JOB REPORT

B. D. King III
Marine Biologist

Project No. MO-R-6 Date: October 22, 1965

Project Name: Survey of Oyster Populations and Associated Organisms

Period Covered: January 1, 1964 - December 31, 1964 Job No. 4

Study of Oyster Growth and Population Structures of the Public Reefs in Matagorda, East Matagorda, Tres Palacios and Lavaca Bays.

Abstract: There were two distinct peaks of oyster spat (Crassostrea virginica) setting on the three reefs sampled in 1964. The first occurred in late May and early June with the second and smaller peak occurring in October.

All three reefs sustained heavy mortalities in 1964, beginning in August on Gadwall and Middle Ground reefs and in December on Sand Point Reef. The cause of the Gadwall and Sand Point mortalities was unknown. Data obtained to determine the incidence of Dermocystidium marinum on each reef indicated this organism was a causative agent of the Middle Ground mortalities.

Studies made to determine the growth rates of commercial and Gulf oyster populations in the Matagorda Bay area indicated that the average growth rate of commercial oysters varied between .08 mm per day and .23 mm per day while that of Gulf oysters ranged from .09 mm per day to .10 mm per day.

Oyster production in the Matagorda Bay area in 1963-1964 was very low with only 12 per cent of the oysters handled by local plants coming from waters in this area.

Objectives: To obtain data on the growth and population structure of oysters on the public reefs in Matagorda, East Matagorda, Tres Palacios and Lavaca Bays for use in making management recommendations and to determine the centers of commercial harvest in the area.

Procedure:

Population Studies

Three oyster reefs were sampled at monthly intervals throughout the year: the sampling stations were located on Sand Point Reef in lower Lavaca Bay, Gadwall Reef midway between Schicke Point and Well Point in upper Matagorda Bay, and Middle Ground Reef located on the east side of the Channel to Palacios between Marker 30 and Beacon 32 in Tres Palacios Bay.

A small dredge was used to obtain each sample which consisted of one standard bushel of unculled oysters. Dividers were used to determine, to the nearest millimeter, the length of each oyster in the sample, the measurements being taken between the hinge and bill on the right valve.

This procedure was followed throughout the sampling year with all oysters 26 mm or more in length and during the months January, February, March, April, and May with oysters measuring 25 mm or less (spat). However, beginning with the initial spat set in early June and continuing through the end of the sampling

year in December, the extremely large numbers of spat appearing in the samples precluded the possibility of measuring all spat-sized oysters. In such cases, estimates of size distribution and number of spat were based upon sub-samples of one-quarter bushel taken at random from the bushel samples. At least 400 spat in each sub-sample were measured, the remainder counted.

Samples from each reef were examined to determine the size and number of Gulf oysters (Ostrea equestris) present. This was done by examining a sub-sample of 100 oysters chosen at random from each population sample. Species determination was based upon the presence or absence of teeth on the right valve near the hinge ligament, these being present in the Gulf oyster but absent in the commercial oyster (Menzel, 1955). These oysters were measured and the number of Gulf oysters in the sub-sample was taken as the percentage incidence in the total population.

Notes were taken on the types and abundance of various organisms constituting the oyster reef communities at each station. Water temperature (in degrees Centigrade) and salinity (in parts per thousand) were recorded at each sampling (King, 1964).

Market samples were taken from Middle Ground and Gadwall Reefs in January (Middle Ground only), February, April, June, August and October. Sand Point reef was not sampled due to the lack of market-size oysters caused by heavy mortality in the fall and winter of 1963-1964. These samples were discontinued on Middle Ground and Gadwall reefs in December because of the heavy mortality of larger oysters which began in August.

Market samples consisted of 5 standard bushels of unculled oysters. All oysters 75 mm or more in length were measured as described above and recorded.

Growth Studies

An attempt was made to determine the growth rates of both the commercial and Gulf oysters on each reef by utilizing data obtained from population samples. The method used was an extension of the data obtained from regular checks of the percentage incidence of Gulf oysters in the samples as described above. The percentage of Gulf and commercial oysters in each 5 mm group was determined from the length frequency distribution of the Gulf oyster checks. The number of oysters in each 5 mm group in the quarter-bushel sub-samples was then reduced by the percentage of Gulf oysters to give an approximation of the actual number of commercial oysters present. The same procedure was followed to estimate the number of Gulf oysters in the sample. Growth was then followed by noting the progression of modes in length frequency graphs prepared for each species.

Mortality Studies

During the months April through December, selected oysters were cultured to determine the incidence of Dermocystidium marinum using the method of Ray (1952). Culture analyses were performed at the Marine Laboratory at Rockport and later at the Marine Laboratory in Seabrook.

Findings and Discussion:

Population Studies

Results of population studies on each reef are summarized in Tables 1 through 6. Table 1, gives the number of all oysters in each size class; no corrections were made to exclude Gulf oysters from these data.

Survival of previous year's spat on Gadwall Reef appeared very good as shown

by the fairly rapid increase in numbers of market oysters in the 5-bushel samples (Table 2). Gadwall, which is a small experimental reef, has not been worked commercially in the three years since it was constructed. The lack of periodical culling and the survival of previous settings of spat resulted in a moderate degree of overcrowding. Prior to the heavy mortality in August, the larger seed and market oysters were in good condition and had retained a rounded shape indicative of sufficient growing space. The number of market oysters reached a peak of 297 in 5 bushels in April. Thereafter the number declined to a low of 1 per bushel in December.

The population of Gulf oysters on Gadwall Reef was initially much larger than that on Middle Ground and slightly smaller than that on Sand Point Reef (Table 3). This species constituted a substantially smaller percentage (18 per cent) of the spat on Gadwall Reef in June than on either of the other two reefs, but because of the mortality of commercial oysters in August the percentage of Gulf oysters rose to 89 per cent of the total population in December.

Gadwall Reef was relatively free of fouling organisms throughout most of the year (Table 5). The boring sponge (Cliona celata) was absent until summer when it became well established in the shells of freshly killed oysters. Encrusting bryozoans (Membranipora sp.) were prevalent all year. Other species fluctuated seasonally in abundance as shown in the table.

A heavy initial spat set occurred on all three reefs in late May and early June (Table 1) with a lighter set occurring in October. The sets on Sand Point Reef and Middle Ground Reef were heaviest in June, but the October set on Gadwall Reef was the year's heaviest with 18,000 spat per bushel.

Conditions on Middle Ground Reef remained virtually the same as in 1963 (King, 1963) with only a small increase in the number of market oysters (Table 2). The reef consisted of clustered oysters on a soft mud bottom, and market oysters were rarely found in good condition and were smaller in volume than oysters of comparable length on Gadwall or Sand Point reefs.

During the first 5 months of the year, Middle Ground Reef had the smallest population of Gulf oysters, which constituted from 23 to 35 per cent of the total population (Table 3). However, the June spat set, with 44 per cent Gulf oysters, increased this population to a level approximating that of Gadwall Reef. The heavy mortality of commercial oysters in late summer rapidly increased the ratio of Gulf oysters in the remaining population to a high of 90 per cent in November.

Fouling was more extensive on Middle Ground than on the other reefs. Infestation with boring sponge was heavy and mudworms (Polydora websteri) were seasonally abundant. Mussels (Brachiodontes sp.) and serpulid worms constituted the bulk of the remaining fouling organisms.

Sand Point Reef recovered rapidly from heavy oyster mortalities suffered during the fall and winter of 1963-64 (Table 1). In January, the largest oysters were of small seed size. By November these oysters had reached a size of 90 to 100 mm. The first market oysters were taken in May. These increased in number until December when excessive mortality again occurred on the reef.

Sand Point received a good set of spat in June and a second, but much lighter set, in October. Gulf oyster spat constituted the major portion of both sets with 78 per cent in June and 75 per cent in October (Table 3). The reef maintained a large population of this species throughout the year, 56 per cent in January being the lowest incidence recorded. The largest Gulf oyster taken during the year (47 mm) was observed on this reef in August. Gulf oysters of this size are very rare in the Matagorda Bay area. Menzel's (1955) limit of 35 mm for Gulf oysters

in the Port Aransas area can be applied with equal validity to those in this area.

Boring sponge and serpulids constituted the bulk of fouling organisms on Sand Point in 1964. Other species of minor importance occurred seasonally during the year (Table 6).

Growth Studies

Growth rates of C. virginica on each of the three reefs are shown in Figures 1-3. These were based upon the progression of modes in monthly population samples. Because of the relatively small number of larger oysters in the samples, the only modes which could be followed with certainty were those of the spat which set in June and October. Spat which set in June were designated as the "A" group; those in October were designated as the "B" group.

Growth of the commercial oyster spat on Middle Ground Reef is shown in Figure 1. The mode of the "A" group was lost after 2 months because of the heavy mortality of oysters in August. Average growth during this period was .10 mm per day, the lowest figure obtained during the study. Oysters of the "B" group showed an increase of 4 mm in 50 days or .08 mm per day.

It was possible to follow the "A" group on Gadwall Reef through November when it was lost because of mortality. This group showed a 29 mm increase in length in 154 days; a growth rate of .19 mm per day. The "B" group, followed for 28 days, showed a growth rate of .18 mm per day.

Commercial oysters on Sand Point Reef had the highest growth rates recorded during the year. Fortunately, the "A" group could be followed through December (a total of 170 days). Average growth for this group was .23 mm per day. The "B" group, however, showed a growth rate of only .13 mm per day over a 60 day period - only slightly higher than the Middle Ground "A" group. The reason for this relatively slow growth is unknown.

In 1962, Moffett and Murray (1961-1962) calculated growth rates of commercial oysters from various locations in the Matagorda Bay area. These locations included the three described above. Since growth rates for the 1962 year-class were reported in mm per month, the figures cited above were converted to this standard on the basis of 30-day months for comparison.

Growth rates for the 1962 year-class were reported as follows: Middle Ground Reef, 2.57 mm per month; Gadwall Reef, 2.50 mm per month; Sand Point Reef, 3.00 mm per month. Growth rates of the 1964 year-class were found to be 3.00 mm per month on Middle Ground Reef, 5.70 mm per month on Gadwall Reef, and 6.90 mm per month on Sand Point Reef.

Comparison of the above figures shows a similarity in growth rates for Middle Ground Reef only. The figures for the 1964 year-class on Gadwall and Sand Point Reefs are more than twice as large as those reported for 1962.

Growth rates of O. equestris spat, based upon modal progression in monthly sub-samples, are shown in Figures 1-3.

Modes of the 1964 year-class on Middle Ground Reef could be followed through November; the average growth of this period was .10 mm per day. The average growth on Gadwall Reef through December was .09 mm per day as was that of Sand Point Reef (followed through October).

These growth rates are slightly lower than those presented by Menzel (1955)

for this species in the Port Aransas area (calculated for a period of six months). This was expected of oysters growing under reef conditions since those he observed were grown off the bottom on glass plates.

Mortality Studies

Each of the reefs sampled suffered heavy mortalities during the year. Very little mortality occurred until August, when market and larger seed oysters began dying in large numbers on Middle Ground and Gadwall reefs. Sand Point Reef remained unaffected until December when heavy mortalities similar to those of the fall of 1963 began.

The progress and effects of these mortalities can be seen in Tables 1 and 2.

Examination of Table 7 which shows the weighted incidence and extent of infection by Dermocystidium marinum on each reef, indicates that this organism was the probable cause of the Middle Ground mortalities but eliminates it as the causative agent on Gadwall and Sand Point reefs. The heaviest infection of single oysters found on both reefs was 0.5.

Heavy mortality of market oysters on Middle Ground Reef began in August when the weighted incidence reached 3.7. Seed oysters remained unaffected until October when their weighted incidence reached 3.2. Although inconclusive, the data suggest a critical threshold of about 3.0, beyond which heavy mortality can be expected.

Because of a lack of larger commercial oysters on Middle Ground Reef in November, nine of the oysters sampled were O. equestris ranging from 27 mm to 28 mm in length. Analysis showed these to be free from infection by D. marinum. The one commercial oyster (34 mm) had an incidence rating of 4.

In December, 14 commercial oysters between 7 mm and 14 mm in length were cultured. One (11 mm) had an infection of 0.5; those remaining were negative.

The cause of the mortalities on Gadwall and Sand Point Reefs is unknown at the present time. Dr. J. G. Mackin (personnal communication) stated that a variant strain of D. marinum or a closely related species may have been responsible; however, much work remains to be done before definite conclusions can be reached.

Production

During the 1963-64 oyster season, oyster houses in the Matagorda Bay area opened a total of approximately 36,146 gallons. Only 4,413 gallons or 12.2 per cent were harvested from this area. The remaining 31,733 gallons (87.8 per cent) were trucked to local oyster houses for opening. Most of these were taken from the Galveston Bay area; smaller quantities were brought in from San Antonio and Espiritu Santo Bays.

None of the reefs sampled were worked commercially. The two centers of production in the Matagorda Bay area during the past two seasons were upper Lavaca Bay and the eastern arm of Matagorda Bay near the Colorado River delta.

Comments: Two major difficulties were encountered in attempting to discern growth rates. One was a lack of sufficient numbers of larger oysters in the one bushel samples making it difficult to recognize modes in the length frequency graphs.

The second factor limiting the validity of growth data on G. virginica obtained from population samples is the presence of significant numbers of Gulf oysters, which grow at a much slower rate and reach a smaller maximum size than commercial oysters in estuarine waters (Menzel, 1955). If compensation for the

presence of this species is not made in the data, the calculated growth rates will be much lower than the actual growth rates. This factor may, however, be taken into consideration, and data may be obtained to be used in compensating for the presence of this species.

The growth rates given in this paper should be considered as only roughly approximating the actual growth of each species.

It is recommended that in future growth rate studies which may be attempted using the methods described above, the minimum number of oysters observed in the Gulf oyster checks be no less than 400. During periods of heavy spatfall even this figure may be too low.

Prepared by: B. D. King III
Marine Biologist

R. P. Hofstetter
Project Leader

Approved by: Terrance R. Leary
Coordinator

James R. Stevens
Regional Supervisor

Literature Cited

King, B. D. 1963. Study of oyster growth and population structure of the public reefs in Matagorda, Tres Palacios and East Matagorda Bays. Project Reports, Coastal Fish. Div., Tex. Game and Fish Comm.

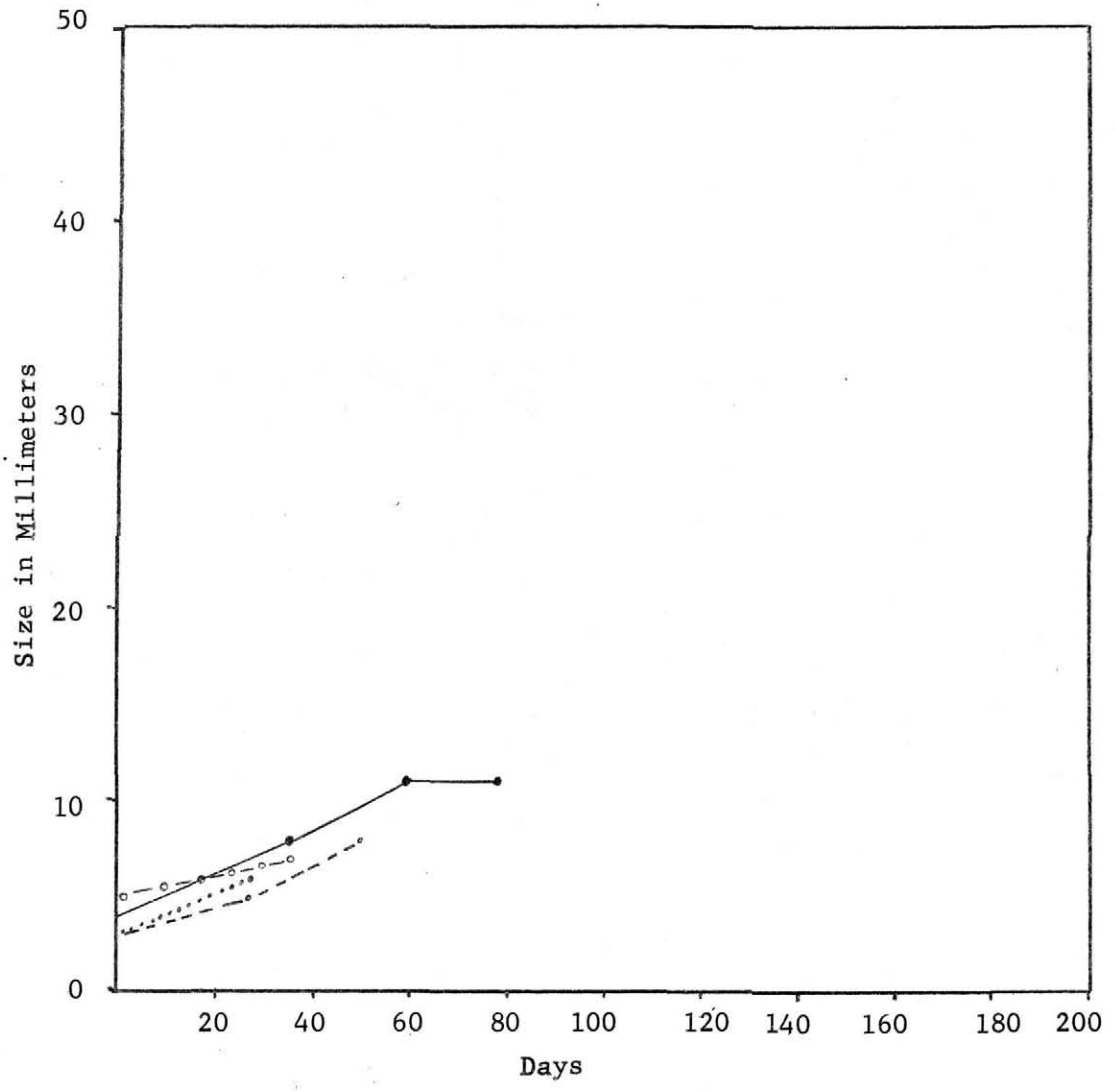
Menzel, R. W. 1955. Some phases of the biology of Ostria equestris bay and a comparison with Crassostrea virginica (Gmelin). Publ. Inst. Mar. Sci. IV (1).

Moffett, A. W. and F. A. Murray. 1961-1962. Study of oyster growth and population structure of the public reefs in Matagorda, Tres Palacios and East Matagorda Bays, Project Reports, Coastal Fish. Div., Tex. Game & Fish Comm.

Munro, George J. and B. D. King III. 1964. Hydrographic and Meteorological Study of the Matagorda Bay System. Project Reports, Coastal Fish. Div., Texas Parks & Wildlife Dept.

Ray, S. M. 1952. Cultural studies of Dermocystidium marinum with special reference to dragnosis of this parasite in oysters. Master's Thesis. Rice Inst. Houston, Texas.

Figure 1: Progression of modes of C. virginica and O. equestris on Middle Ground Reef



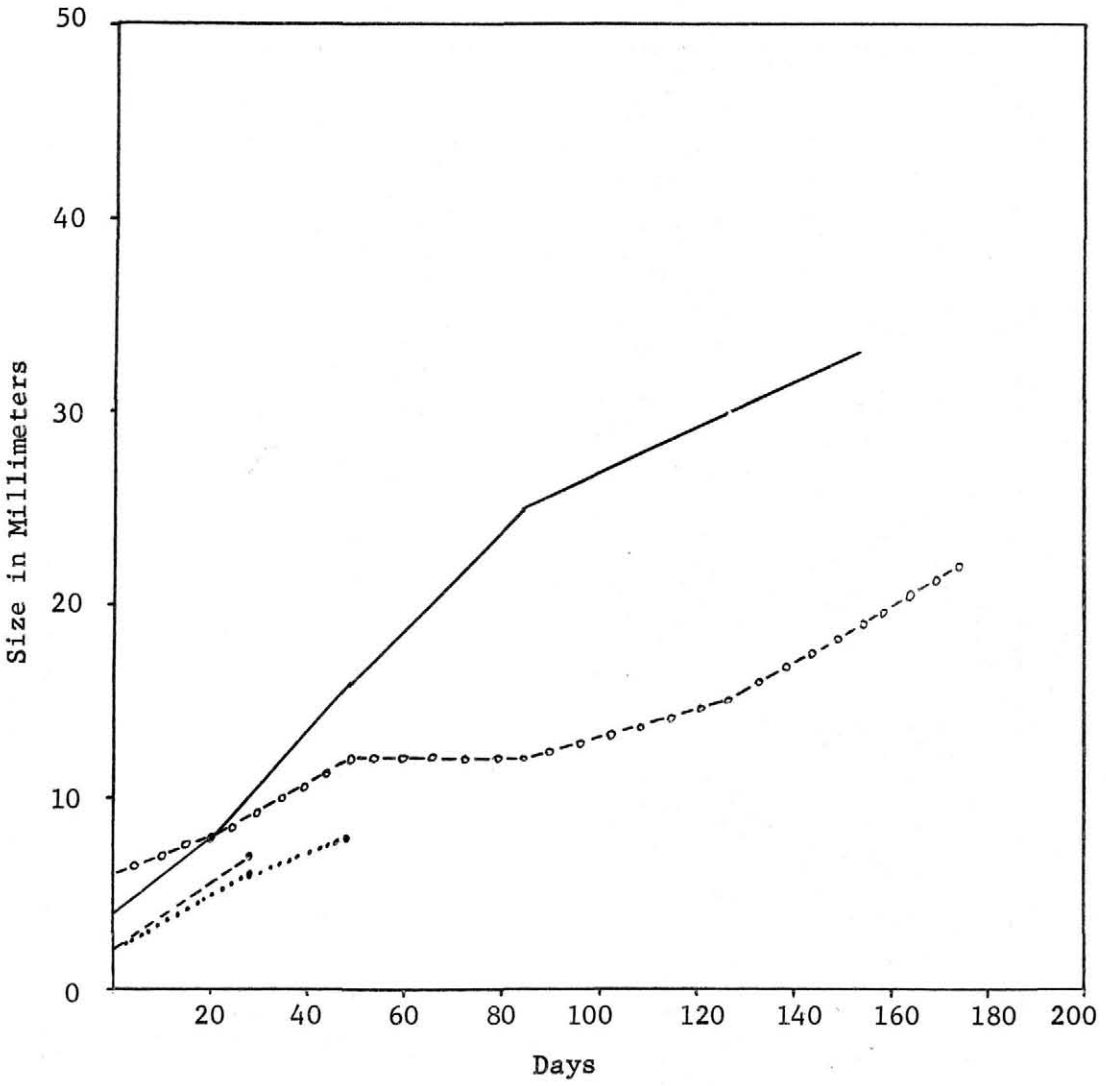
——— C. virginica Group "A"

– – – – C. virginica Group "B"

–o–o– O. equestris Group "A"

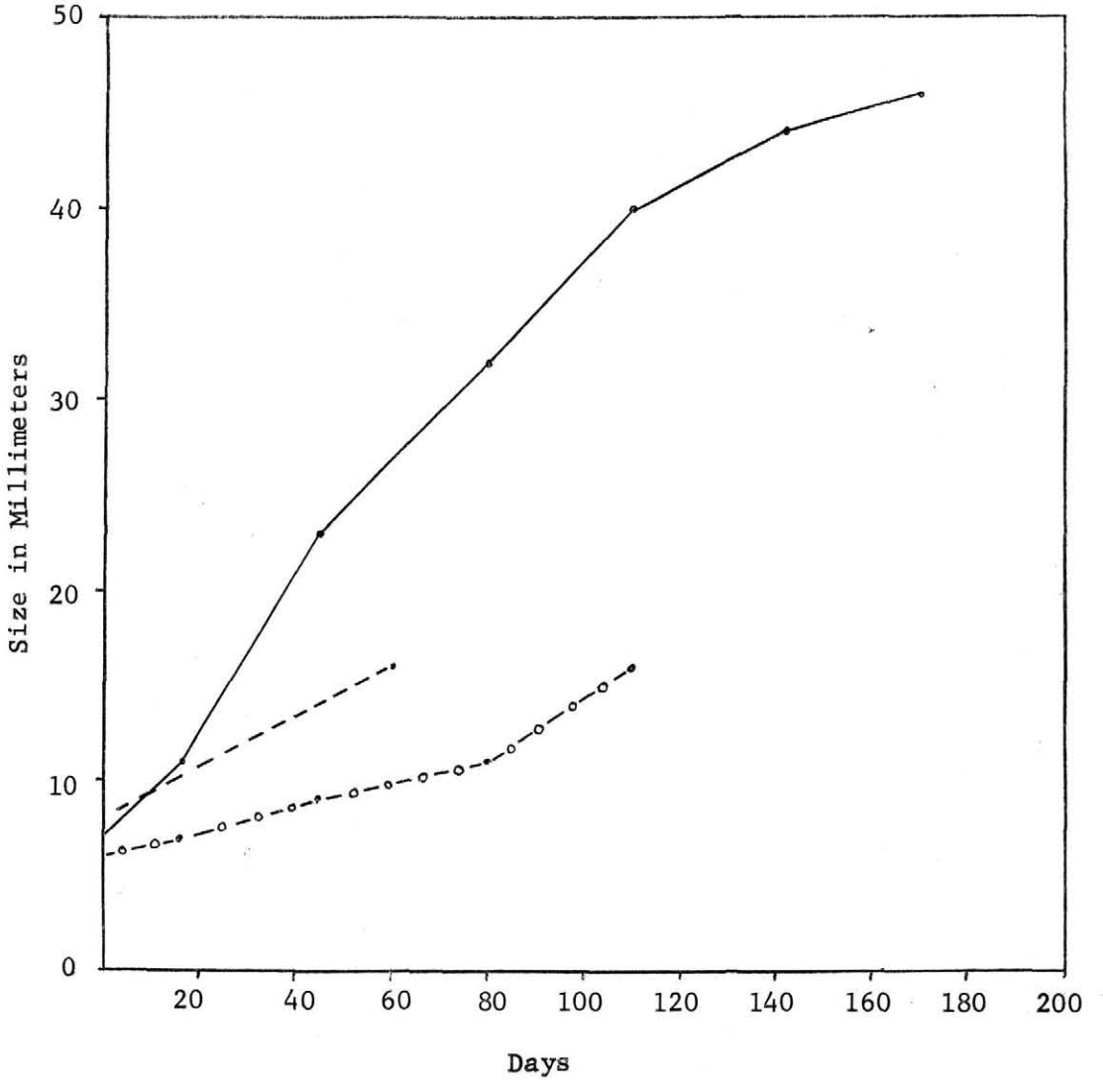
..... O. equestris Group "B"

Figure 1: Progression of modes of C. virginica and O. equestris on Gadwell Reef



——— C. virginica Group "A"
– – – – C. virginica Group "B"
–o–o– O. equestris Group "A"
····· O. equestris Group "B"

Figure 3: Progression of modes of C. virginica and O. equestris on Sand Point Reef.



——— C. virginica Group "A"
– – – – C. virginica Group "B"
—o—o— O. equestris

Table 1: Number of spat, seed and market oysters per bushel - 1964

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Middle Ground Reef	110	255	151	123	172	16,304	6,696	4,876	3,804	7,784	4,768	5,736
	264	301	217	210	228	176	199	135	176	127	53	51
	41	54	44	43	75	38	48	39	30	3	0	0
Gadwall Reef	708	646	420	454	402	6,212	5,504	3,708	2,852	18,448 11,000 9,000	7,596	6,164
	656	497	449	415	526	261	232	245	277	427	184	165
	108	59	56	65	53	41	42	18	19	18	2	1
Sand Point Reef	307	-	262	293	240	16,552 3,000 13,000	12,060	9,344	5,700	6,264	5,016	3,464
	64	-	79	165	170	243	163	378	525	696	538	398
	-	-	0	0	1	1	1	0	1	12	10	7

Table 2: Number of Market Oysters* in Five Bushel Samples - 1964
* 76 mm and over

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Middle Ground											
193	237	---	237	---	205	---	172	---	22	---	---
Gadwall											
---	245	---	297	---	236	---	122	---	72	---	---
Sand Point											
---	---	---	---	---	---	---	---	---	---	---	---

Table 3: Percent Ostrea equestris in One Bushel Samples - 1964
* Spat
** Seed & Market

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Middle Ground											
23.0	25.0	27.0	35	28	44*/2**	42	44	52	48	90	87
Gadwall											
29.0	45.0	45.3	58	63	18*/18**	26	51	61	60	79	89
Sand Point											
56.0	No Data	58.0	62	62	78	83	64	69	75	76	79
36	35	43.4	51.7	51.0	46.7	50.3	53.0	60.7	61.0	82.6	85.0

Table 4: Occurrence of Associated Organisms - Middle Ground Reef

	1	2	3	4	5	6	7	8	9	10
January	A	S		P	S	S		S	P	A
February	A	S	S	P	S	S		P	S	A
March	A	S		M	F	F		S	S	A
April	A		A	M	F	S		S		A
May	A	S	A		M	F	P	M		A
June	A			M	F		A	A		P
July	A	S		F	S	M		S		P
August	A			F	F	P		M		A
September	M		A	S		S		F		S
October	A	M	P	S	F	S	P	P		A
November	A	S		F	F	F	F	M		P
December	A	S			F		S	F		M

1. Cliona celata
2. Membranipora sp.
3. Polydora websteri
4. Brachiodontes recurvus
5. Crepidula sp.
6. Balanus sp.
7. Panopeus herbstii
8. Petrolisthes armatus
9. Brown algae
10. Serpulids

S = Sparse
F = Few
M = Moderate
A = Abundant
P = Plentiful

Table 5: Occurrence of Associated Organisms - Gadwall Reef

	1	2	3	4	5	6	7	8	9	10
January		A		S	S	P	S	S		A
February		A			S	S	F			M
March		A		F		F	M	S		
April		P			S	S	F			M
May		M	A		S	M	M	M		M
June		S	P	F		F	P	A		
July	S	S		M	S			A		
August	S	P		S	S			F		S
September		P	S		S	M		P		S
October	M	P	M	S	F	P	P	P		
November	P	M	A	F	F	S				M
December	M	P		S	F	S	P	M		M

1. Cliona celata
2. Membranipora sp.
3. Polydora websteri
4. Brachiodontes recurvus
5. Crepidula sp.
6. Balanus sp.
7. Panopeus herbstii
8. Petrolisthes armatus
9. Brown algae
10. Serpulids

S = Sparse
F = Few
M = Moderate
A = Abundant
P = Plentiful

Table 6: Occurrence of Associated Organisms - Sand Point Reef

	1	2	3	4	5	6	7	8	9	10
January	M	M		S	S	S	S	S		A
February					NO DATA					
March	A	S		S	F	S	A	S	S	A
April	A	S		S	F	S	M	F		A
May	A	S		S	P	S	A	A		A
June	A	S		F	F	S	A	A		A
July	A	S		S	M	F		F		P
August	A			P	S	M	F	P		M
September	A				S	S			S	F
October	A	S		S	F	S	S	F		S
November	A	S	F	F	S	S	F	P		S
December	A			S	S	S	M	M	A	F

1. Cliona celata
2. Membranipora sp.
3. Polydora websteri
4. Brachiodontes recurvus
5. Crepidula sp.
6. Balanus sp.
7. Panopeus herbstii
8. Petrolisthes armatus
9. Brown algae
10. Serpulids

S = Sparse
F = Few
M = Moderate
A = Abundant
P = Plentiful

Table 7: The weighted incidence and per cent infection of *Dermocystidium marinum* in samples from three reefs in the Matagorda Bay Area, 1964

	Middle Ground Reef		Gadwall Reef		Sand Point Reef	
	W.I.	% I.	W.I.	% I.	W.I.	% I.
April	2.4	90	0.0	0	--	--
May	2.8	80	0.1	20	--	--
June	3.5	100	0.2	40	--	--
July	1.8*	90*	0.15	30	0.2	40
	2.7#	70#				
August	1.45*	80*	0.0	0	0.0	0
	3.7#	100#				
September	2.5*	90*	0.15	30	0.1	20
	3.3#	100#				
October	3.2*	100*	0.05	10	0.0	0
	3.3#	100#				
November	See page 5		--	--	--	--
December	See page 5		--	--	--	--

* denotes incidence and infection in seed oysters
\# denotes incidence and infection in market oysters