLUSIONS

1. The sunray venus clam can be harvested in commercial quantities, providing hydraulic dredging equipment is used. However, equipment and engines must be maintained in good working condition to insure complete harvesting efficiency.
2. Other species of animals are harvested in association with this clam. Some of these species, especially quahogs and surf clams, could be of commercial value if located and harvested in quantity.
3. Growth is rapid. Commercial size is apparently attainable in four to five years.
4. Problems and difficulties in handling and processing this clam are present and make several improvements desirable.
5. The cleaned meats of this clam are of good quality and readily used for stripping, mincing, clam cakes, and chowders.
6. Based on these data, it appears that production of the sunray venus clam *Macrocallista nimbosa* (Solander) near Port St. Joe, Gulf County, Florida, is a commercially feasible operation.
7. The operation described in this report and the equipment employed have not been found to be harmful to the marine resources of the area in which the harvesting was done.

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