A QUANTITATIVE COMPARISON OF THE EPIFAUNA ON *THALASSIA TESTUDINUM* KONIG IN THREE HYDROGRAPHICALLY DISTINCT AREAS IN SOUTHERN FLORIDA

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This thesis was prepared under the direction of the candidate's major professor, Dr. G. Alex Marsh, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the College of Science and accepted in partial fulfillment of the requirements for the degree of Master of Science.

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ABSTRACT

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Title: A quantitative comparison of the epifauna on *Thalassia testudinum* Konig in three hydrographically distinct areas in southern Florida.

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The invertebrate macrofauna and algal epiphytes occurring on *Thalassia* in three hydrographically distinct areas in southern Florida were sampled during 14 June-21 June, 1974. A total of 178 invertebrate species was collected. The dominant non-colonial invertebrate taxa were Amphipoda, Isopoda, Mollusca, Polychaeta, and Tanaidacea. These groups included 93.8% of the fauna and 70.4% of the non-colonial invertebrate species. A relatively high faunal homogeneity was observed at each site. Turbidity and the abundance of algal epiphytes were important environmental factors affecting the observed differences in the composition and density of the epifauna between sites. Similarities in diversity (H') between Chicken Key (2.75), Lake Surprise (2.89) and San Carlos Bay (2.93), were presumably due to equivalent substrates with similar degrees of environmental instability. The *Thalassia* epifauna showed a high degree of parallelism with the *Zostera marina* epifauna.

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INTRODUCTION

Much of the level bottom in shallow marine and estuarine areas of the world is covered by seagrass beds. This dense vegetation produces large quantities of organic material and provides a suitable substrate for numerous epiphytes and colonial invertebrates. The decomposition of these grasses provides large quantities of detrital material which serves as a base for an extensive food chain (Fenchel, 1970).

Turtle grass, *Thalassia testudinum* Konig, is the dominant seagrass occurring in extensive sublittoral beds in the Gulf of Mexico and Caribbean Sea. It provides one of the largest single habitats of western Atlantic shallow tropical waters (Phillips, 1960; Moore, 1963; Thorhaug, 1976). The importance of *Thalassia* in marine productivity has been well documented (Odum, 1957; Wood *et al.*, 1969; Thorhaug *et al.*, 1973; Taylor *et al.*, 1973). *Thalassia* blades serve as a host for large numbers of epiphytes which further add to the productivity of these areas (Humm, 1964).

Previous studies on the animal communities associated with *Thalassia* have been primarily limited to the infauna, including nematodes (Hopper and Meyers, 1967), molluscs (Jackson, 1972; 1973), and polychaetes (Santos and Simon, 1974).

Few studies have examined any major portion of the invertebrate community associated with *Thalassia*. Hoese and Jones (1963) investigated the seasonality of larger animals in a Texas turtle grass community. Their collecting technique utilized a drop net quadrant having a 19mm mesh size. O'Gower and Wacasey (1967) and Moore _et al_. (1968) studied the _Thalassia_ macro-invertebrate communities retained by a 3mm and a 1.6mm screen, respectively, in Biscayne Bay, Florida. In neither case was epifauna separated from infauna.

Recently, Thorhaug and Roessler (in press) completed a three-year study on the _Thalassia_ communities in Biscayne Bay and Card Sound, Florida. Their study was part of an environmental impact assessment of the Turkey Point power plant. Epibenthic invertebrates and fish were collected in an otter trawl lined with a 0.63mm bar mesh. Amphipods and isopods were not counted or identified while polychaetes were identified only to family. As these taxa are major epifaunal constituents, the study failed to adequately describe the community.

The following is a quantitative study of the invertebrate macrofauna and common algal epiphytes found living on the photosynthetic surfaces of _Thalassia testudinum_. It is primarily an attempt to describe and compare the _Thalassia_ communities in three hydrographically distinct areas in southern Florida. The composition and structure of the major epifaunal assemblages are discussed in the light of environmental conditions prevailing at the three localities. The concept of parallelism in epifaunal communities is examined in light of previous studies by Nagle (1968), Marsh (1973), Parker (1975), and others.

DESCRIPTION OF STUDY SITES

Lake Surprise

Lake Surprise (Fig. 1), located on the western side of Key Largo, Florida, is a shallow lagoon approximately 1-2m deep over most if its area. The lagoon, roughly oval in shape, is 2.1 km long and 1.2 km wide. Lake Surprise is approximately equally divided along the short axis by a causeway supporting U.S. Highway 1.

A sampling site was selected at a depth of approximately 1.6m in the center of the lagoon 200m north of U.S. Highway 1 (25°10'52"N, 80°22'55"W). In this northern half of Lake Surprise a dense *Thalassia* bed covers more than 50% of the level bottom. Calm conditions prevail in this relatively undisturbed section surrounded entirely by red mangroves.

Seawater enters this half of Lake Surprise through a single narrow channel, 40m wide, connecting Lake Surprise to Jewfish Creek. Due to restricted water movement, high salinities often prevail during periods of low rainfall and high evaporation.

San Carlos Bay

San Carlos Bay (Fig. 2) is located at the mouth of the Caloosahatchee River on the southwestern coast of Florida. The bay is partially enclosed by Sanibel Island on the south and Pine Island on the west. The bay is approximately 6.4 km long from Sword Point to Sanibel Island and 5.4 km wide from Pine Island to Shell Point. Water depths in the bay are generally less than 2m.,

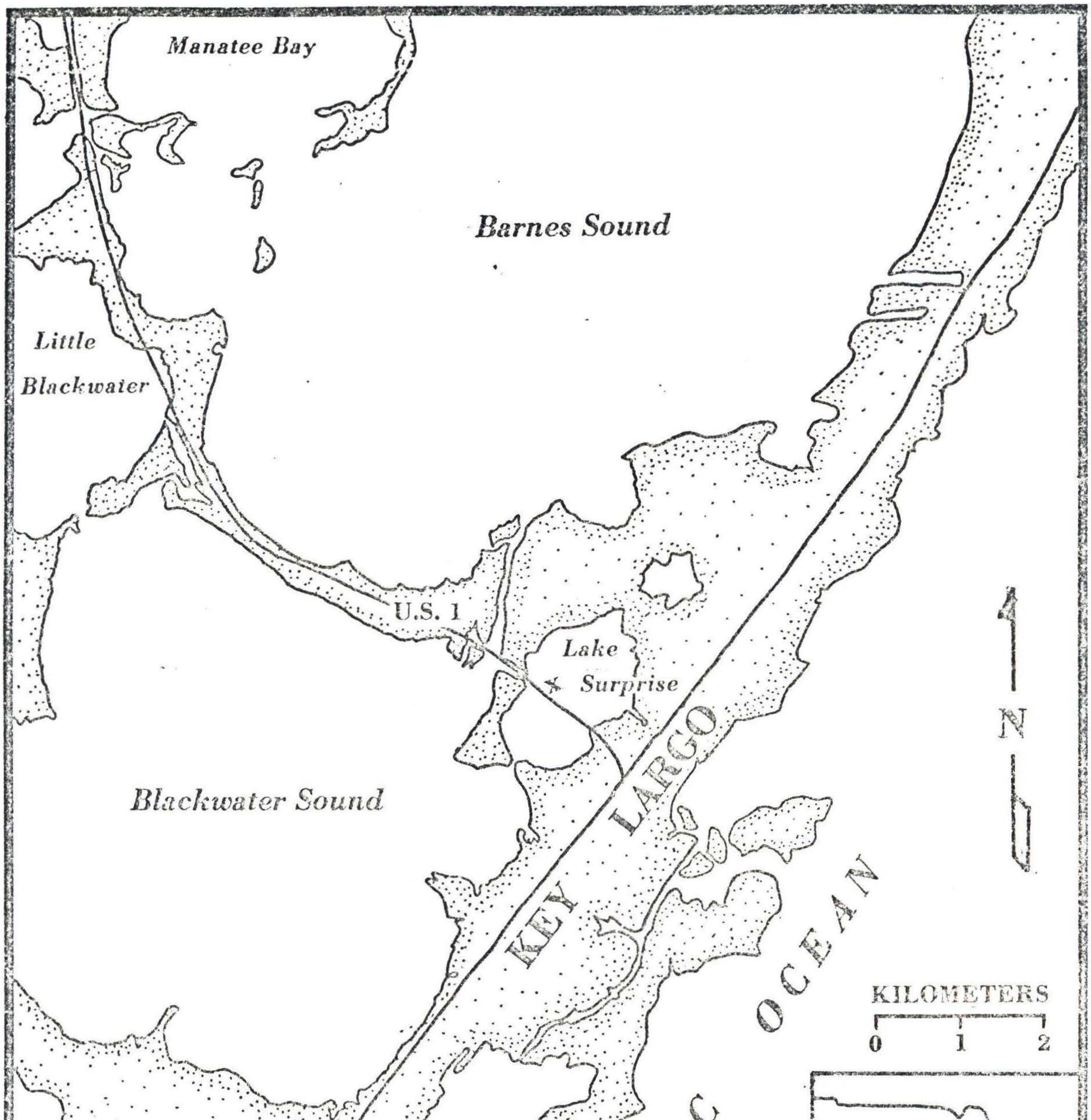


Figure 1. - Map of area showing collection site (X) in Lake Surprise.

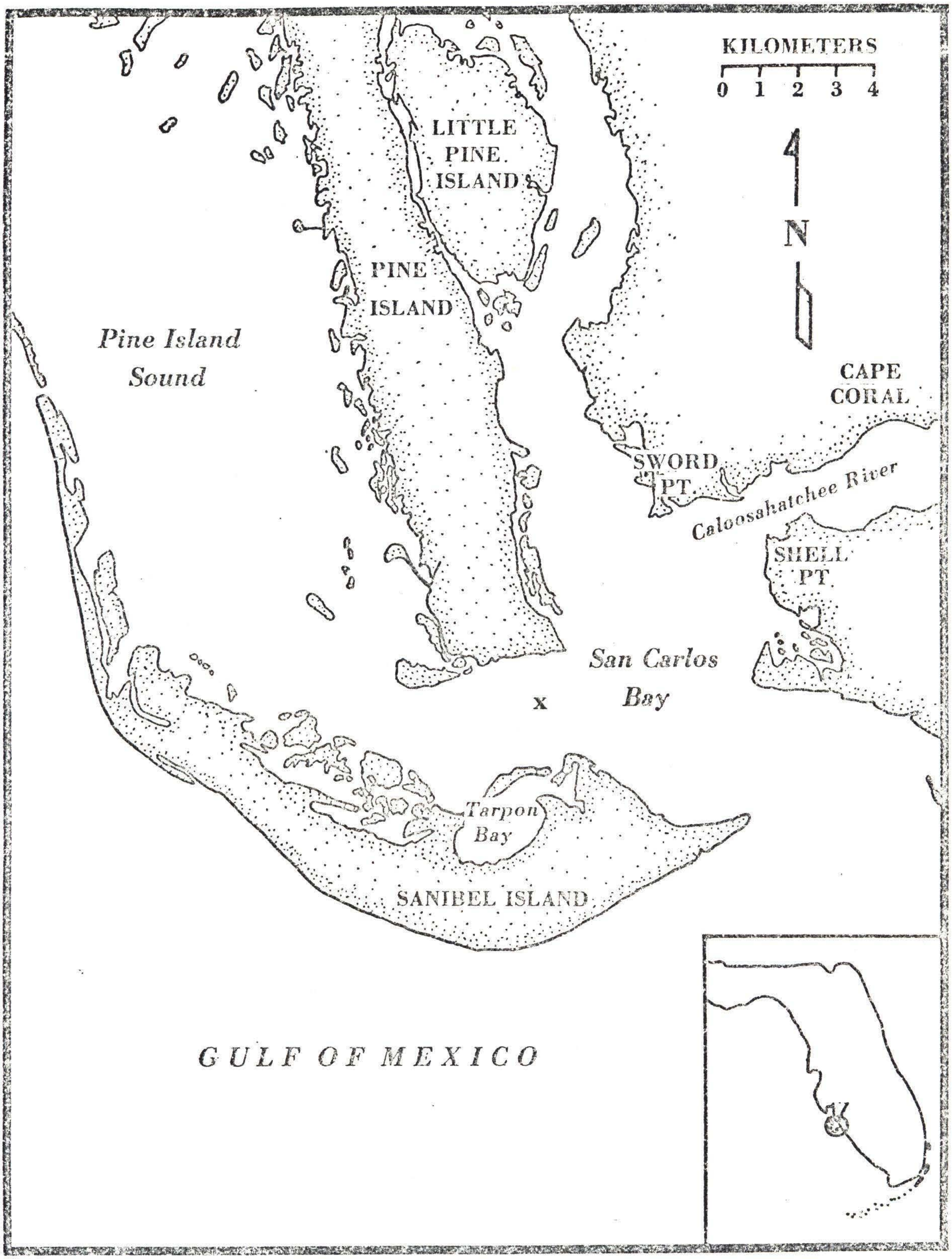


Figure 2. Map of area showing collection site (X) in San Carlos Bay.

In the western part of San Carlos Bay a wide channel (2.8 km) connects the bay to Pine Island Sound. The Intracoastal Waterway system cuts through this channel at maximum depths of approximately 7m. A sampling site was selected 500m south of the Intracoastal Waterway (26°28'48"N, 82°4'26"W) at a depth of 1.6m.

Hydrographic conditions in San Carlos Bay fluctuate greatly with discharges of the Caloosahatchee River. The Caloosahatchee flows for 63 miles between Lake Okeechobee and Fort Meyers and is one of the primary outlets regulating Lake Okeechobee flood levels. The river broadens considerably at Fort Meyers and extends for an additional 14 miles to San Carlos Bay. Periods of peak river flow coincide with the regional pattern of seasonal precipitation (Huang, 1966). Maximum precipitation and peak river flow occur during the wet season in southern Florida (June-Sept.). San Carlos Bay is characterized by fluctuating estuarine conditions and has low salinities for most of the year.

Chicken Key

Chicken Key (Fig. 3) is located in the west-central portion of Biscayne Bay. The Bay, a semi-tropical coastal lagoon, extends 53.3 km in a north-south direction and has a maximum width of 12.9 km. Biscayne Bay is partially enclosed by a series of barrier islands, including Miami Beach on the north, Key Biscayne and Virginia Key on the northeast, and Elliott Key on the southeast. A shoal area, the Safety Valve, extends for 14.5 km between Elliott Key and Key Biscayne and is the Bay's longest connection with the Atlantic Ocean. Biscayne Bay is very shallow averaging approximately 2m in depth.

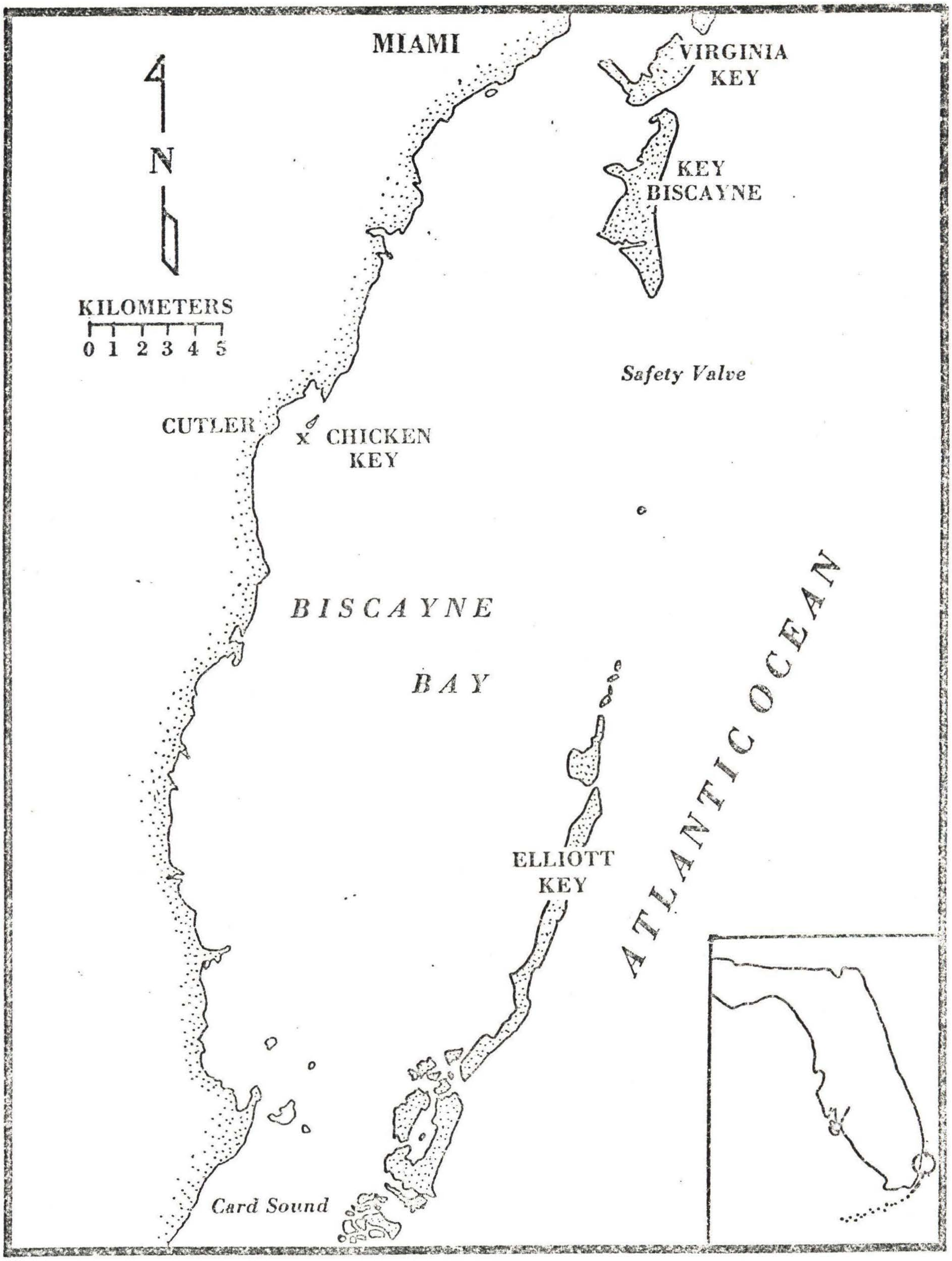


Figure 3. Map of area showing collection site (X) off Chicken Key, Biscayne Bay.

Chicken Key is a mangrove island, approximately 500m long and 100m wide, located 1.2 km east of the town of Cutler. A dense *Thalassia* bed 320m south of Chicken Key (25°37'3"N, 80°17'21"W) was selected for study. Water depth at the Chicken Key site was approximately 1.6m.

Chicken Key is more exposed to wave and wind action than either San Carlos Bay or Lake Surprise. In central Biscayne Bay, tidal waters enter the Safety Valve and flow generally southward. Salinities along the western shore are usually lower than those on the eastern side of the Bay. However, during periods of low rainfall and high evaporation, this gradient can be reversed, resulting in hypersaline conditions along the western shore (Roessler and Beardsley, 1974; Lee and Rooth, 1976).

MATERIALS AND METHODS

Collecting Apparatus

A quantitative sampler constructed for collecting the Thalassia blades consisted of a $0.25m^2$ iron rod frame to which a net bag was attached (Fig. 4). The bag was approximately 0.8m deep and had a 0.3mm nylon mesh netting (Nitex No. 308) sewn into the bottom. The top half of the bag, closest to the mouth, consisted of a transparent plastic material (Plastipane .019 gauge) while the bottom half was made of 4 oz. nylon cloth. The clear plastic increased visibility and permitted more accurate quantitative sampling. A draw string was attached around the mouth of the bag.

The sampler was inverted over a patch of Thalassia. Four plastic floats (1.5 inch diameter) attached to the upper corners of the net, maintained the bag in an upright position and effectively reduced contact with the blades. In this manner any disturbance of the epifaunal community was minimized. The plants were carefully clipped at their bases as the mouth of the bag was drawn tight preventing loss of grass and associated epifauna.

Field Operations

Since there was no attempt to describe temporal changes in the epifauna, a single collection was made at each site. Thalassia growth in southern Florida follows a definite seasonal cycle with May-June being months of peak biomass (Thorhaug, 1976). Biological and hydrographic samples were collected at the three study sites during the period 14 June-

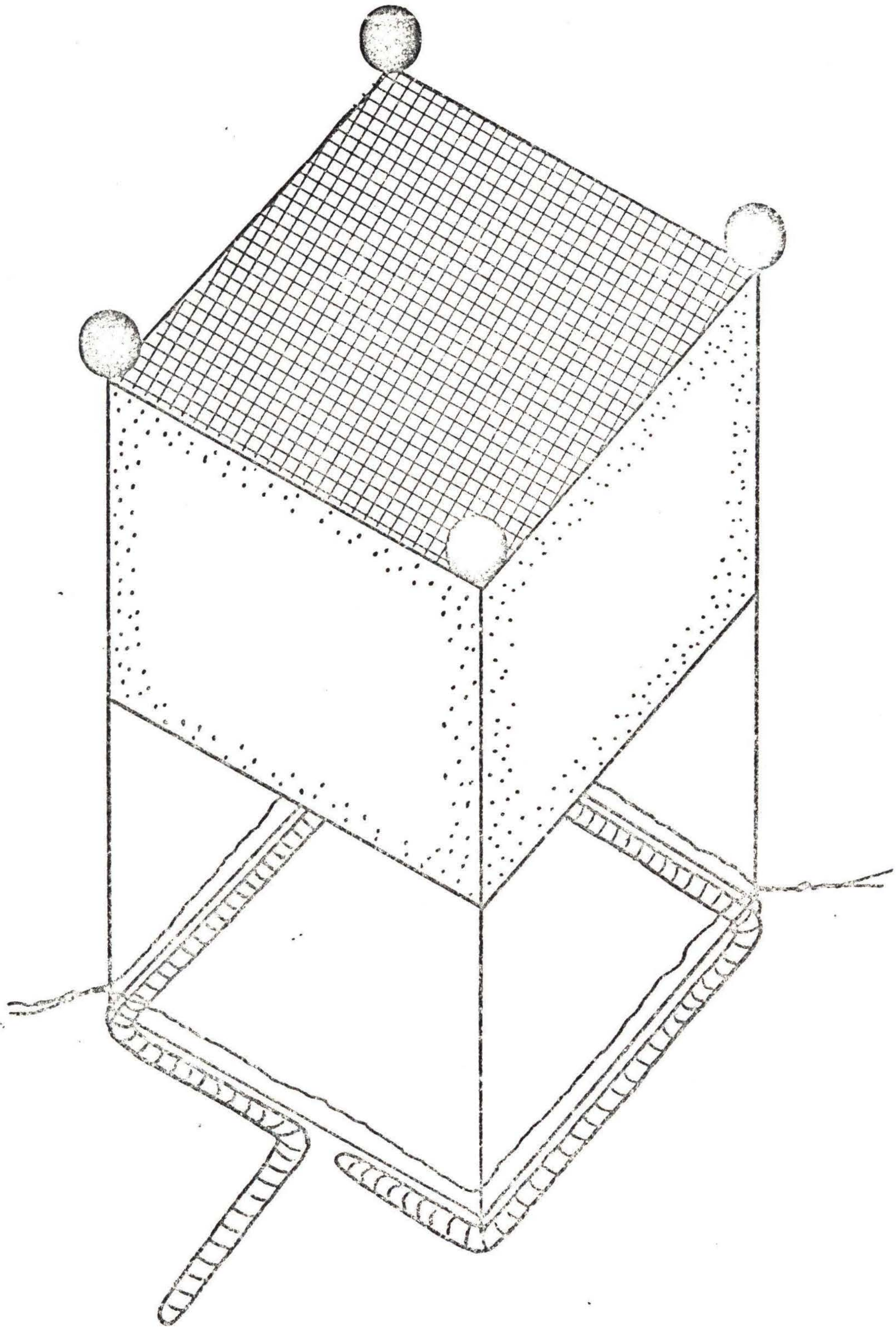


Figure 4. Collecting Apparatus for sampling *Thalassia.*

21 June, 1974.

Sampling was conducted from a small boat with the aid of SCUBA, garden clippers, and the collecting apparatus. At each site, three $0.25m^2$ replicate samples of Thalassia were collected from equivalent depths within a 10-15m radius of the anchored boat. Upon completion of each sample, the net was handed to an assistant in the boat, and the contents were immediately transferred into a 10% seawater-formalin solution. Two sediment samples were collected with 10cm coring jars at each site.

Hydrographic conditions were examined over a 24-hour period at each site. Water samples for laboratory analysis were collected at mid-depth (approximately 1m) every three hours with a Kemmerer bottle. Temperature at mid-depth was measured with a stem thermometer attached to a short line. An 8 ft. benchmark, marked in increments of one inch, was buried in the sediment and observed at the surface every three hours for changes in tidal level.

Laboratory Procedure

In the laboratory, the Thalassia blades were individually stripped of all sediment, epiphytes, and colonial and non-colonial invertebrates.

The macroepiphytes were sorted and identified. Dominant species were dried at 80°C for 48 hours and weighed to the nearest 0.1g. The calcareous encrusting forms fragmented when scraped from the blades and could not be quantified.

All non-colonial invertebrates retained by a 0.5mm screen were sorted, counted, and identified to species if possible. All specimens were preserved in 40% isopropyl alcohol. The relative abundance of colonial invertebrates was noted but not further quantified.

Voucher specimens were deposited in the Invertebrate Museum, Florida Atlantic University, Boca Raton, Florida. Appendix II lists the literature used in the identification of the epifauna and macroalgal epiphytes found on Thalassia in the present study.

A representative sample of cleansed Thalassia (150 blades) collected from each site was measured for determination of surface area. All Thalassia blades in each sample were oven dried at 80°C for 48 hours and weighed to the nearest 0.1g. The abundance of each non-colonial animal species was expressed as: 1) numbers/0.25m^2 of level bottom, 2) numbers/gram dry weight of Thalassia and 3) numbers/m^2 of Thalassia blade surface.

Water samples were analyzed for salinity (Mohr titration), dissolved oxygen (Winkler titration), and turbidity (Hach Turbidimeter Model #2100).

A sediment sample from each site was dispersed in a 5.5g/l solution of sodium hexametaphosphate (Calgon) for 24 hours. The dispersed sediments were washed through a 0.62mm screen. The silt-clay fraction which passed through the screen was oven dried at 80°C for 24 hours and weighed to the nearest 0.001g. The retained sand fractions were similarily oven dried and then shaken for 10 minutes through a U.S. Standard Sieve Series (2.0, 1.0, 0.5 , 0.25, and 0.125mm). All fractions were weighed and the proportions of each were determined.

The organic content of the sediments was determined by incineration. A second sediment sample, oven-dried at 103°C for six hours, was weighed and then incinerated in a 600°C furnace for one hour. A percent organic content was calculated as a weight function:

$$\% \text{ Organic} = \frac{\text{weight initial} - \text{weight final}}{\text{weight initial}}$$

RESULTS

Physical-Chemical Conditions

A comparison of the range of physical-chemical conditions monitored during a 24-hour period at each of the three sampling sites revealed distinct differences (Fig. 5).

The differences in temperature and dissolved oxygen between sites appeared to be insignificant. Temperature ranges of 27-31.3°C, 28.3-31°C, and 29.5-31.2°C, were observed at San Carlos Bay, Lake Surprise, and Chicken Key, respectively. Dissolved oxygen was influenced by the photosynthetic activity of *Thalassia* and showed a maximum concentration in late afternoon and a minimum in the early morning hours. Dissolved oxygen concentrations ranged from 3.68-6.72mg/l, 4.49-6.59mg/l, and 3.90-7.57mg/l, at San Carlos Bay, Lake Surprise, and Chicken Key, respectively.

Major differences in salinity existed between the three sites. Seasonal salinity fluctuations are for the most part a response to the wet-dry periods of southern Florida. Approximately 60% of the annual precipitation occurs between June-September in response to tropical depressions and thunderstorms (Taylor, 1974). Periods of maximum salinity follow periods of minimum rainfall by approximately 1-2 months (Lee and Rooth, 1976). Accordingly, the samples in this study were collected during periods of expected maximum salinity. A mean salinity, during a 24-hour period, of 35.8ppt was recorded at San Carlos Bay. Taylor (1974) reported a yearly salinity range of 25.5-36.2ppt in this same area. Chicken Key showed a mean salinity of 39.9ppt

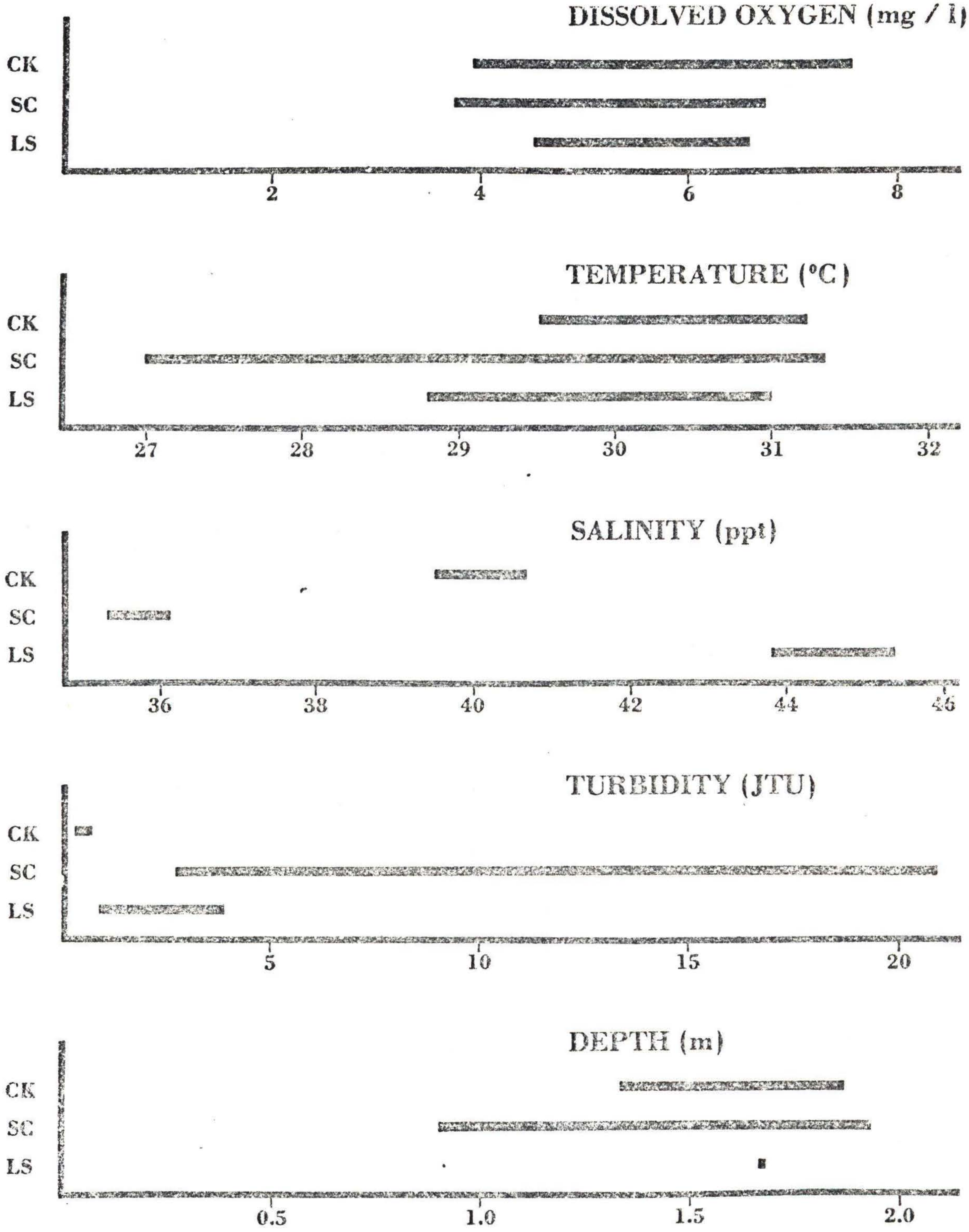


Figure 5. Comparison of the range of physical-chemical conditions during a 24 hour period at Chicken Key (CK), San Carlos Bay (SC), and Lake Surprise (LS).

while Lake Surprise was distinctly hypersaline with a mean value of 44.6ppt. The variation in salinity during a complete tidal cycle was less than 1.6ppt at all sites.

San Carlos Bay showed the greatest variation in turbidity (2.8-21.0 JTU). This variation coincided with tidal changes within the estuary. High turbidity resulted from discharges of the Caloosahatchee River while low turbidity prevailed on the incoming tide. Chicken Key, relatively unaffected by land runoff, had the lowest turbudity (0.38-0.64 JTU). Lake Surprise also had little land runoff and was generally low in turbidity (0.9-3.9 JTU), although higher turbidities sometimes occur due to the effect of wind on the shallow lagoon (Nickelsen, pers. comm.).

Tidal ranges are distinctly different at the three sampling sites. Lake Surprise, connected to a series of shallow bays, is remote from oceanic tidal influences and exhibits no significant tidal variation. A tidal range of 0.53m was observed off Chicken Key. Schneider (1969) recorded a mean tidal range of 0.58m in this same area. San Carlos Bay opens directly into the Gulf of Mexico and is more influenced by tidal fluctuations than are the other two sites. A tidal range of 1.02m was observed during the sampling period.

Sediment analysis revealed distinct differences in sediment particle sizes at the three sites (Fig. 6). The silt-clay fraction dominated in Lake Surprise and comprised 51.9% by weight of the total sediment. Chicken Key was dominated by fine sands which comprised 65.2% of the sediment. Sediments at San Carlos Bay had relatively high percentages of fine sands (21.2%), very fine sands (27.1%), and

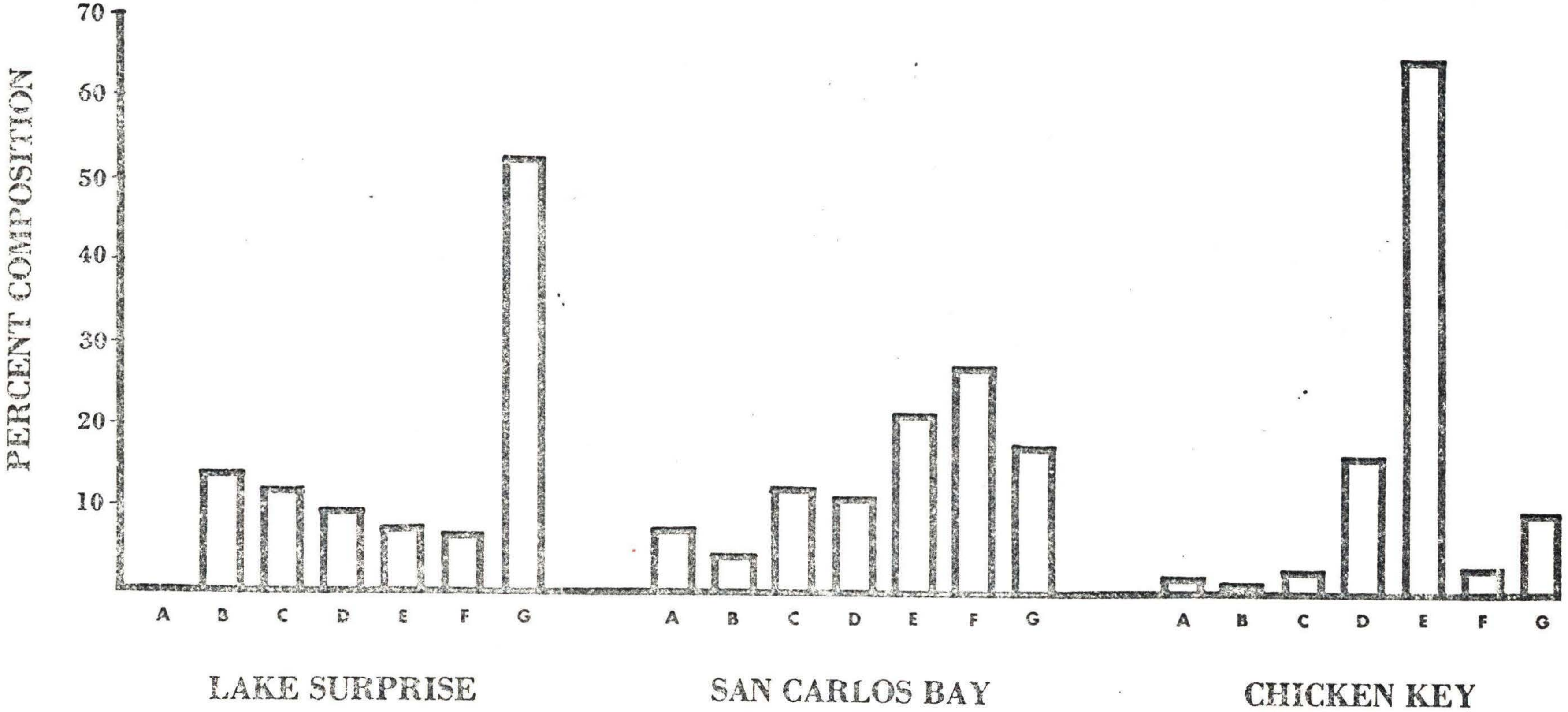


Figure 6. Sediment particle size distribution at each site (A = >2mm, B = 2-1mm, C = 1-.5mm, D = .5-.25mm, E = .25-.125mm, F = .125-.062mm, G = <.062mm)

silt-clays (17.6%).

Lake Surprise had the highest total organic content (25.18%), followed by San Carlos Bay (4.28%) and Chicken Key (3.05%).

Thalassia and Associated Epiphytes

Differences were apparent in the biomass of *Thalassia* between sites and even among samples from the same site. The *Thalassia* blades had the greatest biomass at Lake Surprise (221.5g dry wt/m^2) followed by Chicken Key (170g dry wt/m^2) and San Carlos Bay (135.9g dry wt/m^2). Lake Surprise had a very homogeneous *Thalassia* bed and showed little variation in biomass among samples (216.4-226.0g dry wt.m^2). At Chicken Key, a patchy distribution within the bed was shown by a relatively large biomass range among samples (136.8-198g dry wt/m^2). The biomass range at San Carlos Bay was intermediate between Chicken Key and Lake Surprise (115.2-156g dry wt/m^2).

The average blade length and surface area of *Thalassia* were also different between the three sampling sites. San Carlos Bay had the longest mean blade length (36.3cm), followed by Lake Surprise (31.2cm) and Chicken Key (28.9cm), respectively. Surface area of the *Thalassia* blades was greatest at Lake Surprise (10.4m^2 of blade surface/m^2 of level bottom), followed by Chicken Key (8.8m^2 of blade surface/m^2 of level bottom) and San Carlos Bay (8.4m^2 of blade surface/m^2 of level bottom).

A total of nine species of macro-algal epiphytes were found associated with *Thalassia* at the three sampling sites. Red algae dominated with seven species while the brown and blue-green algae were represented by one species each.

The *Thalassia* blades at Lake Surprise were relatively clean of sediment and epiphytes. The only macroscopic epiphytes collected were two species of red algae, *Hypoglossum involvens* and *Polysiphonia havanensis*; each was found in small amounts of less than 1g dry wt/m^2.

Chicken Key had the greatest abundance of algal epiphytes of the three sites. The dominant epiphyte was a filamentous blue-green alga, *Lyngbya sp.* *Lyngbya* formed a loose mat on top of the *Thalassia* and added considerable surface area and biomass (40.3g dry wt/m^2) to the community. Two species of red algae, *Laurencia poitei* and *Spyridia filamentosa*, were found in small amounts (less than 5gm/m^2) twisted within the *Lyngbya* mat. A coralline red alga, *Fosliella farinosa*, was found in small amounts attached to older *Thalassia* blades.

The dominant epiphyte at San Carlos Bay was *Fosliella farinosa*. Although this alga was not quantified, it covered much of the photosynthetic surface of the *Thalassia*. Other epiphytes found in small amounts (less than 1g dry wt/m^2) were the red algae, *Ceramium sp.* and *Chondria sp.*, and the brown alga, *Dictyota dichotoma*.

Community Composition

A total of 164 species of non-colonial invertebrates, including 40,794 individuals, was collected from *Thalassia* at the three sites. Appendix I lists all non-colonial invertebrate species and the number of individuals in each of three 0.25m^2 samples collected from each site. The dominant taxa were Amphipoda (37.5% of fauna; 19 species), Isopoda (16.3% of fauna; 3 species), Mollusca (15.9% of fauna; 58 species), Polychaeta (14.4% of fauna; 33 species) and Tanaidacea (9.7% of fauna; 3 species). These groups comprised 93.8% of the fauna and 70.4% of the non-colonial invertebrate species.

In Table 1 all species of non-colonial invertebrates collected from Lake Surprise, are ranked in order of abundance. Percent composition and cumulative percents for each species are indicated. The five most abundant species (*Leptochelia sp.*, *Bagatus stylodactylus*, *Ischnochiton papillosus*, *Spirorbis sp.*, and *Syllis cornuta*) accounted for 60.9% of the total fauna; 95.2% of the fauna constituted the 33 top-ranked species.

The density of the invertebrate fauna was relatively low at Lake Surprise. The number of individuals/m^2 of level bottom (extrapolated) ranged from 3984 to 5380 with a mean of 4901 individuals/m^2. The average number of individuals/g dry wt of *Thalassia* (22.2) and numbers/m^2 of blade surface (471) were also relatively low.

Four of the five most abundant species at San Carlos Bay (Table 2) were amphipods (*Ampithoe longimana*, *Pontogeneia longleyi*, *Erichthonius brasiliensis*, and *Corophium tuberculatum*). The tanaidacean *Leptochelia sp.* ranked third in abundance. The five most abundant species accounted for 57.8% of the total fauna; 95.3% of the fauna constituted the 32 top-ranked species.

The average number of individuals/m^2 of level bottom at San Carlos Bay (11,384) was approximately 2.3 times greater than the density at Lake Surprise while the number of individuals/g dry wt was nearly four times greater (86.5). The average number of individuals/m^2 of blade surface was 1349.

Table 1. Species ranked by abundance of individuals collected at Lake Surprise. Percent of total fauna and cummulative percent are indicated for each species.

Rank	Species		No.	% Comp	Cum %
1	*Leptochelia sp.*	Tan*	636	17.30	17.30
2	*Bagatus stylodactylus*	Iso	619	16.84	34.14
3	*Ischnochiton papillosus*	Chi	464	12.62	46.76
4	*Spirorbis sp.*	Pol	281	7.64	54.41
5	*Syllis cornuta*	Pol	238	6.47	60.88
6	*Vallicula multiformis*	Cte	175	4.76	65.64
7	*Dorvillea rubra*	Pol	134	3.65	69.29
8	*Platynereis dumerillii*	Pol	99	2.69	71.98
9	*Capitellides jonesi*	Pol	80	2.18	74.16
10	*Elasmopus pocillimanus*	Amp	69	1.88	76.03
11	*Amphiscolops sp.*	Tur	68	1.85	77.88
12	*Bunodeopsis globulifera*	Cni	61	1.66	79.54
13	*Thor floridanus*	Dec	57	1.55	81.09
14	*Elysia clena*	Opi	53	1.44	82.54
15	*Polychoerus caudatus*	Tur	46	1.25	83.79
16	*Sagitta hispida*	Cha	43	1.17	84.96
17	*Turbo castaneus*	Pro	41	1.12	86.07
19	*Caecum nitidum*	Pro	40	1.09	87.16
19	*Phyllaplysia engeli*	Opi	40	1.09	88.25
20	*Lysidice ninetta*	Pol	39	1.06	89.31
21	*Exogone dispar*	Pol	34	.92	90.23
22	*Luconacia incerta*	Amp	33	.90	91.13
23	*Carditamera floridana*	Biv	30	.82	91.95
24	*Odontosyllis enopla*	Pol	18	.49	92.44
26	*Tubulanus pellucidus*	Rhy	15	.41	92.85
26	*Fabricia sabella*	Pol	15	.41	93.25
27	*Apseudes propinquus*	Tan	14	.38	93.63
28	*Pontonema sp.*	Nem	13	.35	93.99
29	*Marginella carnea*	Pro	12	.33	94.31
33	*Modulus modulus*	Pro	11	.30	94.61
33	*Tegula fasciata*	Pro	11	.30	94.91
33	*Erichsonella attenuata*	Iso	11	.30	95.21
33	*Pontogeneia longleyi*	Amp	11	.30	95.51
34	*Granulina ovuliformis*	Pro	9	.24	95.76
36	*Gnesioceros floridana*	Tur	8	.22	95.97
36	*Achelia sawayai*	Pyc	8	.22	96.19

*Tan= Tanaidacea, Iso= Isopoda, Chi= Polyplacophora, Pol=Polychaeta, Cte= Ctenophora, Amp= Amphipoda, Tur= Turbellaria, Cni= Cnidaria, Dec= Decapoda, Opi= Opisthobranchia, Cha= Chaetognatha, Pro= Prosobranchia, Biv= Pelecypoda, Rhy= Rhyncocoela, Nem= Nematoda, Pyc= Pycnogonida, Cop= Copepoda, Hol= Holothuroidea, Sip= Sipunculida, Neb= Nebaliacea, Ast= Asteroidea, Oph= Ophiuroidea

Table 1. Continued

Rank	Species		No.	% Comp	Cum %
38	*Brachidontes exustus*	Biv	7	.19	96.38
38	*Spirorbis corrugatus*	Pol	7	.19	96.57
41	*Acmaea pustulata*	Pro	6	.16	96.74
41	*Brania clavata*	Pol	6	.16	96.90
41	*Ridgewayia sp.*	Cop	6	.16	97.06
47	*Pinctada imbricata*	Biv	5	.14	97.20
47	*Autolytus sp.*	Pol	5	.14	97.33
47	*Branchiomma nigromaculata*	Pol	5	.14	97.47
47	*Callipallene brevirostrum*	Pyc	5	.14	97.61
47	*Hippolyte zostericola*	Dec	5	.14	97.74
47	*Synaptula hydriformis*	Hol	5	.14	97.88
53	*Marginella sp.*	Pro	4	.11	97.99
53	*Runcina sp.*	Opi	4	.11	98.10
53	*Podarke obscura*	Pol	4	.11	98.20
53	*Golfingia elongata*	Sip	4	.11	98.31
53	Phoxichilidiidae #1	Pyc	4	.11	98.42
53	*Erichthonius brasiliensis*	Amp	4	.11	98.53
60	*Zygonemertes virescens*	Rhy	3	.08	98.61
60	*Caecum pulchellum*	Pro	3	.08	98.69
60	*Cerithiopsis emersoni*	Pro	3	.08	98.78
60	*Chione cancellata*	Biv	3	.08	98.86
60	*Cirriformia filigera*	Pol	3	.08	98.94
60	*Paracerceis caudata*	Iso	3	.08	99.02
60	*Carinobatea cuspidata*	Amp	3	.08	99.10
70	*Notoplana sp.*	Tur	2	.05	99.16
70	*Crepidula fornicata*	Pro	2	.05	99.21
70	*Favorinus auritulus*	Opi	2	.05	99.27
70	*Anomia simplex*	Biv	2	.05	99.32
70	*Dodecaceria corallii*	Pol	2	.05	99.37
70	*Hydroides dianthus*	Pol	2	.05	99.43
70	*Nereiphylla fragilis*	Pol	2	.05	99.48
70	*Thelepus setosus*	Pol	2	.05	99.54
70	*Cymadusa compta*	Amp	2	.05	99.59
70	*Leucothoe spinicarpa*	Amp	2	.05	99.65
83	Acoel Turbellarian #1	Tur	1	.03	99.67
83	*Thysanozoon sp.*	Tur	1	.03	99.70
83	*Oerstedia dorsalis*	Rhy	1	.03	99.73
83	*Diodora dysoni*	Pro	1	.03	99.76
83	*Epitonium echinaticostum*	Pro	1	.03	99.78
83	*Tricolia bella*	Pro	1	.03	99.81
83	*Naineris laevigata*	Pol	1	.03	99.84
83	*Polydora hamata*	Pol	1	.03	99.86
83	*Spio pettiboneae*	Pol	1	.03	99.89

Table 1. Continued

Rank	Species		No.	% Comp	Cum %
83	Paranebalia longipes	Neb	1	.03	99.92
83	Lysianopsis alba	Amp	1	.03	99.95
83	Echinaster sentus	Ast	1	.03	99.97
83	Amphiodia pulchella	Oph	1	.03	100.00

Table 2. Species ranked by abundance of individuals collected at San Carlos Bay. Percent of fauna and cumulative percent are indicated for each species.

Rank	Species		No.	% Comp	Cum %
1	*Ampithoe longimana*	Amp*	1522	17.83	17.83
2	*Pontogeneia longleyi*	Amp	1516	17.76	35.58
3	*Leptochelia sp.*	Tan	809	9.48	45.06
4	*Erichthonius brasiliensis*	Amp	627	7.34	52.40
5	*Corophium tuberculatum*	Amp	462	5.41	57.81
6	*Luconacia incerta*	Amp	456	5.34	63.15
7	*Spirorbis corrugatus*	Pol	276	3.23	66.39
8	*Cerapus tubularis*	Amp	244	2.86	69.24
9	*Crepidula maculosa*	Pro	225	2.64	71.88
10	*Phyllaplysia engeli*	Opi	214	2.51	74.39
11	*Elasmopus pocillimanus*	Amp	210	2.46	76.84
12	*Branchiomma nigromaculata*	Pol	201	2.35	79.20
13	*Bunodeopsis globulifera*	Cni	183	2.14	81.34
14	*Gitanopsis tortugae*	Amp	142	1.66	83.01
15	*Sagitta hispida*	Cha	120	1.41	84.41
16	*Gnesioceros floridana*	Tur	114	1.34	85.75
17	*Brania clavata*	Pol	97	1.14	86.88
19	*Diastoma varium*	Pro	80	.94	87.82
19	*Grandidierella bonnieroides*	Amp	80	.94	88.76
20	*Fabricia sabella*	Pol	76	.89	89.65
21	*Spirorbis sp.*	Pol	71	.83	90.48
22	*Anachis avara*	Pro	62	.73	91.20
23	*Hippolyte zostericola*	Dec	57	.67	91.87
24	*Paracerceis caudata*	Iso	49	.57	92.45
25	*Platynereis dumerillii*	Pol	43	.50	92.95
26	*Anomia simplex*	Biv	39	.46	93.41
27	*Thelepus setosus*	Pol	35	.41	93.82
29	*Ischnochiton papillosus*	Chi	33	.39	94.20
29	*Polydora websteri*	Pol	33	.39	94.59
30	*Crepidula plana*	Pro	30	.35	94.94
32	*Polydora hamata*	Pol	28	.33	95.27
32	*Lucifer faxoni*	Dec	28	.33	95.60
33	*Zygonemertes virescens*	Rhy	27	.32	95.91
34	*Melita appendiculata*	Amp	25	.30	96.21
35	*Pontonema sp.*	Nem	24	.28	96.49
36	*Carditamera floridana*	Biv	22	.26	96.74

*Amp= Amphipoda, Tan= Tanaidacea, Pol= Polychaeta, Pro= Prosobranchia, Opi= Opisthobranchia, Cni= Cnidaria, Cha= Chaetognatha, Tur= Turbellaria, Dec= Decapoda, Iso= Isopoda, Biv= Pelecypoda, Chi= Polyplacophora, Rhy= Rhynchocoela, Nem= Nematoda, Cop = Copepoda, Ins = Insecta, Cte= Ctenophora, Pyc= Pycnogonida, Ast= Asteroidea.

Table 2. Continued

Rank	Species		No.	% Comp	Cum %
38	*Exogone dispar*	Pol	16	.19	96.93
38	*Pagurus annulipes*	Dec	16	.19	97.12
39	Prosthiostomidae #1	Tur	15	.18	97.29
41	*Symplocostoma sp.*	Nem	14	.16	97.46
41	*Ampelisca abdita*	Amp	14	.16	97.62
42	*Tubulanus pellucidus*	Rhy	12	.14	97.76
44	*Autolytus sp.*	Pol	11	.13	97.89
44	*Calanoida #1*	Cop	11	.13	98.02
45	*Erichsonella attenuata*	Iso	10	.12	98.14
46	*Sabella microphthalma*	Pol	9	.11	98.24
49	*Prostomatella murula*	Rhy	8	.09	98.34
49	Bivalve #1	Biv	8	.09	98.43
49	*Odontosyllis enopla*	Pol	8	.09	98.52
50	*Capitellidae #1*	Pol	7	.08	98.61
53	*Mediomastus californiensis*	Pol	6	.07	98.68
53	*Naineris laevigata*	Pol	6	.07	98.75
53	Dipteran larva	Ins	6	.07	98.82
57	*Euplana gracilis*	Tur	5	.06	98.88
57	*Brachidontes exustus*	Biv	5	.06	98.93
57	*Pista palmata*	Pol	5	.06	98.99
57	*Carinobatea cuspidata*	Amp	5	.06	99.05
64	*Vallicula multiformis*	Cte	4	.05	99.10
64	*Acanthozoon maculosum*	Tur	4	.05	99.14
64	*Elysia clena*	Opi	4	.05	99.19
64	*Anadara transversa*	Biv	4	.05	99.24
64	*Onuphis magna*	Pol	4	.05	99.29
64	*Cymadusa compta*	Amp	4	.05	99.33
64	*Photis dentata*	Amp	4	.05	99.38
69	*Amphiscolops sp.*	Tur	3	.04	99.41
69	*Caecum nitidum*	Pro	3	.04	99.45
69	*Marginella aureocincta*	Pro	3	.04	99.48
69	*Polycera aurisula*	Opi	3	.04	99.52
69	*Callipallene brevirostrum*	Pyc	3	.04	99.55
82	*Caecum pulchellum*	Pro	2	.02	99.58
82	*Crepidula fornicata*	Pro	2	.02	99.60
82	*Granulina ovuliformis*	Pro	2	.02	99.63
82	*Mitrella lunata*	Pro	2	.02	99.65
82	*Odostomia seminuda*	Opi	2	.02	99.67
82	*Triphora nigrocincta*	Pro	2	.02	99.70
82	*Okenia impexa*	Opi	2	.02	99.72
82	*Dodecaceria corallii*	Pol	2	.02	99.74
82	*Leucothoe spinicarpa*	Amp	2	.02	99.77
82	*Lysianopsis alba*	Amp	2	.02	99.79

Table 2. Continued

Rank	Species		No.	% Comp	Cum %
82	*Stenothoe sp.*	Amp	2	.02	99.81
82	*Penaeus duorarum*	Dec	2	.02	99.84
82	*Echinaster sentus*	Ast	2	.02	99.86
94	*Notoplana sp.*	Tur	1	.01	99.87
94	*Filoncholaimus sp.*	Nem	1	.01	99.88
94	*Polyplacophoran #1*	Chi	1	.01	99.89
94	*Fasciolaria sp.*	Pro	1	.01	99.91
94	*Marginella carnea*	Pro	1	.01	99.92
94	*Chione cancellata*	Biv	1	.01	99.93
94	*Polymesoda maritima*	Biv	1	.01	99.94
94	*Capitellides jonesi*	Pol	1	.01	99.95
94	*Cirriformia filigera*	Pol	1	.01	99.96
94	*Nereis falsa*	Pol	1	.01	99.98
94	*Prionospio cirrobranchia*	Pol	1	.01	99.99
94	*Paracaprella pusilla*	Amp	1	.01	100.00

At Chicken Key (Table 3), the five most abundant species (Bagatus stylodactylus, Elasmopus pocillimanus, Caecum pulchellum, Melita appendiculata, and Leptochelia sp.) accounted for 66.2% of the total fauna; 95.3% of the fauna constituted the 24 top-ranked species.

The invertebrate fauna at Chicken Key had a mean density (38108/m^2) that was nearly 7.8 times greater than the density at San Carlos Bay. Chicken Key also showed the largest variation within samples, with densities ranging from 24108 to 49864 individuals/m^2. The average number of individuals/g dry wt of Thalassia (223.3) and number of individuals/m^2 of blade surface (4350) were also greater than at either Lake Surprise or San Carlos Bay.

Faunal Affinity

Pronounced differences were apparent in both species composition and abundance between the three sampling sites. Two methods were used in this study to assess the degree of faunal affinity.

The index of affinity (Sanders, 1960) is a measure of the percentage of the fauna common to a pair of samples. The index is obtained by summing the smaller percentage frequencies of those species present in both samples. An obvious advantage of this index is that it not only considers the component species in a sample but also takes into consideration the relative abundances of these species. As this method is based on percent composition, the dominant species are emphasized while the rarer species common to both samples are devalued.

Figure 7 shows a matrix of the index of affinity values for all sample pairs. The Thalassia community showed a high faunal homogeneity

Table 3. Species ranked by abundance of individuals collected at Chicken Key. Percent of fauna and cumulative percent are indicated for each species.

Rank	Species		No.	% Comp	Cum %
1	*Bagatus stylodactylus*	Iso*	5909	20.68	20.68
2	*Elasmopus pocillimanus*	Amp	4779	16.72	37.40
3	*Caecum pulchellum*	Pro	3107	10.87	48.27
4	*Melita appendiculata*	Amp	2635	9.22	57.49
5	*Leptochelia sp.*	Tan	2479	8.67	66.16
6	*Brania clavata*	Pol	1336	4.67	70.84
7	*Spirorbis sp.*	Pol	1104	3.86	74.70
8	*Fabricia sabella*	Pol	739	2.59	77.28
9	*Grandidierella bonnieroides*	Amp	720	2.52	79.80
10	*Syllis cornuta*	Pol	495	1.73	81.54
11	*Ischnochiton papillosus*	Chi	447	1.56	83.10
12	*Caecum nitidum*	Pro	420	1.47	84.57
13	*Gitanopsis tortugae*	Amp	412	1.44	86.01
14	*Erichthonius brasiliensis*	Amp	396	1.39	87.40
15	*Lysianopsis alba*	Amp	343	1.20	88.60
16	*Harpacticoida #1*	Cop	267	.93	89.53
17	*Pontogeneia longleyi*	Amp	237	.83	90.36
18	*Diastoma varium*	Pro	236	.83	91.19
19	*Phyllaplysia engeli*	Opi	229	.80	91.99
20	*Crepidula maculosa*	Pro	223	.78	92.77
21	*Linhomoeus sp.*	Nem	207	.72	93.49
22	*Sagitta hispida*	Cha	191	.67	94.16
23	*Cymadusa compta*	Amp	170	.59	94.76
24	*Gnesioceros floridana*	Tur	145	.51	95.26
25	*Vallicula multiformis*	Cte	93	.33	95.59
26	*Exogone dispar*	Pol	84	.29	95.88
27	*Brachidontes exustus*	Biv	79	.28	96.16
28	*Cerapus tubularis*	Amp	74	.26	96.42
29	*Branchiomma nigromaculata*	Pol	61	.21	96.63
30	*Pontonema sp.*	Nem	59	.21	96.84
31	*Dorvillea rubra*	Pol	57	.20	97.04
32	*Carditamera floridana*	Biv	52	.18	97.22
33	*Cyclaspis varians*	Cum	51	.18	97.40
34	*Tubulanus pellucidus*	Rhy	46	.16	97.56
35	*Phanoderma sp.*	Nem	45	.16	97.72
36	*Phenacolepas hamillei*	Pro	44	.15	97.87
37	*Carinobatea cuspidata*	Amp	43	.15	98.02

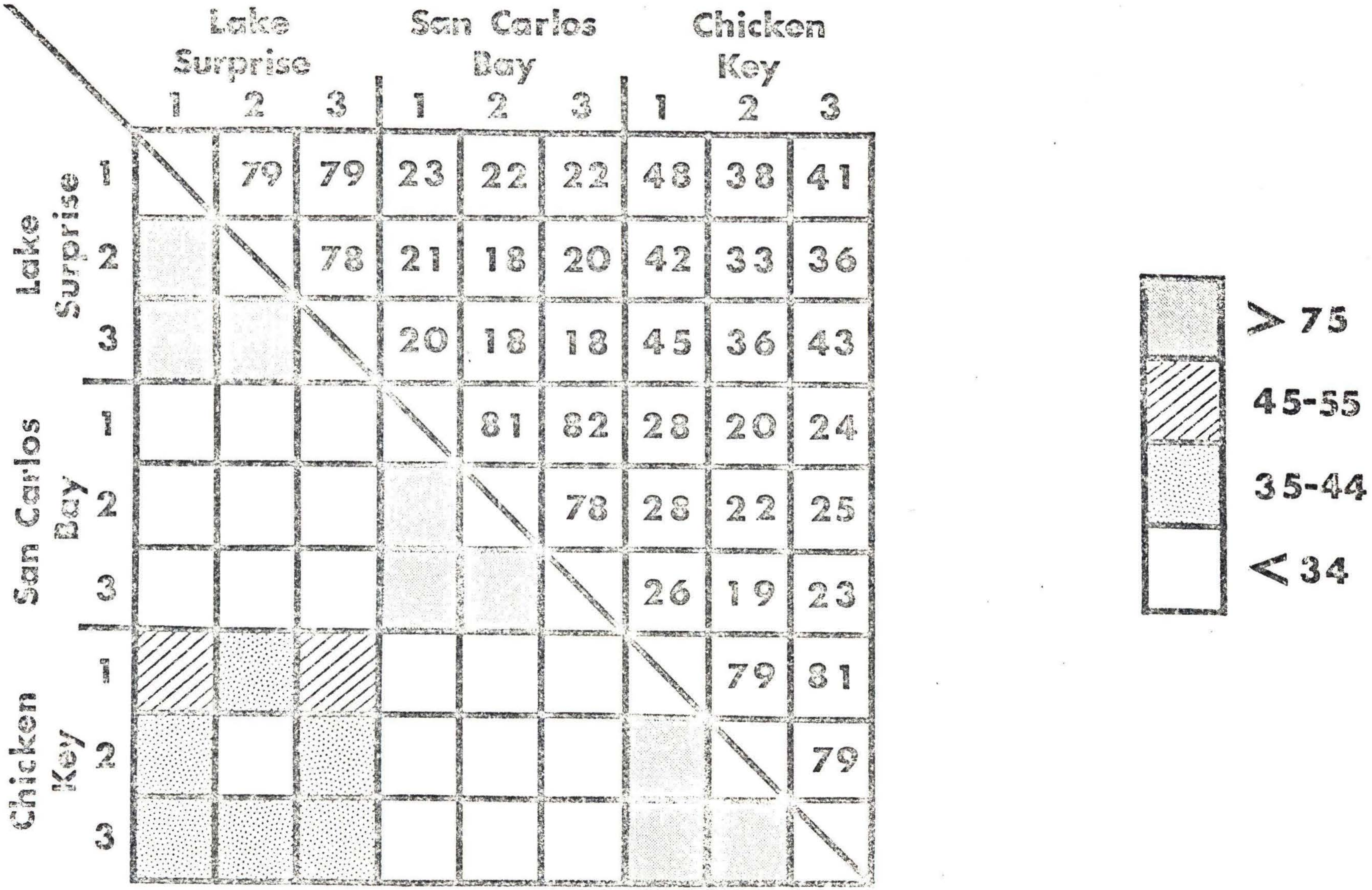
*Iso= Isopoda, Amp= Amphipoda, Pro= Prosobranchia, Tan= Tanaidacea, Pol= Polychaeta, Chi= Polyplacophora, Cop= Copepoda, Opi= Opisthobranchia, Nem= Nematoda, Cha= Chaetognatha, Tur= Turbellaria, Cte= Ctenophora, Biv= Pelecypoda, Cum= Cumacea, Rhy= Rhyncocoela, Dec= Decapoda, Cni= Cnidaria, Ara=Arachnida, Oph= Ophiuroidea, Hol= Holothuroidea, Hir= Hirudinea, Pyc = Pycnogonida

Table 3. Continued

Rank	Species		No.	% Comp	Cum %
38	Ridgewayia sp.	Cop	41	.14	98.16
39	Thor floridanus	Dec	40	.14	98.30
40	Paracerceis caudata	Iso	33	.12	98.42
41	Syllis gracilis	Pol	28	.10	98.52
43	Elysia clena	Opi	26	.09	98.61
43	Platynereis dumerillii	Pol	26	.09	98.70
44	Haminoea elegans	Opi	24	.08	98.78
46	Bunodeopsis globulifera	Cni	23	.08	98.86
46	Podarke obscura	Pol	23	.08	98.94
47	Hydracarina #1	Ara	22	.08	99.02
49	Notoplana sp.	Tur	20	.07	99.09
49	Tricolia bella	Pro	20	.07	99.16
50	Luconacia incerta	Amp	17	.06	99.22
52	Amphiscolops sp.	Tur	16	.06	99.28
52	Acoel Turbellarian #1	Tur	16	.06	99.33
53	Thysanozoon sp.	Tur	12	.04	99.37
55	Leucothoe spinicarpa	Amp	11	.04	99.41
55	Hippolyte zostericola	Dec	11	.04	99.45
58	Triphora nigrocincta	Pro	10	.03	99.49
58	Turbonilla dalli	Opi	10	.03	99.52
58	Spirorbis corrugatus	Pol	10	.03	99.56
60	Mitrella lunata	Pro	9	.03	99.59
60	Amphiodia pulchella	Oph	9	.03	99.62
61	Synaptula hydriformis	Hol	8	.03	99.65
64	Rissoina sp.	Pro	7	.02	99.67
64	Sayella sp.	Opi	7	.02	99.70
64	Cirriformia filigera	Pol	7	.02	99.72
66	Marginella carnea	Pro	6	.02	99.74
66	Aegires sublaevis	Opi	6	.02	99.76
68	Prostomatella murula	Rhy	4	.01	99.78
68	Lapinura divae	Opi	4	.01	99.79
76	Oncholaimid #1	Nem	3	.01	99.80
76	Anachis sp.	Pro	3	.01	99.81
76	Rissoina catesbyana	Pro	3	.01	99.82
76	Urosalpinx perrugata	Pro	3	.01	99.83
76	Diplodonta punctata	Biv	3	.01	99.84
76	Pinctada imbricata	Biv	3	.01	99.85
76	Dodecaceria corallii	Pol	3	.01	99.86
76	Lysmata sp.	Dec	3	.01	99.87
84	Pseudoceros crozieri	Tur	2	.01	99.88
84	Micrura leidyi	Rhy	2	.01	
84	Cerithiopsis emersoni	Pro	2	.01	99.89
84	Marginella apicina	Pro	2	.01	99.90
84	Turbo castaneus	Pro	2	.01	99.91
84	Pseudocyclops sp.	Cop	2	.01	

Table 3. Continued

Rank	Species		No.	% Comp	Cum %
84	*Stenothoe sp.*	Amp	2	.01	99.92
84	*Pagurus annulipes*	Dec	2	.01	
104	*Prosthiostomidae #2*	Tur	1		99.93
104	*Eurystomina sp.*	Nem	1		
104	*Symplocostoma sp.*	Nem	1		
104	*Alvania auberiana*	Pro	1		99.94
104	*Cantharus cancellarius*	Pro	1		
104	*Cerithium eburneum*	Pro	1		
104	*Hyalina avenacea*	Pro	1		99.95
104	*Marginella aureocincta*	Pro	1		
104	*Turbonilla sp.*	Opi	1		
104	*Turritella exoleta*	Pro	1		99.96
104	*Aglaia sp.*	Opi	1		
104	*Chione cancellata*	Biv	1		99.97
104	*Ceratonereis mirabilis*	Pol	1		
104	*Hydroides protulicola*	Pol	1		
104	*Thelepus setosus*	Pol	1		99.98
104	*Pontobdella sp.*	Hir	1		
104	*Callipallene brevirostrum*	Pyc	1		
104	*Ampithoe longimana*	Amp	1		99.99
104	*Gammaropsis sp.*	Amp	1		
104	*Penaeus duorarum*	Dec	1		100.00



	Lake Surprise 1	Lake Surprise 2	Lake Surprise 3	San Carlos Bay 1	San Carlos Bay 2	San Carlos Bay 3	Chicken Key 1	Chicken Key 2	Chicken Key 3
Lake Surprise 1		79	79	23	22	22	48	38	41
Lake Surprise 2	▓		78	21	18	20	42	33	36
Lake Surprise 3	▓	▓		20	18	18	45	36	43
San Carlos Bay 1					81	82	28	20	24
San Carlos Bay 2				▓		78	28	22	25
San Carlos Bay 3				▓	▓		26	19	23
Chicken Key 1	▨	░	▨					79	81
Chicken Key 2	░		░				▓		79
Chicken Key 3	░	░	░				▓	▓	

▓ > 75
▨ 45-55
░ 35-44
☐ < 34

Figure 7. Matrix of the Index of Affinity values for all sample pairs.

within each site. The average index of affinity for all within-site sample pairs at Lake Surprise, San Carlos Bay, and Chicken Key was 78.8%, 80.6%, and 79.7%, respectively. Lake Surprise and Chicken Key showed the highest average affinity between sites (40.3%) followed by Chicken Key and San Carlos Bay (24.0%) and Lake Surprise and San Carlos Bay (20.2%).

A second method used to assess the degree of faunal similarity is Sorensen's (1948) quotient of similarity (K):

$$K = \frac{2C}{A+B} \times 100$$

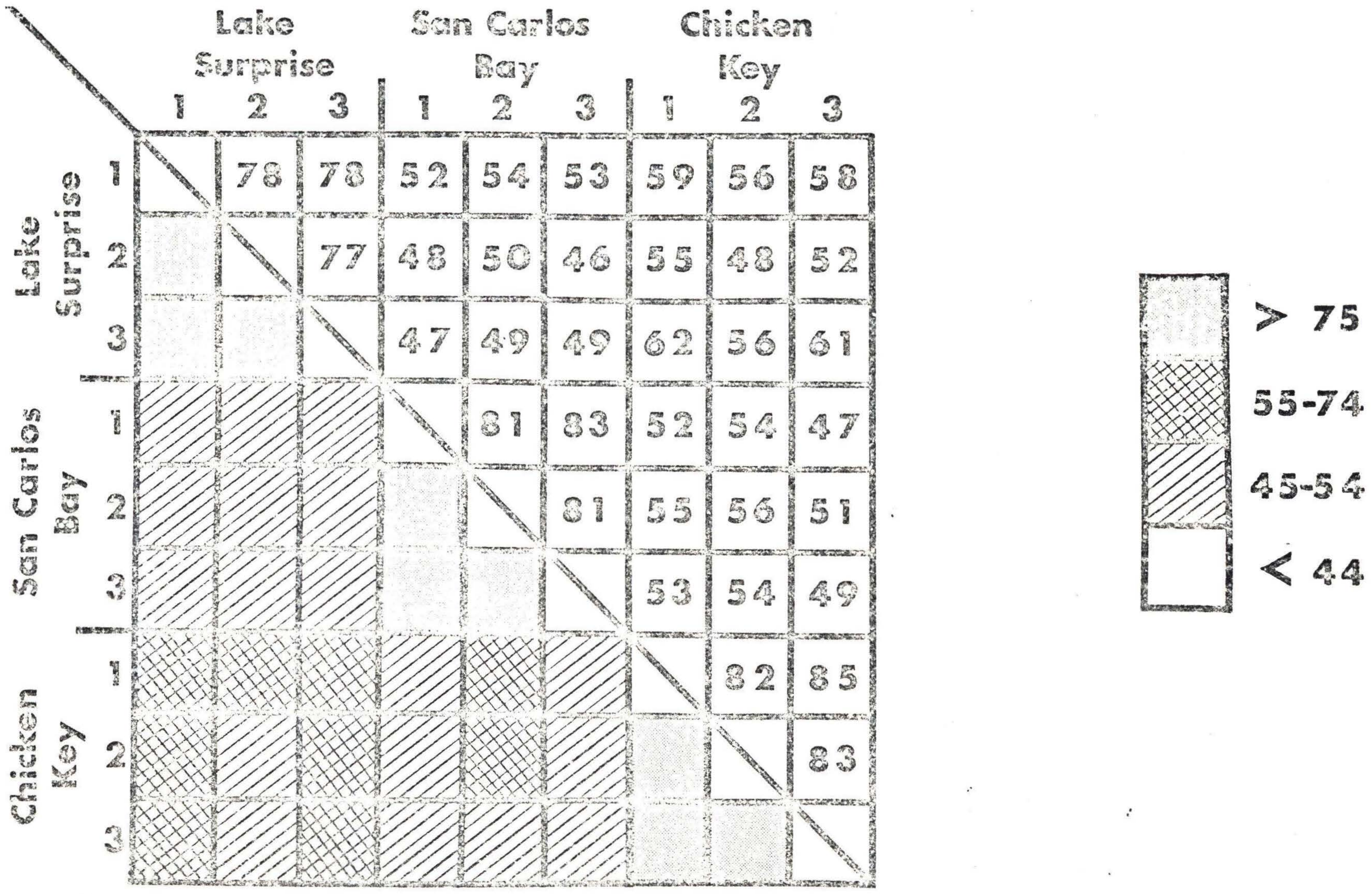
where A = number of species in sample A

B = number of species in sample B

C = number of species common to both samples.

Sorensen's quotient (K) estimates similarity of sites based simply on the presence of species common to both samples. As this index does not consider the relative abundance of individuals, each species is given equal value. In this study, the index is useful in comparing different sites where unequal samples can have a disproportionate effect on affinity when calculations are based on abundance (Fager, 1957; Sanders, 1960).

Figure 8 shows a matrix of Sorensen's quotient of similarity (K) for all sample pairs. High faunal homogeneity was again evident for within-site sample pairs. Lake Surprise, San Carlos Bay, and Chicken Key had a mean faunal affinity for within-site sample pairs of 77.9%, 81.8%, and 83.3% respectively. Sorensen's quotient (K) showed a much higher faunal affinity between sample pairs of different sites (mean 52.8%)



		Lake Surprise 1	Lake Surprise 2	Lake Surprise 3	San Carlos Bay 1	San Carlos Bay 2	San Carlos Bay 3	Chicken Key 1	Chicken Key 2	Chicken Key 3
Lake Surprise	1		78	78	52	54	53	59	56	58
	2	░		77	48	50	46	55	48	52
	3	░	░		47	49	49	62	56	61
San Carlos Bay	1	▨	▨	▨		81	83	52	54	47
	2	▨	▨	▨	░		81	55	56	51
	3	▨	▨	▨	░	░		53	54	49
Chicken Key	1	▦	▦	▦	▨	▦	▨		82	85
	2	▦	▨	▦	▨	▦	▨	░		83
	3	▦	▨	▦	▨	▨	▨	░	░	

░	> 75
▦	55-74
▨	45-54
□	< 44

Figure 8. Matrix of Sorensen's quotient of Similarity (K) for all sample pairs.

than did the index of affinity (mean 28.2%). Lake Surprise and Chicken Key again showed the highest average affinity (56.2%) followed by Chicken Key and San Carlos Bay (52.3%) and Lake Surprise and San Carlos Bay (49.3%).

The use of these two indices showed that the species composition at Lake Surprise, San Carlos Bay, and Chicken Key was very similar, although the relative abundance of the component species often differed.

The abundances of the dominant taxa at each site are presented in Fig. 9. Amphipods, found in small numbers at Lake Surprise (3.4% of fauna; 8 species), were the dominant taxon at San Carlos Bay (62.3% of fauna; 18 species) and Chicken Key (34.4% of fauna; 15 species). Of the 19 amphipod species collected in this study, eight species (42%) were found at all three sites while 14 species (74%) were collected at a minimum of two sites. Elasmopus pocillimanus was the dominant amphipod collected at Lake Surprise (19% of the total fauna) and Chicken Key (16.7% of the total fauna) but ranked seventh among amphipods at San Carlos Bay (2.5% of the total fauna). The dominant amphipod at San Carlos Bay, Ampithoe longimana, was not found at Lake Surprise and was represented by a single individual at Chicken Key.

Isopods comprised 20.8%, 17.2%, and 0.7% of the fauna at Chicken Key, Lake Surprise, and San Carlos Bay, respectively. Bagatus stylodactylus was the dominant species at Chicken Key (20.7% of the total fauna), ranked second in abundance at Lake Surprise (16.8% of the total fauna), and was not collected at San Carlos Bay.

Molluscs had the highest percent composition at Lake Surprise (20.5% of fauna; 24 species), followed by Chicken Key (17.5% of fauna; 37

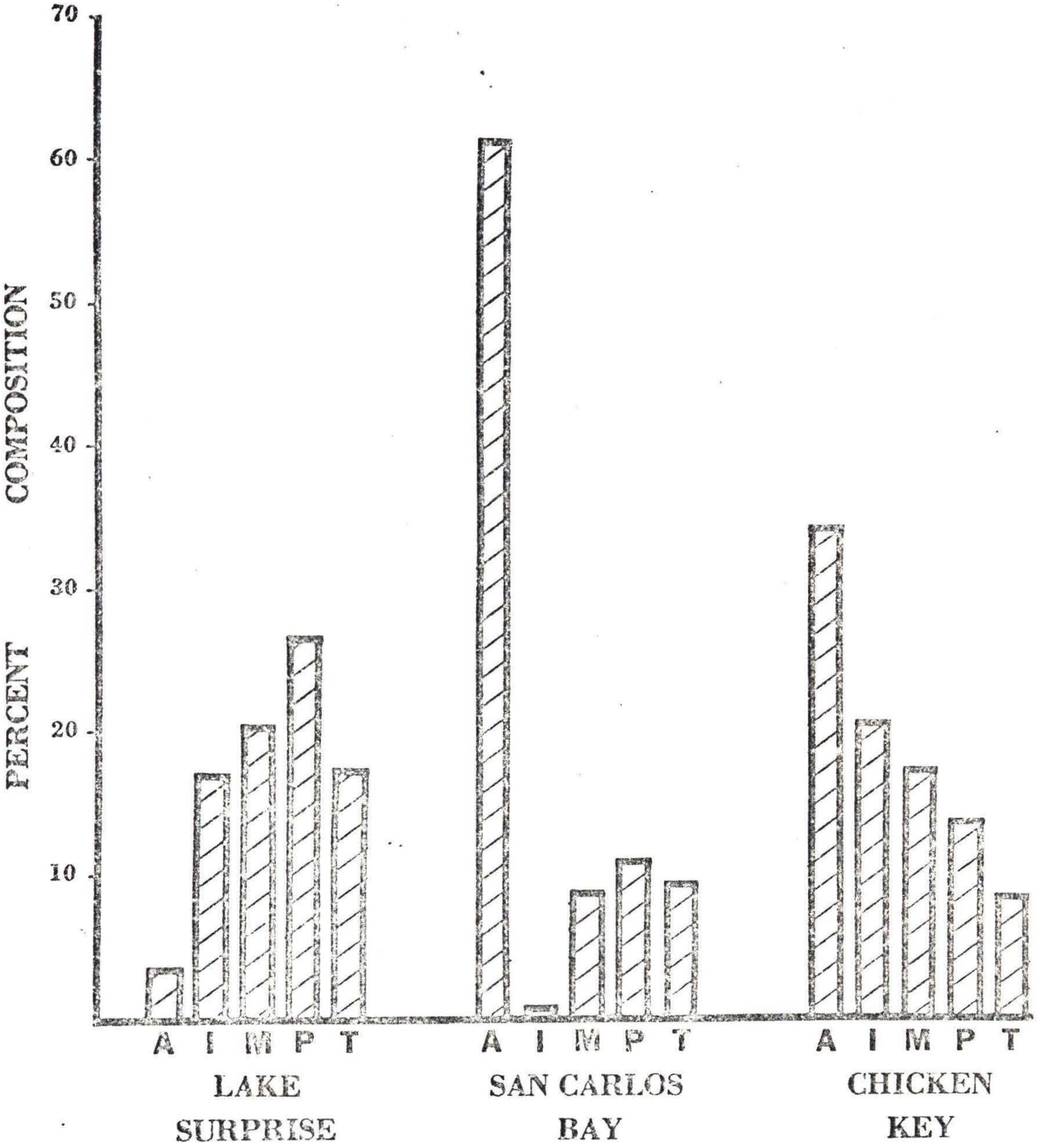


Figure 9. Comparison of the dominant taxa at each site. (A = Amphipoda, I = Isopoda, M = Mollusca, P = Polychaeta, T = Tanaidacea).

species) and San Carlos Bay (8.8% of fauna; 27 species). Of the 58 species of molluscs collected in this study only 9 species (15.5%) were found at all three sites while 21 species (36.2%) were found at a minimum of two sites. The sacoglossan opisthobranch, *Phyllaplysia engeli*, and the chiton, *Ischnochiton papillosus*, were found abundantly at all sites. Among the molluscan fauna, *Phyllaplysia engeli* ranked fifth, second, and fifth, while *Ischnochiton papillosus* ranked first, sixth, and second, at Lake Surprise, San Carlos Bay and Chicken Key, respectively.

Polychaetes ranked nearly equally with molluscs in abundance and had the highest percent composition at Lake Surprise (26.6% of fauna; 22 species), followed by Chicken Key (13.9% of fauna; 16 species) and San Carlos Bay (11.0% of fauna; 23 species). Of the 33 polychaete species collected, 10 species (30.3%) were found at all three sites, while 18 species (54.5%) were found at a minimum of two sites. *Spirorbis sp.* was the dominant polychaete at Lake Surprise and ranked second at Chicken Key while *Spirorbis corrugatus* was the dominant polychaete at San Carlos Bay. *Brania clavata* was the dominant polychaete species at Chicken Key and ranked third and eleventh among polychaetes at San Carlos Bay and Lake Surprise, respectively.

The tanaidacean, *Leptochelia sp.*, was a dominant member of the community at each of the sampling sites and ranked first, third, and fifth of the total fauna at Lake Surprise, San Carlos Bay, and Chicken Key, respectively.

Diversity

Diversity is an important parameter of community structure. A commonly used index which is sensitive to both species richness and equitability, yet which is relatively sample size independent is the Shannon-Weaver diversity index (Shannon and Weaver, 1963):

$$H' = -\sum_{i=1}^{S} Pi \log_2 Pi$$

where H' = diversity expressed as information content in bits/individuals,

S = total number of species

Pi = the proportion of the sample belonging to the i^{th} species.

Diversity values ranged from 2.66 to 2.99 bits/individual with means of 2.93, 2.89, and 2.75 at San Carlos Bay, Lake Surprise, and Chicken Key, respectively. Average H' for all samples was 2.86.

A separate index which effectively measures equitability based on the Shannon-Weaver diversity index is suggested for general use by Sheldon (1969):

$$E = \frac{H'}{\ln S}$$

where E = equitability

H' = diversity (bits/individual) calculated from Shannon-Weaver index.

S = total number of species

Equitability values ranged from 0.60 to 0.71 with means of 0.70, 0.68, and 0.62 at Lake Surprise, San Carlos Bay, and Chicken Key, respectively. Average E for all samples was 0.67. These generally high equitability values indicate a relatively even distribution of individuals among species.

Colonial Forms

A total of 14 species of colonial invertebrates was found associated with *Thalassia* at the three sites (Table 4). None of these species was very common among the epifauna.

The sponges were represented by a single species, *Chondrilla nucula*, found infrequently at San Carlos Bay and Chicken Key. Small growths, 2-3 cm in diameter, were found attached to the bases of several plants.

Six hydroid species were collected in small colonies at Lake Surprise and San Carlos Bay. No hydroid species was collected at more than one site. *Clytia cylindrica* was the dominant hydroid among the four species collected at San Carlos Bay. *Eudendrium tenellum* and *Obelia sp.* were found infrequently at Lake Surprise.

Among the seven species of ectoprocts collected, only one, *Schizoporella unicornis*, occurred at all sites. Small colonies, 4-8mm in diameter, were found encrusting older *Thalassia* blades. *Bugula neritina*, found only at San Carlos Bay, was by far the most abundant ectoproct collected. Numerous branching colonies, 5-6 cm in length, were found attached to *Thalassia* blades in all samples.

Table 4. Colonial invertebrate species found infrequently on *Thalassia* at Lake Surprise, San Carlos Bay, and Chicken Key.

Species	Lake Surprise	San Carlos Bay	Chicken Key
Porifera			
Chondrilla nucula		+	+
Hydrozoa			
Bimeria sp.		+	
Eudendrium tenellum	+		
Clytia cylindrica		+	
Obelia sp.	+		
Ophiodissa caciniformis		+	
Sertularia cornicina		+	
Ectoprocta			
Aeverrillia setiger			+
Bugula neritina		+	
Holoporella mordax			+
Membranipora sp.		+	
Parasmittina trispinosa			+
Schizoporella unicornis	+	+	+
Sundanella sibogae		+	+

DISCUSSION

A community has been defined as a "group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and separable by means of ecological survey from other groups" (Mills, 1969). One prerequisite for identification of a community is the similiarity in faunal samples (Dexter, 1969). In the present study, the epifauna collected at each site showed a high degree of faunal homogeneity, indicating the presence of distinct epifaunal communities.

The success of the component species in a community is controlled by both physical and biological interactions. The relative importance of these two factors determines the structure of any community (Sanders, 1960). Sanders (1965) observed that communities located in estuaries, hypersaline bays, and other areas of fluctuating environmental conditions are predominantly controlled by physical factors. In the present study, differences in the physical factors appeared to be responsible for observed differences in community structure between sites. The important environmental factors affecting the epifauna included the hydrographic conditions and the amount of substrate and shelter provided by *Thalassia* and its epiphytes. The communities' dependence on *Thalassia* is apparent in areas where *Thalassia* has been removed. In such areas, the animal communities utilizing *Thalassia* primarily for substrate and cover rapidly decline (Wood *et al.*, 1969; Thorhaug, 1976).

In the following sections, the similarities and differences in the structures of the *Thalassia* epifaunal communities are discussed. The important environmental factors that influence the abundance of Thalassia and its epiphytes and the composition and abundance of the major sessile and motile epifaunal assemblages are also examined. Finally, the concept of parallel seagrass communities is discussed in light of previous studies by Marsh (1973) and Parker (1975).

Thalassia and Associated Epiphytes

The characteristics of Thalassia growth, turnover, and seasonal fluctuations are important parameters regulating the epifaunal community. Thalassia blades make up 15-25% of the dry weight of each plant (Jones, 1968; Zieman, 1974). A single plant, containing 3-5 blades of varying age and length, balances the loss of old blades with a constant replacement by young ones (Wood *et al*., 1969; Tomlinson, 1972). Thalassia blades grow in length but do not increase in width as they grow. The long older blades detach easily and rapidly decay, loosing 65% of their original weight in seven weeks (Zieman, 1974). The decaying blades become coated with a layer of microorganisms (Meyers and Hopper, 1967; Fenchel, 1970) and provide food for a number of epifaunal detritivores.

Zieman (1968; 1974) attached plastic staples to Thalassia in Biscayne Bay and observed that 80-90% of all subsequent growth occurred at the base of each blade. Although growth rates vary seasonally and in different physical-chemical conditions, average values indicate blade growth of 2-5mm/day with maximum values exceeding 1cm/day (Phillips, 1960; Thomas *et al*., 1961; Jones, 1968; Wood *et al*., 1969; Zieman 1968; 1974).

The concept of Thalassia blade turnover is important in assessing the role of Thalassia as a substrate for colonial and non-colonial sessile epifauna. While each Thalassia plant has a turnover time of approximately 17 months (Jones, 1968), the turnover time for individual blades is much more rapid. Zieman (1974) observed a mean blade population change of 1.9%/day in Card Sound and Biscayne Bay. This value indicates a mean blade turnover time of 54 days and a production of 6.8 crops of blades/year. The maximum blade population change (3%/day) indicated a blade turnover time of 33 days.

Seasonal studies on Thalassia productivity (Jones, 1968; Zieman, 1974) indicate that Thalassia attains its maximum growth and biomass in May through July of each year. Samples in the present study were therefore collected during a period of expected maximum growth and community biomass.

The biomass of Thalassia as well as its growth and turnover rate are related to a variety of environmental parameters. Environmental factors important to benthic plants include light, temperature, salinity, and availability of nutrients (Conover, 1958). Previous data on physiological aspects of Thalassia are primarily observational, rather than experimental, and the interrelation of these environmental factors is still poorly understood. Jones (1968) concluded that light and water clarity appeared to be the most important factors for optimum Thalassia productivity. Thalassia requires temperatures of 20-30°C (Phillips, 1960; Moore, 1963; Hartog, 1970; Zieman, 1970) with optimum growth occurring near 30°C (Jones, 1968; Zieman, 1974; 1975). Thalassia appears to be tolerant of salinity extremes and has been found exposed for at least brief periods to salinities of 5-60ppt (Thorhaug, 1976). Favorable salinities occur between 24-35ppt (Phillips, 1960; Jones, 1968; Zieman, 1970) with optimum growth occurring near 30 ppt (Zieman, 1974). Little data are available on the source and quantities of required nutrients. Patriquin (1972) examined the availability of phosphorus and nitrogen to the *Thalassia* community and found a considerable reserve in the sediment. Although the site of nutrient uptake is still unclear, it appears likely that *Thalassia* pumps nutrients from the sediments in a manner similar to that described by McRoy and Barsdate (1970) for eelgrass (*Zostera marina*).

The differences observed in *Thalassia* biomass between sites were apparently due to differences in light penetration. The intensity of light impinging on *Thalassia* at equivalent depths (approximately 1.6m at all sites) is dependent on water clarity and the shading effect of epiphytic algae (Humm, 1964). San Carlos Bay had the lowest *Thalassia* biomass (135.9g dry wt/m^2) of the three sites and the highest observed turbidity (21 JTU). The coralline red alga, *Fosliella farinosa*, covered much of the photosynthetic surface of *Thalassia*. In contrast, waters were generally low in turbidity (less than 3.9 JTU) with resultant higher *Thalassia* biomass at both Chicken Key (170.0g dry wt/m^2) and Lake Surprise (221.5g dry wt/m^2). The lower value at Chicken Key may have been due to shading by the dense *Lyngbya* mat.

Temperature and salinity appeared to have little effect on the observed differences in *Thalassia* biomass between the three sites. Temperatures of 28-31°C at all sites were optimal for growth (Zieman, 1975), while the observed salinity values were all far above the optimum of 30ppt (Zieman, 1974). San Carlos Bay, closest to the optimum salinity ($\bar{X}$ = 35.8ppt), had the lowest *Thalassia* biomass, and Lake Surprise, furthest from the optimum salinity ($\bar{X}$ = 44.6ppt) had the highest biomass.

A number of previous studies have described the epiphytes associated with *Thalassia*. Reyes-Vasquez (1970) examined the diatom flora in Biscayne Bay and identified 42 species on the blades of *Thalassia*. Humm (1964) found 113 species of macroepiphytes on *Thalassia* in Florida; 92 of these were found in Biscayne Bay. Other studies on macroepiphytes associated with seagrasses include works by Ballantine and Humm (1975) and Croley and Dawes (1970).

Epiphyte colonization is related to the growth of the *Thalassia* blade. Sieburth and Thomas (1973) found that initial colonization of eelgrass (*Zostera marina*) by diatoms was apparently necessary for further colonization by other microorganisms and epiphytes. When growth of *Thalassia* is relatively slow, macroepiphytes have more time to colonize the leaves (Humm, 1964; Jones, 1968). Jones (1968) estimated initial colonization in 3-6 weeks. As a result, the older blades of a plant are more heavily epiphytized.

Samples were collected in this study during the seasonal minimum occurrence of epiphytes on *Thalassia*. Phillips (1960) and Humm (1964) observed the occurrence of few epiphytes in the summer followed by increases in the fall and winter. This seasonal increase in epiphytes is probably due to the reduced growth of *Thalassia* coupled with an increase in available nutrients released from decaying blades (Thorhaug, 1974).

The macroepiphytes collected in this study included both attached (six species) and unattached forms (three species). The relatively low number of attached epiphytes was expected in light of the rapid Thalassia growth. Of the four attached epiphytes at San Carlos Bay, the coralline red alga, Fosliella farinosa, was the most abundant. Humm (1964) noted that larger algae were able to live on Thalassia because of the pioneering effect of the coralline algae. The dead layers of calcified cells provided a favorable surface for the attachment of spores.

The unattached macroepiphytes formed a mat entangled within the tops of the Thalassia blades at Chicken Key. The dominant species, Lyngbya sp., has not been previously reported on Thalassia in Florida (Humm, 1964). The red alga, Laurencia poitei, was found both attached to older blades and unattached within the Lyngbya mat. Laurencia poitei was reported as one of the dominant macroepiphytes in Biscayne Bay (Humm, 1964; Thorhaug, 1974).

Sessile Fauna

The succession of fouling communities has been previously observed in studies by Scheer (1945), Crisp (1965), and Haderlie (1969). A film of bacteria and diatoms initially forms on a virgin substrate and makes it more suitable for the settlement of primary foulers. Primary fouling organisms include barnacles, hydroids, ectoprocts, and serpulid polychaetes. These foulers further alter the substrate and promote the settlement of secondary foulers including ascidians, poriferans, and mussels. Crisp (1965) noted that ectoprocts were also important secondary foulers in some areas. These sessile foulers promote the establishment of a motile fauna by providing shelter and to some extent food (McDougall, 1943).

The dominant sessile epifauna associated with *Thalassia* in the present study was very similar between sites. This similarity was presumably due to the rapid blade turnover which provided a short term fouling substrate at each site and favored those attached forms that were able to settle, grow to maturity, and reproduce in a limited amount of time. The sessile epifaunal communities were typical of early fouling succession and were similar to fouling communities observed on short-term submerged panels.

Serpulid polychaetes of the genus *Spirorbis* were the dominant members of the sessile communities at all sampling sites. *Spirorbis corrugatus* ranked seventh among the total fauna at San Carlos Bay, and *Spirorbis sp.* ranked fourth and seventh among the total fauna at Lake Surprise and Chicken Key, respectively. These small coiled tube-worms are capable of self-fertilization and are found to incubate their eggs in an opercular brood chamber (Bailey, 1970). Growth is dependent on water temperature and is very rapid in the summer months (deSilva, 1967). The released larvae swim briefly and settle gregariously (Bailey, 1970). Studies on larval settlement indicate a high larval specificity for certain substrates (deSilva, 1962; Gee and Knight-Jones, 1962). Bailey (1970) found six species of *Spirorbis* attached to *Thalassia* throughout the Caribbean. A number of species of *Spirorbis* have also been found on short-term submerged panels (Millard, 1952; Crisp, 1965; Haderlie, 1969).

The anthozoan, *Bunodeopsis globulifera*, was also a common member of the sessile fauna at each sampling site. Mean densities of 81 ind/m^2, 244 ind/m^2 and 31 ind/m^2 were found at Lake Surprise, San Carlos Bay, and Chicken Key, respectively. This small active anemone can readily free itself from a substrate and has been observed to move slowly through the water with tentacles fully expanded (Duerden, 1902). In this manner B. globulifera is presumably capable of moving from a dead Thalassia blade to a young growing blade.

Although bivalves made up a relatively small portion of the epifaunal molluscs, two species, Brachidontes exustus and Carditamera floridana, were commonly found at all sites. Young individuals, less than 8mm in size, were attached to Thalassia by byssal threads. Chione cancellata, found infrequently at all sites, is an important Thalassia infaunal species (O'Gower and Wacasey, 1967; Jackson, 1973). Marsh (1970) noted that Zostera played an important role in providing a setting substrate for young clams. Thalassia apparently plays a similar role in southern Florida.

The colonial sessile epifauna, found infrequently at all sites, was composed of primary and secondary foulers including hydroids and ectoprocts. The ectoproct, Schizoporella unicornis, was the only colonial form found at all sites. Bugula neritina, a large branching ectoproct, was the most abundant sessile colonial invertebrate collected. These two ectoprocts have been previously reported on submerged panels in numerous short term fouling studies (McDougall, 1943; Scheer, 1945; Weiss, 1948; Sutherland, 1974; Long, 1974). Both species reproduce rapidly under laboratory conditions (McDougall, 1943) and have been found throughout the year.

Motile Fauna

Similarities and differences were apparent in the composition and abundance of the motile fauna between sites. The major differences were presumably due to the observed differences in the hydrographic conditions and in the amount of substrate and shelter provided by *Thalassia* and its epiphytes.

Among the hydrographic conditions, turbidity appeared to be the most important. Waters of high turbidity carry both suspended inorganic sediments and particulate detritus. This organic detritus is usable as food for a large number of epifaunal suspension feeders (Fox, 1950; Barnard, 1958). As water currents are reduced within seagrass beds, detritus also settles on the *Thalassia* blades and provides food for epifaunal deposit feeders. The similarities in temperature and dissolved oxygen between sampling sites indicated that these factors had little influence on the observed faunal differences. Although the effect of salinity was not tested in the present study, a maximum salinity range of only 10ppt between stations was probably insufficient to account for the observed faunal differences.

Amphipoda

Amphipods were the dominant motile epifaunal taxon associated with *Thalassia*. Table 5 ranks the eight dominant amphipod species collected at each site and indicates the total number of individuals and species in three $0.25m^2$ samples.

Faunal affinity among amphipods was very high between the different sites ($\overline{K} = 72.0\%$). All eight species of amphipods collected at Lake

Table 5. Rank by abundance of the dominant species of amphipods collected at Lake Surprise, San Carlos Bay, and Chicken Key. Total numbers of individuals and species in three 0.25m^2 samples are indicated for each site.

	Lake Surprise		San Carlos Bay		Chicken Key
1.	*Elasmopus pocillimanus*	1.	*Ampithoe longimana*	1.	*Elasmopus pocillimanus*
2.	*Luconacia incerta*	2.	*Pontogeneia longleyi*	2.	*Melita appendiculata*
3.	*Pontogeneia longleyi*	3.	*Erichthonius brasiliensis*	3.	*Grandidierella bonnieroides*
4.	*Erichthonius brasiliensis*	4.	*Corophium tuberculatum*	4.	*Gitanopsis tortugae*
5.	*Carinobatea cuspidata*	5.	*Luconacia incerta*	5.	*Erichthonius brasiliensis*
6.	*Cymadusa compta*	6.	*Cerapus tubularis*	6.	*Lysianopsis alba*
7.	*Leucothoe spinicarpa*	7.	*Elasmopus pocillimanus*	7.	*Pontogeneia longleyi*
8.	*Lysianopsis alba*	8.	*Gitanopsis tortugae*	8.	*Cymadusa compta*
Total Individuals					
	125		5318		9841
Total Species					
	8		18		15

Surprise were also found at both Chicken Key and San Carlos Bay. Highest affinity was observed between Chicken Key and San Carlos Bay (K = 84.8%) where amphipods were represented by 15 and 18 species, respectively.

Two factors appeared to control the composition and abundance of the epifaunal amphipods on Thalassia. These factors were the degree of shelter provided and the abundance of available food.

Since amphipods serve as food for a number of species of fish living within the Thalassia bed (Carr and Adams, 1973; Brook, 1975), increased shelter would be an important determinant of amphipod abundance. The distribution of some amphipods has been found to correlate with the amount of available shelter (Jones, 1948).

Some species of amphipods create their own shelter in the form of tubes. Other non-tubicolous species may clamber about or cling to algae, rocks, grass, etc. The majority of the epifaunal amphipods collected on Thalassia were tubicolous. Tubicolous amphipods use glandular secretions to cement bits of algae, detritus, mud, etc., in order to construct attached tubes or nests (Bousfield, 1973). These amphipods move in and out of their tubes in search of food and mates (Barnard, 1958). Cerapus tubularis, found at San Carlos Bay and Chicken Key, constructs a portable tube and has been observed to swim with its tube by beating its antennae (Fox and Bynum, 1975).

Amphipod density on Thalassia increased with the amount of algal epiphytes. These epiphytes provided substrate and shelter for both tubicolous and non-tubicolous species. At Chicken Key, a large variation in the biomass of the dominant epiphyte Lyngbya sp. was observed among the three samples. Differences in amphipod density among samples (1705 to 4323 amphipods/0.25m^2) correlated with this variation in Lyngbya biomass (5.4 to 13.1g dry wt/0.25m^2); producing a relatively constant 315 to 330 amphipods/g dry wt Lyngbya. A number of previous studies also have indicated a high correlation of epifauna with algal cover (Nagle, 1968; Thorhaug and Roessler, in press).

The observed differences in the dominant species between sites were also apparently influenced by the abundance of epiphytes. At Chicken Key, where epiphytes were abundant, the dominant species, Elasmopus pocillimanus and Melita appendiculata, were non-tubicolous and dependent on the epiphytes for shelter. In contrast, at San Carlos Bay, few epiphytes created additional shelter for the epifauna. Here, three of the top four species of amphipods were tubicolous (Ampithoe longimana, Erichthonius brasiliensis and Corophium tuberculatum). Although little ecological data are available on the second ranked species Pontogeneia longleyi, it is presumably non-tubicolous as are the northern congeners.

Amphipod abundance was also related to the amount of available food. With the exception of Ampithoe longimana, which feeds primarily on diatoms (Nagle, 1968), and the caprellid Luconacia incerta, which is an active predator (Caine, 1974), the majority of amphipods collected in this study were presumed detritivores. They included both suspension feeders and deposit feeders. Turbidity appeared to be a good indicator of the availability of food. Suspended detritus, readily available to suspension feeders, was effectively trapped by attached epiphytes. Amphipods have been observed cleaning this detritus from the surfaces of epiphytes resulting in mutual benefit from this association (Nagle, 1968). Barnard (1958), Cory (1967), and McNulty (1970) have also observed increased amphipod abundance with increased turbidity.

The density of amphipods varied considerably between sampling sites. Lake Surprise had few epiphytes (little cover and trapped detritus) and low turbidity (little suspended detritus) which together resulted in few epifaunal amphipods (167 amphipods/m^2). At San Carlos Bay, high turbidity coupled with additional cover from epiphytes and the branching ectoproct Bugula neritina resulted in relatively high amphipod densities (6959 amphipods/m^2). Increased shelter and an abundance of trapped detritus were provided by the entangled algal mat at Chicken Key. These two factors led to the highest observed density of the three sampling sites (13124 amphipods/m^2).

Isopoda

Isopods ranked second in abundance to amphipods and were dominated by a single species. Bagatus stylodactylus, found only at Lake Surprise and Chicken Key, accounted for 16% of the total fauna collected on Thalassia in this study. Although B. stylodactylus has not been previously reported from Florida or the Gulf of Mexico, records of its occurrence in Puerto Rico and the South Pacific indicate a pantropical distribution (Menzies and Glynn, 1968). In Puerto Rico, B. stylodactylus was found in shallow water with Thalassia and the alga Laurencia papillosa (Menzies and Glynn, 1968).

Although the feeding habits of B. stylodactylus are not known, the relatively high density of B. stylodactylus at Lake Surprise (825 ind/m^2) coupled with the low total amphipod density (167 ind/m^2) may indicate a lack of dependence on detritus as a source of food. A mean density for

B. stylodactylus of 7879 ind/m^2 was observed at Chicken Key. As with amphipods, the abundance of *B. stylodactylus* in samples from Chicken Key roughly correlated with the biomass of epiphytic algae. Increased epiphytes provided additional substrate for attachment of diatoms which may serve as a food source.

Tanaidacea

The tanaidaceans collected on *Thalassia* presented problems in taxonomy. Although males can be easily separated and identified, it is impossible to separate and identify females of some species within the genus *Leptochelia* (C. Messing, pers. comm.).

In this study, a small number of male *Leptochelia savignyi* and *Leptochelia forresti* and more numerous unidentified females were collected at each site. Due to the large number of unidentified females, all of these were placed within a single taxon, *Leptochelia sp.* *Leptochelia sp.* was the dominant taxon collected at Lake Surprise (848 ind/m^2), ranked third at San Carlos Bay (1078 ind/m^2), and fifth at Chicken Key (3305 ind/m^2). Parker (1975) found *Leptochelia savignyi* in mean densities of 900 ind/m^2 in eelgrass beds off Cape Cod, Massachusetts. *Leptochelia* lives within a tube attached to *Thalassia* and has been found to feed primarily on diatoms (Nagle, 1968).

Mollusca

Table 6 ranks the eight dominant species of molluscs collected at each site and indicates the total number of individuals and species in three 0.25m^2 samples. Epifaunal molluscs were dominated by gastropods which comprised 81% of the molluscs collected on *Thalassia* and five of the six

Table 6. Rank by abundance of the dominant species of molluscs collected at Lake Surprise, San Carlos Bay, and Chicken Key. Total number of individuals and species in three $0.25m^2$ samples are indicated for each site.

	Lake Surprise	San Carlos Bay	Chicken Key
1.	*Ischnochiton papillosus*	*Crepidula maculosa*	*Caecum pulchellum*
2.	*Elysia clena*	*Phyllaplysia engeli*	*Ischnochiton papillosus*
3.	*Turbo castaneus*	*Diastoma varium*	*Caecum nitidum*
4.	*Caecum nitidum*	*Anachis avara*	*Diastoma varium*
5.	*Phyllaplysia engeli*	*Anomia simplex*	*Phyllaplysia engeli*
6.	*Carditamera floridana*	*Ischnochiton papillosus*	*Crepidula maculosa*
7.	*Marginella carnea*	*Crepidula plana*	*Brachidontes exustus*
8.	*Tegula fasciata*	*Carditamera floridana*	*Carditamera floridana*
Total Individuals			
	755	754	4996
Total Species			
	24	27	37

dominant species at each site. Parker (1959) observed that gastropods were excellent indicators of seagrass beds as they were comparatively rare in most other depositional environments.

A low mean molluscan similarity value among site pairs (K = 44.4%) was due primarily to a high number of relatively rare species found at only one or two sites. Of the 58 species of molluscs collected on Thalassia, 29 species (50%) were found at only one site in densities of less than 10 ind/m^2. Although the molluscan similarity value was relatively low, the dominant species were very similar between sites.

The polyplacophoran Ischnochiton papillosus ranked first, second, and sixth among molluscs at Lake Surprise, Chicken Key, and San Carlos Bay, respectively. These small chitons (5-6mm) are presumably herbivorous (Barnes, 1968), feeding primarily on diatoms and multicellular algae scraped from the surfaces of Thalassia.

The small (7-8mm) sacoglossan opisthobranch Phyllaplysia engeli ranked second, fifth, and fifth among molluscs at San Carlos Bay, Chicken Key, and Lake Surprise, respectively. The success of this species may be related to its bright green color which forms an effective camouflage on Thalassia and presumably protects it from predators. Phyllaplysia taylori may play a similar ecological role along the Pacific coast of the U.S. where it commonly occurs on Zostera and grazes primarily on attached diatoms (Abbott, 1974).

Caecum pulchellum and Caecum nitidum were among the smallest molluscs (less than 2mm) collected on Thalassia at all sites. Although found in relatively small numbers at Lake Surprise and San Carlos Bay, these two species were among the dominant molluscs at Chicken Key where they accounted for over 70% of the total molluscs collected. At Chicken Key, C. pulchellum and C. nitidum ranked first and third among molluscs and occurred in densities of 4414 ind/m^2 and 560 ind/m^2, respectively. Moore (1962), in a study of the family Caecidae, observed that Caecum was an active bottom crawler. Moore (1963) also noted high densities of C. pulchellum (13220 ind/m^2) on Thalassia in Biscayne Bay.

Crepidula maculosa was the dominant mollusc collected at San Carlos Bay (300 ind/m^2), ranked sixth among molluscs at Chicken Key (297 ind/m^2), and was not collected at Lake Surprise. Crepidula, sessile as an adult, is a detrital suspension feeder (Jorgensen, 1955; Barnes, 1968). The lack of water current and suspended detritus may have limited its distribution in Lake Surprise. Parker (1975) observed that C. fornicata was confined to areas of relatively high current in the Cape Cod area.

Hendler and Franz (1971) studied the life history of C. convexa in Delaware Bay and observed high motility in young individuals. This motility must also characterize C. maculosa if one is to explain the success of the species in colonizing a rapidly changing substrate such as Thalassia.

Diastoma varium ranked third among molluscs at San Carlos Bay (107 ind/m^2), fourth at Chicken Key (315 ind/m^2), and was not collected at Lake Surprise. It has been previously reported as the dominant epifaunal species on Zostera (Thayer et al., 1974; Marsh, 1973; 1976). Laboratory studies have indicated that Diastoma assimilates large quantities of detritus (Adams and Angelovic, 1970).

Brook (1975) observed that the molluscs in a Thalassia bed in Card Sound were not heavily preyed upon by fish. This would indicate that substrate and available food, rather than cover, would be the principle factors limiting this group. Total mean densities were nearly identical in Lake Surprise (1007 ind/m^2) and San Carlos Bay (1005 ind/m^2). The high density at Chicken Key (6661 ind/m^2) was due to the abundance of micromolluscs that were apparently able to utilize the entangled algal mat for the additional substrate and detritus which it provided. The abundance of *Caecum* at Chicken Key is probably also related to the nature of the bottom sediment there. Parker (1975) correlated the distribution of *Caecum pulchellum* with areas of sandy sediment types similar to those found at Chicken Key. Nagle (1968) noted that the abundance of deposit detritus feeders, such as *Diastoma*, closely followed the abundances of algal epiphytes.

Polychaeta

Table 7 ranks the seven dominant species of polychaetes collected at each site as well as the total number of individuals and species in three 0.25m^2 samples.

The epifaunal polychaetes in this study showed a high similarity between sites (K = 62.1%). In contrast, the composition of the polychaete epifauna showed few similarities with that of infaunal polychaetes associated with *Thalassia*. Only four of the 23 epifaunal species (K = 14%) found at San Carlos Bay were also collected by Santos and Simon (1974) in their study of *Thalassia* infaunal polychaetes in Tampa Bay (approximately 100 miles north of San Carlos Bay).

The sessile serpulids accounted for less than 30% of the total polychaetes collected on *Thalassia*. The remaining polychaetes, having varying degrees of motility, were dominated by syllids. This family,

Table 7. Rank by abundance of the dominant species of polychaetes collected at Lake Surprise, San Carlos Bay, and Chicken Key. Total number of individuals and species in three 0.25m^2 samples are indicated for each site.

	Lake Surprise	San Carlos Bay	Chicken Key
1.	*Spirorbis sp.*	*Spirorbis corrugatus*	*Brania clavata*
2.	*Syllis cornuta*	*Branchiomma nigromaculata*	*Spirorbis sp.*
3.	*Dorvillea rubra*	*Brania clavata*	*Fabricia sabella*
4.	*Platynereis dumerillii*	*Fabricia sabella*	*Syllis cornuta*
5.	*Capitellides jonesi*	*Spirorbis sp.*	*Exogone dispar*
6.	*Lysidice ninetta*	*Platynereis dumerillii*	*Branchiomma nigromaculata*
7.	*Exogone dispar*	*Thelepus setosus*	*Dorvillea rubra*
Total Individuals			
	979	938	3976
Total Species			
	22	23	16

represented by five species on *Thalassia*, accounted for 40.3% of the total polychaetes. The dominant species included *Brania clavata* and *Exogone dispar*, found at all sites, and *Syllis cornuta*, found only at Lake Surprise and Chicken Key. Marsh (1973) observed the common occurrence of *Brania clavata*, and to a lesser extent *Exogone dispar*, on *Zostera* in the York River, Virginia. Brook (1975) also noted large numbers of syllids on *Thalassia* in Card Sound. These small polychaetes are active carnivores (Pettibone, 1963) and their abundance on *Thalassia* is probably related to the availability of prey.

Two sabellid polychaetes, *Fabricia sabella* and *Branchiomma nigromaculata*, were found in soft tubes attached to *Thalassia* at all sites. *Fabricia sabella*, a highly motile suspension feeder, has been observed leaving its tube to colonize new substrates. Favorable substrates are dense algal mats which trap considerable silt and detritus between their filaments (Lewis, 1968). The dense *Lyngbya* mat at Chicken Key probably accounted for the highest observed density of *Fabricia* of the three sites (985 ind/m2). In contrast, Lake Surprise, with little algal cover and suspended detritus, had a much lower observed density of *Fabricia* (20 ind/m^2).

Branchiomma nigromaculata, also a suspension feeder, had its highest density at San Carlos Bay (268 ind/m^2). The industrial and domestic pollution entering the Bay from the Caloosahatchee River, along with *Thalassia*-derived detritus, provided an abundant source of food. McNulty (1970), in studies of northern Biscayne Bay, selected *B. nigromaculata* as a species characteristic of polluted areas.

Other dominant polychaetes included the dorvilleid *Dorvillea rubra* and the nereid Platynereis dumerillii. Dorvillea, a presumed carnivore (Day, 1967), was found only at Lake Surprise (179 ind/m^2) and Chicken Key (76 ind/m^2) where it ranked third and sixth among polychaetes, respectively. Platynereis feeds mainly on epiphytic algae and uses its comblike paragnaths much as a snail uses its radula (Day, 1967). It is a very active swimmer and lives in weakly chitinized tubes (Pettibone, 1963). Although found at all sites, Platynereis was especially abundant at Lake Surprise where it ranked fourth among polychaetes and reached a density of 135 ind/m^2. Marsh (1973) observed the common occurrence of P. dumerillii on Zostera in the York River, Virginia.

Polychaetes are the preferred food for many species of fish living within the Thalassia bed (Brook, 1975). As such, the amount of cover is an important parameter for the success of the taxon. Over 75% of the polychaetes collected on Thalassia in the present study were tube-dwellers. The tubes were either permanent, as in the case of Spirorbis, or temporary dwellings as in the case of Brania clavata and Platynereis dumerillii. The total density of polychaetes at Lake Surprise (1305 ind/m^2) and at San Carlos Bay (1251 ind/m^2) was very similar. The abundant epiphytes at Chicken Key provided additional shelter and substrate for attachment of tube-dwellers which resulted in much higher observed densities (5301 ind/m^2).

Other Common Epifaunal Species

Other species commonly found on Thalassia at all sites included the platyctene ctenophore, Vallicula multiformis, the polyclad turbellarian, Gnesioceros floridana, and the caridean decapod, Hippolyte zostericola.

Vallicula multiformis was found in densities of 233 ind/m^2 at Lake

Surprise, 5 ind/m^2 at San Carlos Bay, and 124 ind/m^2 at Chicken Key. *Vallicula* feeds on small copepods and larval decapods and is capable of assuming various sessile and motile forms. Rankin (1956) found *Vallicula* with the viviparous holothurian, *Synaptula hydriformis*. This small holothurian was also found in small numbers at both Lake Surprise and Chicken Key.

Gnesioceros floridana is an active turbellarian commonly found among seaweeds and algae (Hyman, 1940). Densities of 193 ind/m^2 at Chicken Key, 152 ind/m^2 at San Carlos Bay, and 12 ind/m^2 at Lake Surprise were observed. An unidentified gammarid amphipod was found within the pharynx of one individual indicating a predatory mode of feeding.

Hippolyte zostericola is a common inhabitant of turtle grass flats (Chace, 1972). This small caridean was found in densities of 76 ind/m^2 at San Carlos Bay, 16 ind/m^2 at Chicken Key, and 6 ind/m^2 at Lake Surprise. The northern congener, *H. pleuracantha*, has been reported as a common inhabitant of the eelgrass beds in North Carolina (Thayer *et al*., 1974) and Virginia (Marsh, 1973).

Diversity

Species diversity is highly influenced by environmental stability. In areas of wide fluctuating environmental conditions, communities tend to be physically rather than biologically controlled. Margalef (1968) pointed out that this instability of environmental conditions could hold a community at a particular stage of succession indefinitely. This community type is considered immature and is characterized by relatively low species diversity (Connell and Orias, 1964; Sanders, 1968; Johnson, 1970; Gage, 1972).

In the present study, the Thalassia communities were located in shallow areas having fluctuating hydrographic conditions. Temperature changes of 1.7°C, 2.2°C, and 4.3°C were observed during a 24 hour period at Chicken Key, Lake Surprise, and San Carlos Bay, respectively. Although salinity fluctuations of less than 1.6ppt were observed at each site during a 24 hour period, salinities can rapidly change during periods of heavy rainfall resulting in considerable community stress (Goodbody, 1961). Turbidity fluctuations were greatest at San Carlos Bay (18.2 JTU) in response to tidal changes within the estuary. However, turbidity can vary to some extent in all shallow areas due to the influence of wind on water turbulence (Zeigler, 1969).

In addition to the fluctuating hydrographic conditions, a rapidly changing substrate such as Thalassia adds to the unstable conditions affecting the epifauna. In the present study, only moderate diversity values were observed for the epifaunal communities. Little difference was observed in diversity (H') between Chicken Key (2.75 bits/ind), Lake Surprise (2.89 bits/ind), and San Carlos Bay (2.93 bits/ind). Marsh (1973) reported a mean diversity value (H') of 3.04 bits/ind for the Zostera epifaunal community in the York River, Virginia. The anatomical similarity of the eelgrass substrate coupled with fluctuating hydrographic conditions may have resulted in a species diversity similar to those reported for the Thalassia epifaunal communities in southern Florida.

The mean diversity values observed for the Thalassia community in this study were probably lower than would be obtained in a seasonal study. At other times of the year, as the blade growth rate decreases, the turnover time increases, and the epifaunal substrate remains stable for a longer period of time. This increase in substrate stability could hypothetically result in increased diversity.

Other epifaunal studies where diversity values are available include the prop root epifauna of the red mangrove in Lake Surprise (2.60 bits/ind) (Nickelsen, 1976) and the *Juncus* marsh in northern Florida (2.49 bits/ind) (Subrahmanyam *et al.*, 1976). Both communities were physically controlled and had relatively low diversity values.

Parallelism in Epifaunal Communities

The concept of parallel communities was first defined by Thorson (1957) for the macrofauna of marine level bottoms. Thorson indicated that throughout the world's oceans, areas of similar sediment types occurring at equivalent depths were often inhabited by communities with similar structures; the dominant fauna belonged to the same genera although often to different species.

Nagle (1968) noted that this concept also applied to the epibiota of macroepibenthic plants. Collections from Denmark, the Texas coast, Maryland, and Cape Cod, Massachusetts, revealed numerous "parallel" genera and species. Marsh (1973), in a report of the *Zostera* epifaunal community in the York River, Virginia, noted a high incidence of taxa congeneric and conspecific with those found in preliminary observations of the *Thalassia* epifauna in the Caloosahatchee River estuary in southwestern Florida. Parker (1975) also noted faunal similarities between the *Zostera* community in Cape Cod and the shelf reef assemblage, dominated by *Thalassia*, along the Texas coast. Detailed faunal comparisons were not made in the above studies.

Epifaunal studies on Zostera marina, the temperate zone correlate of Thalassia, provided the best data for comparisons with the Thalassia epifauna in this study. These seagrasses are similar in morphology and provide equivalent habitats for sessile and motile epifauna.

The dominant epifaunal species found on Thalassia in the present study were compared with previous faunal studies utilizing comparable screen sizes on Zostera marina (Table 8). The dominant Thalassia epifauna included the six dominant species of amphipods at each site (93% of total amphipods), the five dominant species of polychaetes (90.1% of total polychaetes), the four dominant species of molluscs (83% of total molluscs), and the single dominant isopod (98.4% of total isopods) and tanaidacean (99.6% of total tanaidaceans). These species accounted for 87% of the total individuals collected on Thalassia in this study. The occurrence of Zostera taxa congeneric or conspecific with those found on Thalassia were noted along with the relative densities reported for those "parallel" forms.

In Florida, major zoogeographical regions meet, resulting in a fauna composed of both tropical caribbean species and warm temperate species (Miller, 1969). As such, it is not surprising that 11 of the 33 dominant species on Thalassia were tropical in distribution and have not been reported north of Florida (Table 8). An additional three species were primarily warm temperate in distribution and do not occur north of North Carolina. The remaining 19 species have reported distributions along much of the eastern U.S. coast.

Table 8. Relative abundances of the dominant *Thalassia* epifaunal species and parallel members of the *Zostera marina* epifauna in the York River, Virginia (Marsh, 1973) and Cape Cod, Mass. (Parker, 1975).

Species	*Thalassia* Lake Surprise	*Thalassia* Chicken Key	*Thalassia* San Carlos Bay	*Zostera* York River Virginia	*Zostera* Cape Cod Mass.
Amphipoda					
Ampithoe longimana		+	+++	+++	+++
* *Carinobatea cuspidata*	+	+	+		
Cerapus tubularis		+	+++		
Corophium tuberculatum			+++	+	++
Cymadusa compta	+	++	+	++	++
Elasmopus pocillimanus	+	+++	++	(+++)	(+++)
Erichthonius brasiliensis	+	+++	+++	+	
* *Gitantopsis tortugae*		+++	++		
# *Grandidierella bonnieroides*		+++	++		
Lysianopsis alba	+	+++	+	+	+++
Melita appendiculata		+++	+	+	
* *Pontogeneia longleyi*	+	+++	+++		
Luconacia incerta	+	+	+++		
Isopoda					
* *Bagatus stylodactylus*	+++	+++			
Tanaidacea					
Leptochelia savignyi	+++	+++	+++	+	+++
Mollusca					
* *Ischnochiton papillosus*	+++	+++	+		
Anachis avara			+	+	(+)
* *Caecum nitidum*	+	+++	+		
Caecum pulchellum	+	+++	+		++
* *Crepidula maculosa*		++	+++	(+++)	(+)
Diastoma varium		+++	++	+++	+++
* *Elysia clena*	+	+	+	(++)	
* *Phyllaplysia engeli*	+	+++	++		
# *Turbo castaneus*	+	+			
Polychaeta					
# *Branchiomma nigromaculata*	+	+	++		
Brania clavata	+	+++	++	+++	+
Capitellides jonesi	++		+		
Dorvillea rubra	++	+			
Exogone dispar	+	++	+	+	
Fabricia sabella	+	+++	++		
Platynereis dumerillii	++	+	+	+	+
Spirorbis sp.	+++	+++	+++		
Syllis cornuta	+++	+++			

* tropical distribution, unreported north of Florida
\# warm temperate, unreported north of North Carolina

+++ abundant (over 300 ind/m^2)
++ common (100-299 ind/m^2)
\+ rare (1-99 ind/m^2)

Parenthesis surrounding relative abundances indicate congeneric forms.

Marsh (1973), also utilizing a 0.5mm screen size, studied the *Zostera* epifauna in the York River, Virginia. Of the ten dominant species collected on *Zostera*, four conspecific (*Diastoma varium*, *Ampithoe longimana*, *Brania clavata*, and *Cymadusa compta*) and two congeneric forms (*Crepidula convexa* and *Elasmopus laevis*) were considered dominant on *Thalassia* in the present study (Table 8). *Paracerceis caudata* and *Erichsonella attenuata*, also among the ten dominant species on *Zostera*, were found less commonly on *Thalassia*.

In addition to the dominant species, many other less abundant species found on *Zostera* were also collected from *Thalassia*. Of the 100 non-colonial species collected on *Zostera* (Marsh, 1973), 27 conspecific and 14 congeneric forms were common to *Thalassia* in this study. The faunal similarity between these seagrasses (K = 31.1%, based on the presence of both conspecific and congeneric forms) was considered high, especially when one considers that samples were collected from different zoogeographical zones separated by nearly 1000 miles.

Of the three *Thalassia* sites, the epifauna at San Carlos Bay had the highest affinity with *Zostera* in the York River (K = 36.1%). A total of 25 conspecific and 10 congeneric forms were common to both sites. This high similarity was presumably due to the equivalent estuarine conditions which prevailed at both sites.

In a benthic study of Hadley Harbor on Cape Cod, Massachusetts, Parker (1975) washed grab samples containing both epifauna and infauna through a 0.25mm screen. Of the four distinct habitats described, two, containing abundant *Zostera*, differed primarily in current velocity. A shallow-water *Zostera* bed, having a low current velocity, was characterized by a fauna dependent on the grass itself, as many of the species utilized the grass and its decomposition products for food. A second community, found in deep channel *Zostera* beds, was characterized by a fauna considered to be algae eaters or suspension feeders, a feeding behavior adapted to swiftly flowing waters. Since many of the channel species were dependent on the grass for protection, Parker found it difficult to distinguish between the channel community and the pure eelgrass community found on the banks of the channels.

Although sampling techniques and sorting sizes were not identical with those used in the present study, similarities with the *Thalassia* epifauna were apparent. Of the 17 infaunal and epifaunal species listed by Parker (1975) as being characteristic of the low current shallow-water *Zostera* bed, four conspecific and five congeneric forms were common to *Thalassia*. Of these, *Leptochelia savignyi*, *Ampithoe longimana*, *Diastoma* (*alternatum*), and *Anachis* (*translirata*) were abundant on *Thalassia* in this study. Parentheses indicate congeneric but not conspecific taxa. Parker (1975) listed 28 additional epifaunal and infaunal species that were considered characteristic of the channel habitat. Those species also abundant on *Thalassia* included *Caecum pulchellum*, *Cymadusa compta*, *Lysianopsis alba*, and *Crepidula* (*fornicata*).

While *Thalassia* and *Zostera* epifauna display a striking parallelism, it appears that few of these species are truely substrate specific. Any substrate providing shelter from predators and located in an area of abundant food would probably house a similar fauna.

To test this hypothesis, the *Thalassia* epifauna was compared with the prop root epifauna of the red mangrove in Lake Surprise (Nickelsen, 1976). In addition to differences in substrate composition and morphology, the prop roots provided a more stable, long term substrate. Of the 92 non-colonial species reported on the prop roots, 41 species were common to the *Thalassia* epifauna in this study. The *Thalassia* community at Lake Surprise had the highest affinity (K = 36.6%) with this prop root community, having 32 species in common. San Carlos Bay (K = 31.2%) and Chicken Key (K = 29.6%) each had 29 species in common with the prop root epifauna. Thus it appears that any more or less vertically oriented substrate located within a given geographic area and having equivalent physio-chemical conditions will support a very similar fauna.

SUMMARY

1. The invertebrate macrofauna and algal epiphytes occurring on Thalassia in three hydrographically distinct areas in southern Florida were sampled during 14 June-21 June, 1974. Three $0.25m^2$ samples were collected at equivalent depths at Lake Surprise (a hypersaline lagoon on Key Largo), San Carlos Bay (a part of the Caloosahatchee River estuary on the Gulf Coast of Florida) and off Chicken Key (Biscayne Bay).

2. The sampling sites differed primarily in salinity, turbidity, tidal range, and the abundance of Thalassia and its associated epiphytes. Differences in epifaunal communities between sites were discussed in light of these environmental conditions.

3. A total of 9 species of algal epiphytes, 14 species of colonial invertebrates, and 164 species of non-colonial invertebrates including 40,794 individuals was collected on Thalassia at the three sites. The dominant non-colonial invertebrate taxa were Amphipoda (37.5% of fauna; 19 species), Isopoda (16.3% of fauna; 3 species), Mollusca (15.9% of fauna; 58 species), Polychaeta (14.4% of fauna; 33 species), and Tanaidacea (9.7% of fauna; 3 species). These groups included 93.8% of the fauna and 70.4% of the non-colonial invertebrate species.

4. The index of affinity between-site sample pairs indicated a high faunal homogeneity at each site. Although numerous species were

common to each site, the relative abundance of the component species often differed.

5. The composition of the sessile fauna was discussed in light of the rapid growth rate and turnover time of individual *Thalassia* blades. Serpulid polychaetes of the genus *Spirorbis* dominated the sessile epifauna at each site.

6. The general ecology as well as similarities and differences in the dominant motile epifaunal assemblages was discussed in light of the environmental conditions prevailing at each site. Epifaunal density increased with increasing turbidity and algal cover.

7. Little difference was observed in diversity (H') between Chicken Key (2.75 bits/ind), Lake Surprise (2.89 bits/ind), and San Carlos Bay (2.93 bits/ind). These similar diversity values were presumably due to equivalent substrates with high degrees of environmental instability.

8. The *Thalassia* epifauna was compared with previous studies on the *Zostera* epifauna. While the epifauna of both seagrasses display a striking parallelism, it appears that few of the epifaunal species were truly substrate specific. A high affinity with the mangrove prop root epifauna was observed.

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APPENDIX I

Species and number of individuals collected in three 0.25m^2 replicate samples at Lake Surprise (LS), San Carlos Bay (SC), and Chicken Key (CK).

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Anthozoa									
Bunodeopsis globulifera	14	22	25	53	51	79	3	12	8
Ctenophora									
Vallicula multiformis	45	87	43		1	3	21	48	24
Turbellaria									
Amphiscolops sp.	30	16	22	2	1		7	8	1
Polychoerus caudatus	25	12	9						
Acoel Turbellarian #1			1				5	7	4
Acanthozoon maculosum						4			
Euplana gracilis				1	2	2			
Gnesioceros floridana	2	3	3	28	35	51	41	62	42
Notoplana sp.	1		1			1	7	6	7
Prosthiostomidae #1				2	8	5			
Prosthiostomidae #2								1	
Pseudoceros crozieri									2
Thysanozoon sp.			1				2	5	5
Rhynchocoela									
Tubulanus pellucidus	9	3	3	3	3	6	12	11	23
Micrura leidyi									2
Oerstedia dorsalis		1							
Prostomatella murula				4	1	3		1	3
Zygonemertes virescens	3			10	7	10			
Nematoda									
Eurystomina sp.								1	
Filoncholaimus sp.				1					
Linhomoeus sp.							82	22	103
Oncholaimid #1							2		1
Phanoderma sp.							8	20	17

APPENDIX I
Continued

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Nematoda									
Pontonema sp.	6		7	9	6	9	13	9	37
Symplocostoma sp.				7	2	5		1	
Polyplacophora									
Ischnochiton papillosus	158	143	163	13	12	8	103	216	128
Polyplacophoran #1					1				
Prosobranchia									
Acmaea pustulata		4	2						
Alvania auberiana								1	
Anachis avara				8	25	29			
Anachis sp.							1	1	1
Caecum nitidum	4	13	23		1	2	102	177	141
Caecum pulchellum		1	2	1	1		582	1607	918
Cantharus cancellarius								1	
Cerithiopsis emersoni	3							1	1
Cerithium eburneum								1	
Crepidula fornicata	2				2				
Crepidula maculosa				51	82	92	56	112	55
Crepidula plana				12	10	8			
Diastoma varium				24	29	27	55	142	39
Diodora dysoni		1							
Epitonium echinaticostum	1								
Fasciolaria sp.					1				
Granulina ovuliformis	2	1	6			2			
Hyalina avenacea								1	
Marginella apicina								2	
Marginella aureocincta				1	1	1		1	
Marginella carnea	4	3	5		1		1	4	1
Marginella sp.		2	2						
Mitrella lunata				1	1		3	6	
Modulus modulus	4	4	3						

APPENDIX I
Continued

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Prosobranchia									
Phenacolepas hamillei							14	15	15
Rissoina catesbyana								3	
Rissoina sp.								4	3
Tegula fasciata	2	6	3						
Tricolia bella		1					1	8	11
Triphora nigrocincta					1	1	2	4	4
Turbo castaneus	4	23	14						2
Turritella exoleta								1	
Urosalpinx perrugata								2	1
Opisthobranchia									
Aegires sublaevis							1	4	1
Aglaja sp.									1
Elysia clena	23	16	14	1	1	2	16	8	2
Favorinus auritulus		2							
Haminoea elegans							3	14	7
Lapinura divae							1		3
Odostomia seminuda					1	1			
Ukenia impexa					1	1			
Phyllaplysia engeli	15	13	12	87	76	51	61	86	82
Polycera aurisula				2		1			
Runcina sp.	1	1	2						
Sayella sp.								4	3
Turbonilla dalli								7	3
Turbonilla sp.								1	
Pelecypoda									
Anadara transversa				2	1	1			
Anomia simplex	1	1		8	14	17			
Bivalve #1				2		6			
Brachidontes exustus	1	1	5	1	2	2	14	34	31
Carditamera floridana	2	9	19	5	5	12	12	32	8

APPENDIX I
Continued

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Pelecypoda									
Chione cancellata			3		1				1
Diplodonta punctata							1	2	
Pinctada imbricata	1	2	2				1	1	1
Polymesoda maritima				1					
Polychaeta									
Autolytus sp.	1	3	1	5	4	2			
Branchiomma nigromaculata	2	1	2	34	30	137	9	11	41
Brania clavata	5	1		38	36	23	521	357	458
Capitellidae #1				6	1				
Capitellides jonesi	16	13	51		1				
Ceratonereis mirabilis							1		
Cirriformia filigera	1		2	1			1	1	5
Dodecaceria corallii	2			1	1			3	
Dorvillea rubra	60	26	48				19	7	31
Exogone dispar	9	10	15	7	6	3	28	15	41
Fabricia sabella	4	3	8	23	40	13	166	207	366
Hydroides dianthus		2							
Hydroides protulicola									1
Lysidice ninetta	3	10	26						
Mediomastus californiensis				4	2				
Naineris laevigata		1		1	1	4			
Nereiphylla fragilis	2								
Nereis falsa						1			
Odontosyllis enopla	8	6	4	4		4			
Onuphis magna					1	3			
Pista palmata				1	3	1			
Platynereis dumerillii	57	15	27	21	14	8	7	4	15
Podarke obscura		3	1				1	9	13
Polydora hamata			1	6	13	9			
Polydora websteri				13	11	9			

APPENDIX I
Continued

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Polychaeta									
Prionospio cirrobranchiata					1				
Sabella microphthalma					5	4			
Spio pettiboneae			1						
Spirorbis corrugatus	3	1	3	128	60	88	2	5	3
Spirorbis sp.	123	80	78	27	26	18	227	505	372
Syllis cornuta	83	45	110				77	116	302
Syllis gracilis							2	13	13
Thelepus setosus		1	1	10	14	11		1	
Hirudinea									
Pontobdella sp.									1
Sipunculida									
Golfingia elongata	1		3						
Arachnida									
Hydracarina #1							3	12	7
Pycnogonida									
Achelia sawayai	3	5							
Callipallene brevirostrum	4	1		1		2		1	
Phoxichilidiiae #1	2	1	1						
Insecta									
Dipteran larvae				1		5			
Copepoda									
Ridgewayia sp.	4	1	1				16	10	15
Calanoida #1				2	4	5			
Pseudocyclops sp.								1	1
Harpacticoida #1							57	87	123
Nebaliacea									
Paranebalia longipes			1						
Cumacea									
Cyclaspis varians							21	10	20
Tanaidacea									
Apseudes propinquus		4	10						

APPENDIX I
Continued

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Tanaidacea									
Leptochelia sp.	226	189	221	270	212	327	843	446	1190
(*L. savignyi*)									
(*L. forresti*)									
Isopoda									
Bagatus stylodactylus	198	138	283				984	1664	3261
Erichsonella attenuata	8	1	2	3	4	3			
Paracerceis caudata	2	1		17	20	12	13	16	4
Amphipoda									
Ampelisca abdita				1	12	1			
Ampithoe longimana				459	630	433		1	
Carinobatea cuspidata	2		1	2	1	2	4	18	21
Cerapus tubularis				96	49	99	10	25	39
Corophium tuberculatum				101	157	204			
Cymadusa compta	2				3	1	37	43	90
Elasmopus pocillimanus	61	3	5	53	77	80	908	1842	2029
Erichthonius brasiliensis	2		2	132	165	330	90	127	179
Gammaropsis sp.									1
Gitanopsis tortugae				40	28	74	82	153	177
Grandidierella bonnieroides				17	27	36	127	276	317
Leucothoe spinicarpa	1		1	1		1		4	7
Lysianopsis alba			1			2	31	106	206
Melita appendiculata				7	6	12	321	1146	1168
Photis dentata				3		1			
Pontogeneia longleyi	8	2	1	534	388	594	88	69	80
Stenothoe sp.				1		1	2		
Luconacia incerta	13	8	12	163	60	233	5	3	9
Paracaprella pusilla						1			
Decapoda									
Lysmata sp.								2	1
Lucifer faxoni				9		19			

APPENDIX I
Continued

SPECIES	LS#1	LS#2	LS#3	SC#1	SC#2	SC#3	CK#1	CK#2	CK#3
Decapoda									
Thor floridanus	34	4	19				10	14	16
Hippolyte zostericola	2	1	2	11	5	41	4	3	4
Penaeus duorarum					1	1		1	
Pagurus annulipes				7	4	5	1	1	
Chaetognatha									
Sagitta hispida	18	21	4	24	22	74	71	30	90
Asteroidea									
Echinaster sentus		1		1	1				
Ophiuroidea									
Amphiodia pulchella			1				2	4	3
Holothuroidea									
Synaptula hydriformis	2	3					3	1	4
TOTALS									
INDIVIDUALS/0.25m^2	1335	996	1345	2626	2533	3379	6027	10087	12466
SPECIES/0.25m^2	62	61	63	72	76	77	70	92	82

APPENDIX II

Literature used in the identification of *Thalassia* epifauna and macroalgal epiphytes

Macroalgal epiphytes

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