The
Midnight Pass
SOCIETY, INC. "MIDNIGHT PASS – PASS IT ON!"

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MIDNIGHT PASS POSITION PAPER

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NON-VERTEBRATE BENTHIC ANIMALS
WHO WAS WHO AT MIDNIGHT PASS

SYNOPSIS

Benthic animals: the critters that live **in** (infauna) or **on** (epifauna) the bay bottom. Most people don't realize how important they are in sustaining other bay inhabitants or, for that matter, the major contribution they make at the other end of the human food chain.

The benthic animal community **had been** a key component in the historic ecosystem of Little Sarasota Bay. The 1983 closing of Midnight Pass so altered environmental conditions in the Bay that the established residents were forced to either move away or die. The **Clam** paper chronicles just one such sorry example.

To assess the condition of the benthos, samples were taken in 1984 and again in 1988. But the Pass had already been closed for several months by the 1984 sampling dates. The animals obtained could well represent "relics"... hangers-on who survived months of closed Pass conditions. By the first sampling date the Bay's benthic population may well have suffered some severe degree of degradation.

Even so, a comparison of the 1984 and 1988 sampling data is revealing. At one station, of the 17 most abundant species found in 1984, only 3 remained in 1988! The crustaceans, the bivalves, the lancelet... **all gone!** The three remaining were polychaete worms... known for their tolerance of poor water quality and soft sediments.

Of 29 macroinvertebrates most common to the area prior to Pass closure, 17 are associated with high quality, inlet-influenced waters. **None** of them inhabit the Pass area today... they don't live here any more.

Long established filter-feeding food webs have all but disappeared. The alien, opportunistic species that moved in represent deposit and organic surficial sediment-feeding food webs. There has been a consequent decline in the available epifaunal biomass for fish, shrimp and crabs that historically availed themselves of this food resource.

The substantial decline in the Little Sarasota Bay benthos has occurred during drought conditions. When area rainfall returns to normal, a further decline in Bay salinity levels can be expected and additional damage done to the salinity-dependent communities of benthic critters.

The only way to restore environmental conditions to what they were before Man closed the inlet... is to restore the inlet. Re-established regimes will enable the benthic animals that called Little Sarasota Bay home... to come home.

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INTRODUCTION

Many technical reports have been published on benthic animals, their communities, their diversity, their utility as indicators of water quality and environmental disturbances. Other studies of animals that live in the bottom (infauna) and on the bottom (epifauna) reveal how dependent predatory animals (fishes, birds, mammals, people) are on many of these small and often semi-microscopic organisms. But to the beachcomber and the bay wader who ventures forth into the intertidal, subtidal and grass beds in search of something interesting, only presence or absence of the larger macroinvertebrates are recognizable and noticed.

Before the closure of Midnight Pass, more than 29 conspicuous macro-invertebrates were common to abundant in the shallows of central Little Sarasota Bay and along the margins of the inlet's two major tidal channels. Amongst these animals (**Exhibit #1**) were resident filter feeders, carnivorous snails and crabs, microdeposit feeders, scavengers and seasonal shore breeders that migrated into the Bay to lay their eggs. Six years after the closure of Midnight Pass, only **four** species (fiddler crabs, one species of hermit crab, crown conch, and stout razor clam (Tagelus Plebius) were still common to abundant along with patches of intertidal oysters. The demise of the majority of these animals was caused by a combination of changes-- closure of the doorway, alteration of daily tidal currents, loss of larval recruitment, episodic changes in water quality, loss of prey food and seagrass habitats, and collapse of historic food webs. These changes are all directly related to the closing of Midnight Pass.

QUANTITATIVE ANALYSIS OF MACROINVERTEBRATE INFAUNA

GENERAL

Various quantitative analyses of the infauna exist for the coastal lagoons and embayments of southwest Florida. These benthic projects have been directed toward deciphering trends and patterns over time and along environmental gradients such as sediments, salinity, tidal currents, depth (intertidal vs. subtidal), vegetated vs. non-vegetated and point and non-point sources of anthropogenic pollutants. Most of these benthic projects have been mission-oriented and restricted in focus and time. Typically, replicate samples have been collected with a total sample area of $\pm 0.10\ m^2$ per sample station event. Generally, the number of individuals per sample station event are converted to number/m^2 for subsequent graphic and mathematical analyses. At each step in this process, certain information is lost.

It appears that ever since Reish (1959) showed that a 0.5 mm screen retained at least 90% of the invertebrates from benthic, soft bottom and grass bed samples, this screen size has been used as the cut off limit for "macroinvertebrates" in most modern benthic faunal studies. However, macroinvertebrates are larger than 1.0 mm, and meiobenthic invertebrates are 0.1 to 1.0 mm (Mann, 1982). Thus, given the size of the sampler, the number of samples and the mesh size of the screen,

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benthic animal studies in terms of numbers of species and numbers of individuals per species, have an inherent bias toward the smaller organisms and an absence of the larger macroinvertebrates. Other sampling and mathematical limitations are nicely reviewed by Estevez (1986).

LITTLE SARASOTA BAY/MIDNIGHT PASS PROJECT AREA

There is practically no recorded information on the benthic fauna of Little Sarasota Bay or the inlet area prior to closure of the Pass in December, 1983. Then, in 1984, the Mote Marine Laboratory (MML) appears to have collected benthic samples from 9 stations on 5/17, 6/12, 7/16, 8/16, 9/18 and 10/24. Of these samples, the species and numbers of individuals were analyzed only for stations B-36 and B-46 for 5/17 (dry season), and 10/24 (end of wet season). Subsequently, in 1988 the MML analyzed subtidal benthic infaunal samples for 8-16-84 benthic stations: B-36 (within inlet flood tide delta area); B-31 (north channel); B-41 (south channel); and B-50 (near-shore Gulf). In addition, on 8-17-88 the MML collected new samples in the vicinity of these 1984 sampling stations plus three more Gulf-shore stations and one historic Cuban shoalweed bed (Station #7). **Exhibit #2** shows the location of the benthic sampling stations.

The raw data (species list and numbers per species) for these benthic stations have been "massaged" via several mathematical formulas for species diversity, Pielou's equitability, log-normal distributions (Sauers and Serviss, 1985); richness, density, diversity, Pielou's equitability, Margalef's richness; Simpsen's Index, Gini's cumulative percent and Moristita's similarity index (FDER Completeness Response, September 8, 1988).

We have examined the various sets of data for overt changes or trends in species composition at Station B-36(1984)/#6(1988) in the "throat" of the historic inlet. We find the following:

1. The total number of species declined from 60 (May 84) to 54 (Oct. 84) to 35 (Aug. 88).
2. The total number of individuals declined from 16,826 (May 84) to 2,873 (Oct. 84) but rebounded to 9,722 (Aug. 88). this increase is primarily due to an increase in numbers of the bamboo worm, Axiothella, and the appearance of a euryhaline worm, Laeonereis (**Exhibit #3**).
3. Of 24 species greater than 1% abundance in 1984, only the bamboo worm, Laeonereis and the cosmopolitan, low water-quality tolerant Capitella capitata worm remained. Some 15 species **had disappeared completely** including the lancelet, Branchiostoma, 9 species of small interstitial crustaceans, 3 species of worms and 5 species of small bivalve clams.
4. In addition to the marked increase in the number of the worm Laeonereis, 3 other euryhaline worms appeared in 1988 along with the bivalve Tellina tampanensis.
5. **Exhibit #3**, the seventeen (17) most abundant benthic

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invertebrates, 1984 vs. 1988, shows that during 1984 there was a **marked decline for nearly every species** during the first year after the closure of the Pass. Depending on the species, it could have been a natural seasonal effect, the result of the July rainfall event that year, predation by fishes such as young flounder and sting rays, or changes in water quality and the absence of tidal circulation. Regardless, the August, 1988 sampling data show there **was little to no recovery**, especially for the lancelet and the crustaceans which are important food for juvenile and adult fishes.

6. Comparison of the August, 1984 and 1988 data for the north and south channel stations show similar trends in **decline of species and total number of individuals** as follows:

	Station #31/5 North channel		Station #41/8 South channel	
	1984	1988	1984	1988
Total # Species	79	39	98	44
Total # Individuals	9,980	6,464	8,973	3,141

Associated with these changes are very low Moristata similarity indices and less than 31% shared species (FDER Completeness summary, Table B-36).

CONCLUSIONS

Collectively, these data on the subtidal benthic invertebrates show that within the first year of closure of Midnight Pass there were measurable changes in the resident assemblages of these animals and that persistence via recruitment and reproduction for many of the species that depended on tidal inlet circulation failed. Many of the species that have disappeared are near the base of several food webs and food chains that culminate in sport and commercial fishes, large wading birds, and the smaller shore birds... especially the least tern.

The changes in the salinity and tidal current regimes at all three of these subtidal benthic faunal sampling stations have indirectly contributed to subtle changes in the environment of the superficial layers of the subtidal sediments which are **adverse for recruitment of many former species.**

At all three stations the predominant number of species are "opportunistic," deposit-feeding worms characteristic of clay-silt sediments. Some are "conveyer belt " species that feed below the surface as they burrow, ingest anaerobic sediments and defecate at the surface to add to the organic matter and bacteria for other invertebrates that feed at the fluid mud-water interface. The very fluid organic-rich layer that has been accumulating in this area (Area III-W) effectively excludes both persistence and recruitment of filter feeders. This accumulation of fluid matter has been accentuated by the decrease in tidal current turbulence at the bottom surface-water interface.

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Another trend is that the general region of Bay Area III-W, west of the ICW, had, by 1988, become more like what Area III-E, east of the ICW, was like back in 1984.

There is virtually no similarity between species of invertebrates collected at the Bay stations and species collected at the Gulf stations in August, 1988. This is markedly different from the overlap of species found at Bay Station B-36 and Gulf Station 50 in August, 1984, eight months after the closing of Midnight Pass.

MACROINVERTEBRATE ASSEMBLAGES IN CUBAN SHOALWEED GRASS BEDS

What holds for non-vegetated marine soft bottoms holds for bottoms vegetated with seagrasses. In general, numbers of species, diversity of feeding types and variety of ecological spaces for both infauna and epifauna are greater in vegetated areas. In addition, the kind and density of seagrass beds add yet another dimension to habitat diversity as well as providing attachment surfaces for cryptic flora and fauna.

The two prevalent seagrasses in this region are turtle grass and Cuban shoalweed. Generally speaking, Cuban shoalweed beds persist in "softer," more fine grain sediments and tolerate lower currents and salinity than turtle grass beds. Given that Cuban shoalweed is something of an "opportunistic" species in the lower intertidal and upper subtidal zones and is the only marine seagrass left in Little Sarasota Bay, it is interesting that the collection from Station #7 in a relic Cuban shoalweed bed was included in the August, 1988 MML benthic fauna study. This particular bed of Cuban shoalweed has existed for many years and is visible in pre-1984 aerial photos.

Discounting Spirobus spirillum found on the grass blades, there were 80 taxa (species) and 14,017 total individuals/m². Of the 23 most abundant species, 11 were annelid worms, 2 were gastropods, 4 were bivalves, 4 were crustaceans, 1 was a sea squirt and 1 was a nemertine worm. Because of the fine sediments and limited current flow, the assembly of invertebrates was dominated by deposit feeding worms. Most of the gastropods, bivalves and crustaceans were also deposit feeders.

The diversity of macroinvertebrates in this particular established Cuban shoalweed bed could indicate a similar diversity in other Cuban shoalweed beds in the general vicinity of the Bird Keys and along the margins of the historic north and south tidal channels. **Alas, it probably does not!** At least it didn't hold true for those Cuban shoalweed areas sampled in the Midnight Pass Society December 2, 1989, Seagrass Study. In this study only four 1/64 m² cores were taken at each substation, and only those animals retained in a 2.0 mm mesh sieve were identified and counted. Thus, the MPS data (**Exhibit #5**) are biased toward the larger macroinvertebrates.

Of the three to four species at each sample site, the **live animals** were limited to one or another of three species-- the stout razor clam (Tagelus plebius), the shaggy tube worm (Diopatra cuprea), and surprisingly, a "special" mesohaline, soft sediment bamboo tube worm (Maldane sarsi). That this bamboo worm is so abundant in this area now

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and not listed as being abundant much less present in other local and benthic studies indicates that a major factor for its presence is the character of the anthropogenic sediments beneath the quiet, shallow waters surrounding the Bird Keys. Those sites where these worms abound today were occupied by dense populations of filter feeding hard shell and angel wing clams when the tidal currents sheet flowed across more than 90 acres of these tidal and subtidal areas every day.

The presence and distribution of the stout razor clam in the area is peculiar. At six of the substations, dead shells were common to relatively abundant. None of the intact shells showed signs of the animals having been eaten by crabs or wading birds. One might conclude that the animals had succumbed to some episodic water quality catastrophe. Yet, live animals of the same size classes were present along with the samples of the dead shells. This indicates these razor clams have yet another predator that kills and digests the "meat" of the animal in situ. Such a predator (Hathaway and Woodburn, 1960) is now present in large numbers on these tidal flats... the crown conch, Melogena corona. So, as of 1989, more than 90 acres of a unique soft bottom intertidal-subtidal habitat was dominated by a very simple, semi-enclosed macroinvertebrate food web.

BENTHIC ANIMALS AS INDICATORS OF WATER QUALITY

Because most of the smaller, adult macroinvertebrates in soft bottoms such as those in Little Sarasota Bay and other embayments and coastal lagoons in Florida do not migrate from their origin, benthic animals and their assemblies or "communities" have been used as indicators of water quality and "pollution-induced" disturbances. In general, stressed and/or young environments will have **fewer species** than non-stressed and/or older environments. However, disturbance may be a key to maintaining high diversity providing the "supply-side" ecology is sufficiently active. At the same time, species present in a stressed, "low quality" environment may be more a question of life history strategies than the tolerance of one life stage to adverse environmental conditions. Then there's the skeptical view of Mills (Mann, 1982) that "much of shallow water benthic ecology seems a rather shabby and intellectually suspect branch of biological oceanography whose methods are, for the most part, those of the 19th century." To which might be added the observation that much of the mathematical massaging of lists of species and numbers of assorted size classes merely elucidates the obvious. **However**, given sufficient collections, a knowledge of life history strategies and some common sense, various workers have utilized certain benthic species as indicator species of short and long term water quality and limiting factors associated with specific habitats and food webs.

LOW QUALITY INDICATORS. In their study of mollusks and benthic environments in Hillsborough Bay, Taylor et. al. (1970) found five indicator species-- dwarf surf clam (Mulina lateralis), paper mussel (Amygdalum papyria), stout razor clam (Tegalus plebius), eastern nassa snail (Nassarius vibex), and the crown conch (Melangena corona).

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"Healthy" benthic stations were where these species were less than 50 percent of all mollusc species present; "marginal" stations were where these indicators were 50 percent or more of all live mollusks; in "unhealthy" areas there were no live mollusks. Tiffany (1975) points out that the scavenging crown conch "if found by itself in high concentrations, would be an indication of low environmental quality in general." According to these criteria, the shallow bottoms surrounding the Bird Keys have lost their original habitat value and would be considered only "marginally healthy" six years after Man's closure of Midnight Pass. Due to the extreme salinity depressions, the lack of current velocities and the absence of food in the water column, many observers would conclude, on those bases alone, that the once vibrant habitat had been reduced to an unhealthy environment.

HIGH QUALITY INDICATORS. The presence and relative abundances of other benthic animals have been positively correlated to "healthy" environmental conditions and used as indicators of "non-polluted" waters. Included are the dwarf tellin (Tellina versicolor), the spiny pen shell (Atrina seminuda), the sulfur sponge (Cliona celata), the variegated sea urchin (Lytechinus Variegatus), the stone crab (Menippe mercanaria) which feeds primarily on live clams and other bivalves, and the colonial tunicates (Botryllus schlosseri, Didemium alkidum, and Amaroucium pellucidium) that typically attach to turtle grass blades. In general, those benthic invertebrates that are plankton filter feeders require equitable salinity regimes and flowing water. The marked exception to this is the common oyster.

The lancelet (Branchiostoma floridae) is peculiar in that it is typical of coarse to medium fine sand sediments in the nearshore Gulf bottoms. But it also occurs in large numbers in embayments and tidal lagoons, particularly in bottoms of tidal channels and along the margins of these channels. The larger, reproductively active individuals occur in coarser sands than the smaller individuals. Thus, its presence indicates sandy bottoms with considerable turbulence and minimal accumulations of silt and organic matter.

Many of these "high water quality" indicator species were common to abundant in Little Sarasota Bay in the years prior to the closure of Midnight Pass. They don't live here anymore.

SUMMARY

Given the above sketches and the fragmentary field collection data along with data on the decline and demise of the seagrass beds in the central region of Little Sarasota Bay, this region of the Bay has declined from a healthy environment to a marginally healthy environment when viewed from the perspective of the benthos. The benthic animals that have died due to the altered environment or that had to migrate to survive would not be so kind!

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FIGURE #1

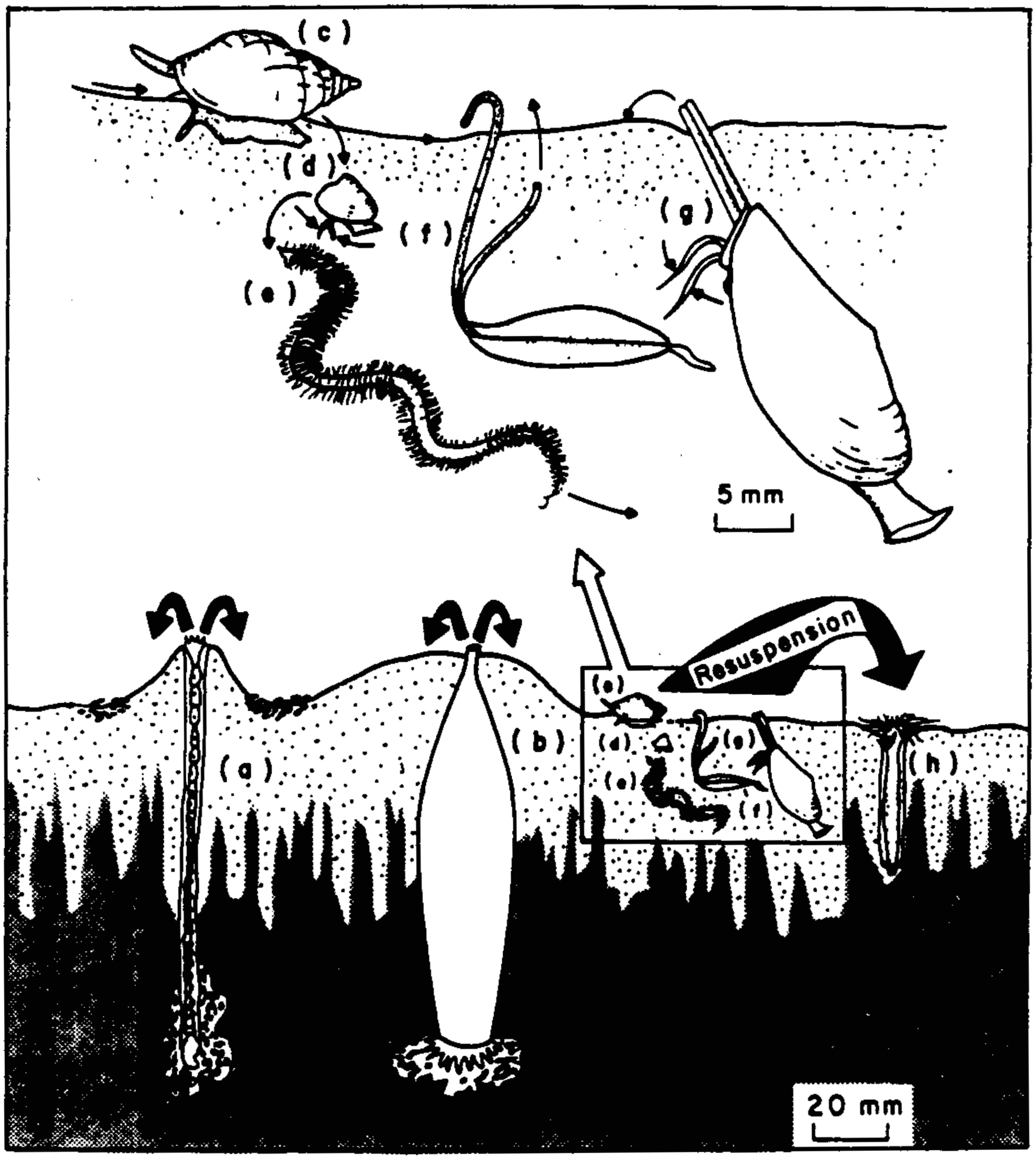

Fig. 7.3 Methods of mixing and recycling of sediment by deposit-feeders: (a) maldanid polychaete; (b) holothurian; (c) gastropod (*Nassarius*); (d) nuculid bivalve (*Nucula* sp.); (e) errant polychaete; (f) tellinid bivalve (*Macoma* sp.); (g) nuculid bivalve (*Yoldia* sp.); (h) anemone (*Cerianthus* sp.). Oxidized mud lightly stippled, reduced mud densely stippled. (From Rhoads 1974.)

REPRESENTATIVE GRAPHIC OF DEPOSIT-FEEDING BENTHIC ANIMALS TYPICALLY FOUND IN SOFT SEDIMENT BAY BOTTOMS

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FIGURE #2

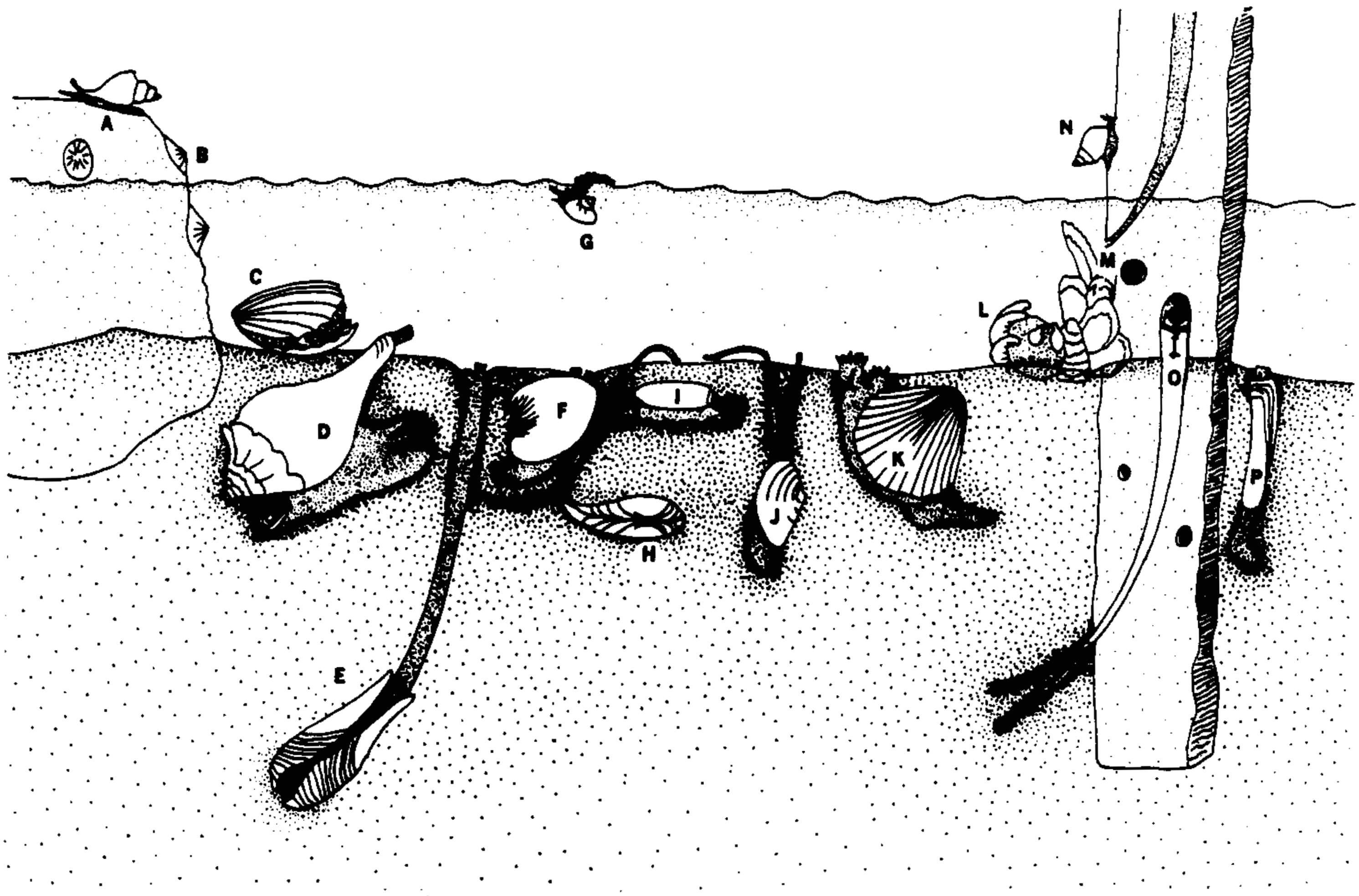

Fig. 9. A variety of mollusks are shown in this highly generalized diagram. The burrowing animal is shown under the sand, while those that live on the surface of the bottom or attached to a substrate are in their relative positions. *Left to right*: *A*, rock shell; *B*, false limpet; *C*, pecten; *D*, whelk; *E*, angel wing; *F*, quahog; *G*, *Janthina*; *H*, *Mactra*; *I*, olive; *J*, tellin; *K*, *Cardium*; *L*, *Crepidula* on old shell; *M*, oyster on shell and piling; *N*, *Littorina*; *O*, *Teredo* in cross-section of piling; *P*, razor clam.

(From Andrews, 1971)

A REPRESENTATIVE GRAPHIC OF THE MOLLUSK COMMUNITY SHOWING BOTH INFAUNA AND EPIFAUNA SPECIES MANY OF WHICH WERE ONCE ABUNDANT IN LITTLE SARASOTA BAY.

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LIST OF CONSPICUOUS MACROINVERTEBRATES THAT WERE COMMON IN CENTRAL LITTLE SARASOTA BAY AND THE VICINITY OF MIDNIGHT PASS BEFORE CLOSURE OF THE PASS IN 1983

Filter Feeders
- Quohog (Mercenaria)
- Atlantic mactra (Mactra fragilis)
- Angel wing clam (Crytopleura)
- Spiny penshell (Atrina)
- True razor clam (Ensis)
- Sulfur sponge (Cliona)
- Sea squirt (Styela)
- Seawhip soft coral (Leptogorgia)
- Colonial tunicates (Botryllus, Amarouceum)
- Parchment tube worm (Chaetopterus)

Predatory Snails and Crabs
- Lightning whelk (Busycon)
- True tulip (Fasciolaria tulipa)
- Banded tulip (F-hunteria)
- Horse conch (Pleuroploca)
- Moon snail (Polinices)
- Stone crab (Menippe)

Deposit Feeders
- Sunray Venus clam (Macrocallista)
- Constricted Macoma (Macoma constricta)
- Variegated sea urchin (Lytechinus)
- Sand dollar (Mellita)
- Sand starfish (Luidia)
- Fiddler crabs (Uca)
- Stout razor clams (Tagelus)

Scavengers
- Fighting conch (Strombus)
- Crown conch (Melongena)
- Hermit crabs (4 species)

Seasonal Migrants
- Sea hares (Aplysia, Bursatella)
- Horseshoe crab (Limulus)
- Bay scallop (Argopecten)

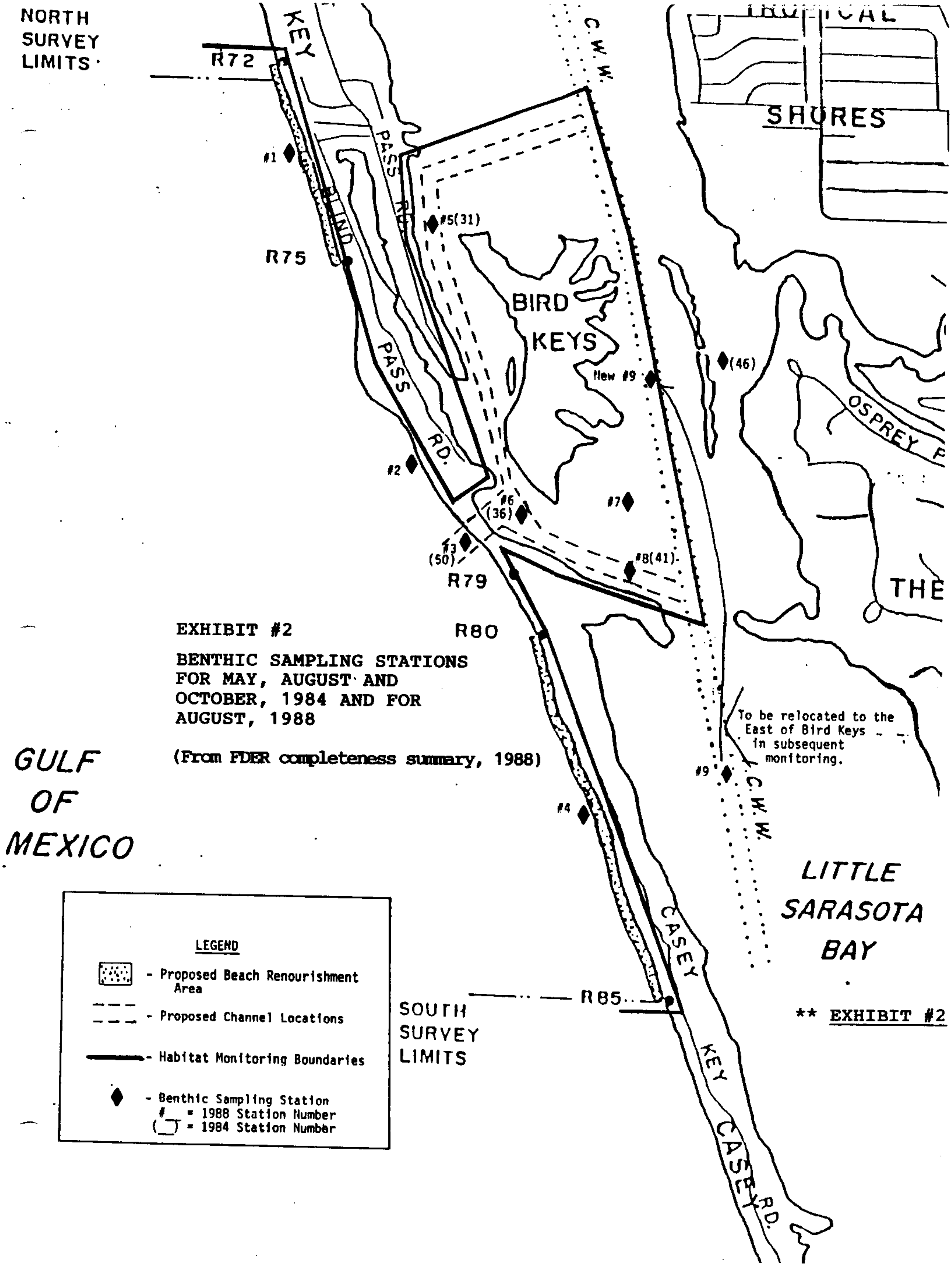

EXHIBIT #2

BENTHIC SAMPLING STATIONS FOR MAY, AUGUST AND OCTOBER, 1984 AND FOR AUGUST, 1988

(From FDER completeness summary, 1988)

** EXHIBIT #2

The Seventeen (17) Most Abundant (Number/meter^2) Species of Benthic Invertebrates at Station 36B in 1984 Compared to Station 6, 1988.

	1984 - Station 36B			1988 - Station 6
	May	August	October	August
Cephalochordata				
Branchiostoma	1026	132	0	0
Polychaete worms				
Travisia	1998	825	53	0
Mediostmatus filiformis	1485	0	96	0
Mediostmatus califormus	459	253	0	0
Axiothella	1293	66	22	3465
Capitella capitata	726	880	22	506
Laeonereis	91	187	224	2112
Bivalves				
Tellina versicolor	171	0	0	0
Mysella	171	22	11	0
Paralucinia	0	1144	0	0
Crustaceans				
Acanthohaustoris	6816	2333	129	0
Haplocetherida	374	0	0	0
Apanthura	160	198	53	0
Listriella	214	33	0	0
Hargeria	107	0	0	0
Rhepoxyius	160	0	0	0
Oxyurostylis	171	33	0	0

From: Sauers and Serviss (1985) and FDER Completeness Response, FDER File No. 581473069. Sept. 1988.

EXHIBIT #3

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The Five (5) Most Abundant Species of Invertebrates
Listed in rank order.

Delta Area of Inlet Throat Stations

B-36/Aug 84	#6./Aug. 88
Acanthohaustoris	Axiothella
Paralucinia	Laeonereis
Travisia	Tellina Tampaenois
Capitella	Microphthalmus
Cypridis	Arcidea

North Channel Stations

B-31/Aug. 84	#5/Aug. 88
Tharyx	Streblospio
Cirriformia	Mediomastus
Cavlleriella	Acteocina
Aricidea	Mysella
Prionospio	Prionospio

South Channel Stations

B-41/Aug. 84	#8/Aug. 88
Paralucinia	Streblospio
Cypridis	Acteocina
Haminoea	Laeonereis
Acteocina	Prionospio
Amplelisca	Mediomastus

Exhibit 5

Benthic Macroinvertebrates at Four Cuban Shoal Weed Seagrass Stations, Bird Keys, Little Sarasota Bay, December 2, 1989, Midnight Pass Society Seagrass Studies

Station		I			II			III			IV	
Substation	A	B	C	A	B	C	A	B	C	A	B	C
Water Depth	22"	23"	Exposed	14"	14"	14"	20"	13"	6"	14"	10"	4"
Cuban S.W. density (#/m^2)	80	176	2768	2480	1456	144	1264	544	2608	2256	3264	2576
Substrate	soft	soft	soft	sandy	muck	muck	soft	soft	sand	sand	sand	sand
Macrofauna												
Worms												
Maldane sarsi	384	288	672	16	624	112	176	128			32	48
Diopatra cuprea	64	32	64	128	496	208	96	80	192	64	16	48
Sabellid												
Glycera americona					16							
Flaccid worm tube	48	80	80		160		16					
Bivalves												
Tagelus plebius live		16	48			48						
Tagelus dead			144		16				368	64	160	240
Angel wing dead			16									
Tellina sp								16	144		16	
Semele proficia									16			
Snails												
Nassarius vibex				16				16		16		16
crown conch						32						
Sipunculido												
peanut worm								32				
Crustaceans												
pink shrimp				16						16		
Total No. live species	3	4	4	4	4	4	3	4	3	3	3	3
Total No. individuals	496	416	864	176	1396	400	288	272	352	96	64	112

EXHIBIT #5

Major Rainfall Events in the Vicinity of

Little Sarasota Bay

Year	Dates	No. Days	Total inches	Notes	Total Rainfall in Inches	
1972	June 12-19	8	6.95	Hurricane Agnes	1972	43.0
	July 23-Aug. 1	10	5.85			
1973	Aug. 31-Sept. 7	8	5.43		1973	43.1
1974	June 24-30	7	9.44		1974	51.7
	July 27-Aug. 14	19	13.00			
	Aug. 26-Sept. 6	12	7.60			
1975	*October 5-9	5	3.81	Total rainfall for yr. 37 inches H-T	1975	43.2
1976	Aug. 1-5	5	3.31			
1977						
1978						
*1979	*Aug. 7-Sept. 7	30	30.00	Total Annual rainfall, 62 inches H-T	1979	62.0
1980						
1981						
1982	June			No Name Tropical Storm		
1983	*February 1-28	28	9.45	Normal "Normal" Average for month = 3.14 inches	1983	71.4
	Aug. 1-9	9	5.71			
	Aug. 31-Sept. 5	6	6.11			
	Sept. 15-21	6	6.62			
	Oct. 11-17	6	6.20			
1984	March 13	1	4.05!		1984	47.9
	April 10	1	3.35!			
	July 10-16	7	6.54			

EXHIBIT #7
MAJOR RAINFALL EVENTS
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