BEDS, BOATS, AND BUOYS: A STUDY IN PROTECTING SEAGRASS BEDS FROM MOTORBOAT PROPELLER DAMAGE

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STATEMENT OF THE PROBLEM

During the last approximately forty years the seagrass bed acreage in Sarasota Bay has shrunk an estimated 25% to 30% (Lewis and Sauers,1987). Motorboat propeller cuts are one of several factors responsible for this decline. Motorboat propellers have carved thousands of sandy, curvilinear trenches in productive seagrass beds. Accrued over the years, each scar takes several years to regenerate.

The focus of the Seagrass Signage Demonstration Project is the damage to seagrasses caused by motorboats and other watercraft and the development of mechanisms to minimize such destruction.

GOALS AND DESIGN OF THE STUDY

GOALS

The purpose of the project is to design, and on a small scale, implement a program to protect selected seagrass beds in Sarasota Bay from motorboat propeller damage. Furthermore, the study requires the evaluation of the project to determine if the program effectively protects the seagrass beds.

Many communities have tried marking grass beds and/or adjacent channels to reduce propeller damage to seagrass meadows. Regulators, in some instances, are requiring markers as a permit condition. However, we are not aware of any study which evaluates the effectiveness of the markers. Before more markers are used it would be wise to determine if they are effective.

DESIGN

Three seagrass meadows in Sarasota Bay were marked with buoys, delineating the edges of and/or the channels adjacent to the grass beds.

Concurrent with the placement of the markers, materials designed to educate boaters were disseminated throughout the bay community. Brochures, signs at public boat ramps, and boat console decals were produced and disbursed. A fifteen minute slide show was presented to boater groups. Newspaper and newsletter articles and news spots on television informed the public about the seagrass signage study as well as the value of seagrasses and the boaters' role in grass bed damage.

Effectiveness of the program was evaluated from two different perspectives: one measured direct damage to the three grass beds by mapping the propeller-cut trails; the other focused on potential damage by examining boaters' behavior patterns.

Aerial photographs of the grass flats were taken to record the number and location of prop cut trails eleven months before, two weeks before, and five months after the buoys were placed. By comparing the number of prop cuts both before and after marker installation it was possible to measure whether markers affected the amount of boat propeller damage to the grass beds.

Boater observation studies of two seagrass meadows recorded boater behavior before and after buoy placement. It provided data concerning boat entry to the grass bed, speed and course change near the markers, grass flat exit procedures, as well as general information about boat size, boater activities, and boat type (motor, sail, personal watercraft, etc.).

Each evaluation method had its strengths and weaknesses. In using two distinct methodologies, the hope was to overcome the limitations inherent in each method of evaluation.

PROJECT SETTING

THE NATURAL ENVIRONMENT

The Bay

Sarasota Bay is a small, shallow, subtropical embayment in southwest Florida, lying approximately at latitude 27° 30' and 82° 43' longitude. The Sarasota Bay study area bridges Sarasota and Manatee Counties and includes Sarasota Bay as well as (from north to south) Anna Maria Sound, Palma Sola Bay, Roberts Bay, Little Sarasota Bay, and Blackburn Bay. (Figure 1).

Oriented along a northwest to southeast axis, the overall length of the study area measures about 56 miles. The width varies from 300 feet to 4.5 miles. The bay, quite shallow in most parts, averages five feet in depth.

The average tidal range is 2.1 feet. Exchange of bay and Gulf of Mexico water occurs through four inlets: Longboat Pass, New Pass, Big Pass, and Venice Inlet. At the north, Anna Maria Sound connects Sarasota Bay to Tampa Bay. Flushing rates for the bay are between two and 15 days.

Freshwater enters the bay through several small tributaries (from north to south): Palma Sola Creek, Bowlees Creek, Whitaker Bayou, Hudson Bayou, Phillippi Creek, Clower Creek, Catfish Creek, North Creek and South Creek. A significant amount of freshwater also enters via stormwater ditches and culverts. Freshwater from the Manatee River also influences the northern bay.

Overall water quality is rated "good to fair" by the Department of Environmental Regulation. However, in most canals and bay tributaries water quality declines to ratings of "fair to poor."

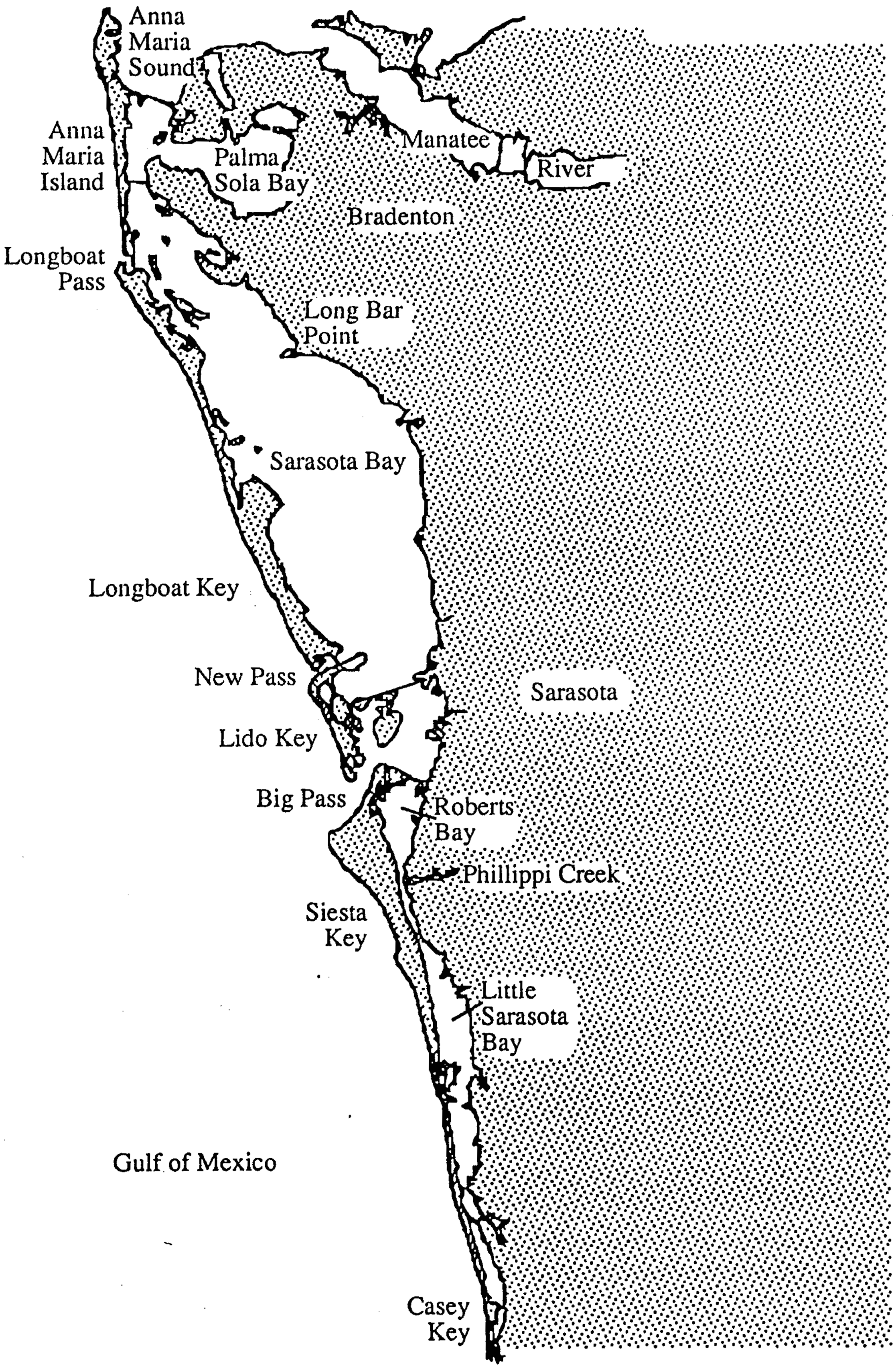
The Uplands

The eastern shore vegetation was once composed of pine flatwoods and an oak-cabbage palm coastal hammock. The area is now primarily residential ranging from towers to town houses and single family homes with a mixture of native plants and home-landscape horticultural varieties of grasses, trees, shrubs, etc. The western shore is composed of a series of barrier islands-- Anna Maria Island, Longboat Key, human-created Lido Key, Siesta Key, and Casey Key. Originally a mangrove forest cloaked the bay side, and salt barrens and coastal hammocks covered the uplands.

The shoreline, once fringed with mangroves and wetlands, is now dominated by hard structures such as seawalls and rip-rap. Only 22% of the bay's shoreline is in its natural state (Roat and Alderson,1990).

During the last thirty years the population in Florida has increased about 2.6 fold. It continues to grow in the Sarasota and Manatee County area at the estimated rate of 32 people per day. (Roat and Alderson,1990)

Figure 1. Sarasota Bay study area



SEAGRASSES

It has been reported that five species of seagrasses occur in the Sarasota Bay area. Turtle grass, *Thalassia testudinum,* and Cuban shoal grass, *Halodule wrightii* are most common. Manatee grass, *Syringodium filiforme*, and widgeon grass, *Ruppia maritima* are common in restricted habitats throughout Sarasota Bay. *Halophila engelmannii* has been observed only on rare occasions (Sauers, 1980).

It has been repeatedly documented that seagrass acreage in Sarasota Bay is declining. The percent change of seagrass varies depending on the area and time span of study. However, all agree that the trend is toward significant reduction of seagrass acreage. See figure 2 which summarizes the data collected for various areas of Sarasota Bay.

The reasons for the seagrass decline involve both water quality degradation as well as mechanical removal and burial. Diminished water clarity lowers light transmission, a critical factor in seagrass health. Surface runoff and hardened shorelines significantly increase turbidity levels.

Massive acreage of seagrasses was lost during large scale dredge and fill operations. The creation of Lido and Bird Keys as well as the dredging and spoiling for the Intracoastal Waterway were responsible for the loss of substantial seagrass acreage.

Cuts from motorboat propellers are also responsible for the mechanical removal of seagrass acreage. The acreage lost by a single motorboat propeller cut is seemingly inconsequential. A typical trench is about 18-24 inches wide and perhaps 100 feet long. Nevertheless, however minor one prop cut appears, the cumulative impacts must be considered. Often multiple prop cuts crisscross a grass bed edge, effectively moving the edge back several feet.

The issue of how prop cuts affect the integrity of a seagrass meadow has not yet been fully addressed. Several researchers question the ability of a grass bed with a propeller-torn rhizome system to weather a hurricane or other high energy storm, compared to a grass bed with an intact rhizome system. A prop-cut bed may be unable to withstand the turbulence of a major storm, while a grass flat without cuts might weather a storm with little damage. Prop cuts may make a grass bed vulnerable to other types of damage as well.

MOTORBOAT AND OTHER WATERCRAFT TRENDS

The number and diversity of activities on the water have skyrocketed during the previous fifty years, paralleling the growing population and new water recreation technology. Boat registration has steadily increased state-wide, as well as in Sarasota and Manatee Counties. During the 26 years between 1965 and 1991, the number of boats registered in Florida has more than quadrupled, from 169,633 to 716,210. (See figure 3.)

Not only are the absolute numbers of boats increasing, but there is a growing trend in the popularity of recreational boating. In 1964 there were 2.1 boat registrations per one hundred Florida residents; in 1985, 4.9 registrations per 100 residents. Currently, in Sarasota County, there are 5.6 boats for every 100 residents.

Additionally, water recreation has expanded in post-war years beyond traditional motor and sail craft to include water skiing, jetskiing, board sailing, and boats specifically designed for shallow waters. Since some of these craft don't require registration, it is difficult to

Figure 2. Summary of historical data collected on seagrass acreage in Sarasota Bay

HISTORICAL acres(hectares)	HISTORICAL year	CURRENT acres(hectares)	CURRENT year	PERCENT CHANGE	AREA STUDIED*	REFERENCE
7,610 (3,080)	1970	---	---	---	SB,LSB	McNulty, Lindall, Sykes (1972)
	1948	1,460 (591)	1974	-25	SSB, RB	Evans, Brungardt (1978)
1,925 (783)	1948	114 (46)	1979	-55	portion of SB	Sauers (1981)
262 (106)	1957	4,4493 (1,818)	1982	-24	NSB	NUS Corp. (1986)
5,902 (2,389)	1957	7,565 (3,062)	1986	-25	SB	Lewis, Sauers (1988)
	1948	4,039 (1,635)	1987	-35	SC	Duke, Kruczynski (1992)
10,000 (4,047						

* SB= Sarasota Bay
LSB= Little Sarasota Bay
SSB= southern portion of Sarasota Bay
RB= Robert's Bay
NSB= northern portion of Sarasota Bay
SC = bays in Sarasota County

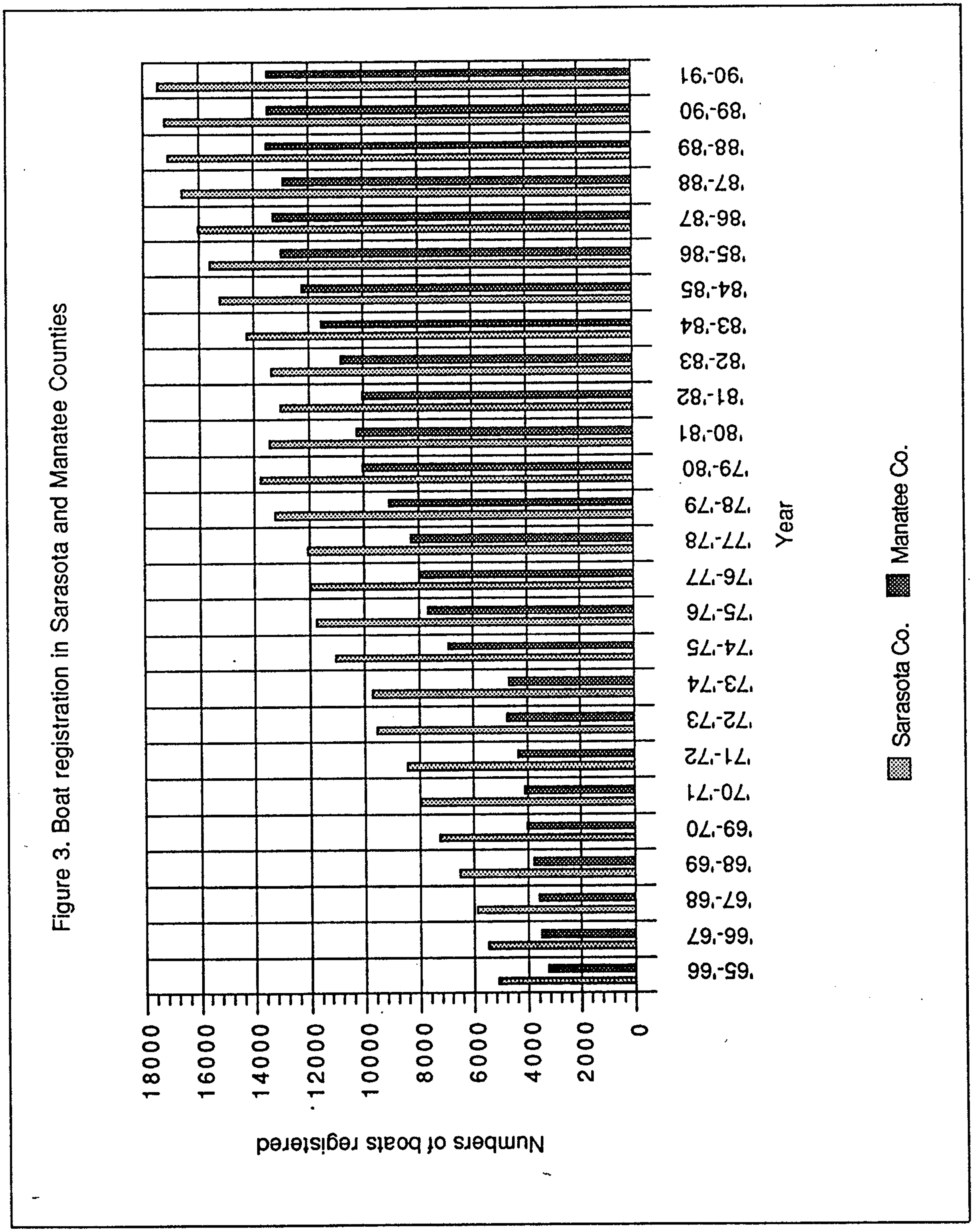


Figure 3. Boat registration in Sarasota and Manatee Counties

track their possible impact. Some of these watercraft, most notably jetskis and other personal watercraft, are believed to damage seagrasses by increasing turbidity and blowing away sediments. No research has been done to quantify the type and extent of damage by various thrillcraft.

Nine marinas rent, in total, about 116 boats in the Sarasota Bay NEP study area. Boat renters, as a group, may be unfamiliar with the bay, and therefore, more likely to churn through seagrass beds.

METHODS

MARKING BEDS

Bed selection process

The process of selecting seagrass beds began with discussions with eight people who are very familiar with Sarasota Bay. They included two county staff members, two bay charter boat captains, a biology professor, two senior biologists at a marine laboratory, and a Sea Grant agent. Each were questioned about which seagrass flats were prone to ongoing prop cuts. Thirty-three vulnerable beds were identified.

Initially five beds were to be selected for marking. However, budget constraints reduced the number to three.

The beds were selected upon the basis of six criteria:

1. **Permissibility.** The edge of the bed to be marked had to be greater than 100 feet from a federally maintained channel, according to Coast Guard regulations.

2. **Variability.** The grass beds had to represent a variety of locations (near marked and unmarked channels, or near a public boat ramp), and a variety of boater uses (a destination in itself or adjacent to a thoroughfare).

3. **Accessibility.** Boater observation studies took place at two grass meadows. It was important that observers could easily reach the two seagrass bed locations and that buoys could be installed.

4. **Readability.** The grasses had to be dense enough so that propeller cuts could be visible in aerial photographs. Beds where *Thalassia* predominated were desirable because this species creates a more stable community and rhizome regeneration is slow. Continuity of the bed from year to year would be maximized.

5. **Measurability.** There had to be sufficient boat traffic near the bed to be able to measure and compare the differences of numbers of prop cuts before and after the buoys would be installed.

6. **Visibility.** As this was a demonstration project it was important to chose beds that were visible to large numbers of the boating public throughout the bay study area.

Three selected beds

Three grass beds were selected to be marked: 1) near Sister Keys in Manatee County, 2) City Island in Sarasota County, and 3) near Big Pass in Sarasota County. (See figure 4.)

1. Sister Keys

Sister Keys are four spoil islands in northern Sarasota Bay surrounded by a large grass bed. (See figure 5.) The Intracoastal Waterway bisects the bed parallel to the westernmost edges of Sister Keys. The northern and eastern edge of the grass flat is a broadly sweeping curve along a northwest-southeast axis for approximately 2.6 miles. Along the northernmost 0.4 mile there is a 90 foot wide, shallow (5 feet) channel. Bounding the north side of the channel is a small (~18 acre) triangular grass meadow. Continuing south, the channel widens into slightly deeper (6-8 feet) open water. The edge of the grass bed

Figure 4. Characteristics of three seagrass beds selected for marking.

Location	Area (acres)	Number of buoys	Date buoys installed	Amount of boat traffic	Water activities or near grass bed
Sister Keys	840	20	12-10-91	low	recreational and commercial fishing
City Island	189	10	06-09-90	medium	recreational and commercial fishing, water skiing, boat launching from nearby public ramp
Big Pass	68	7	12-11-91	high	many boats passing on three adjacent channels, occasional recreational and commercial fishing

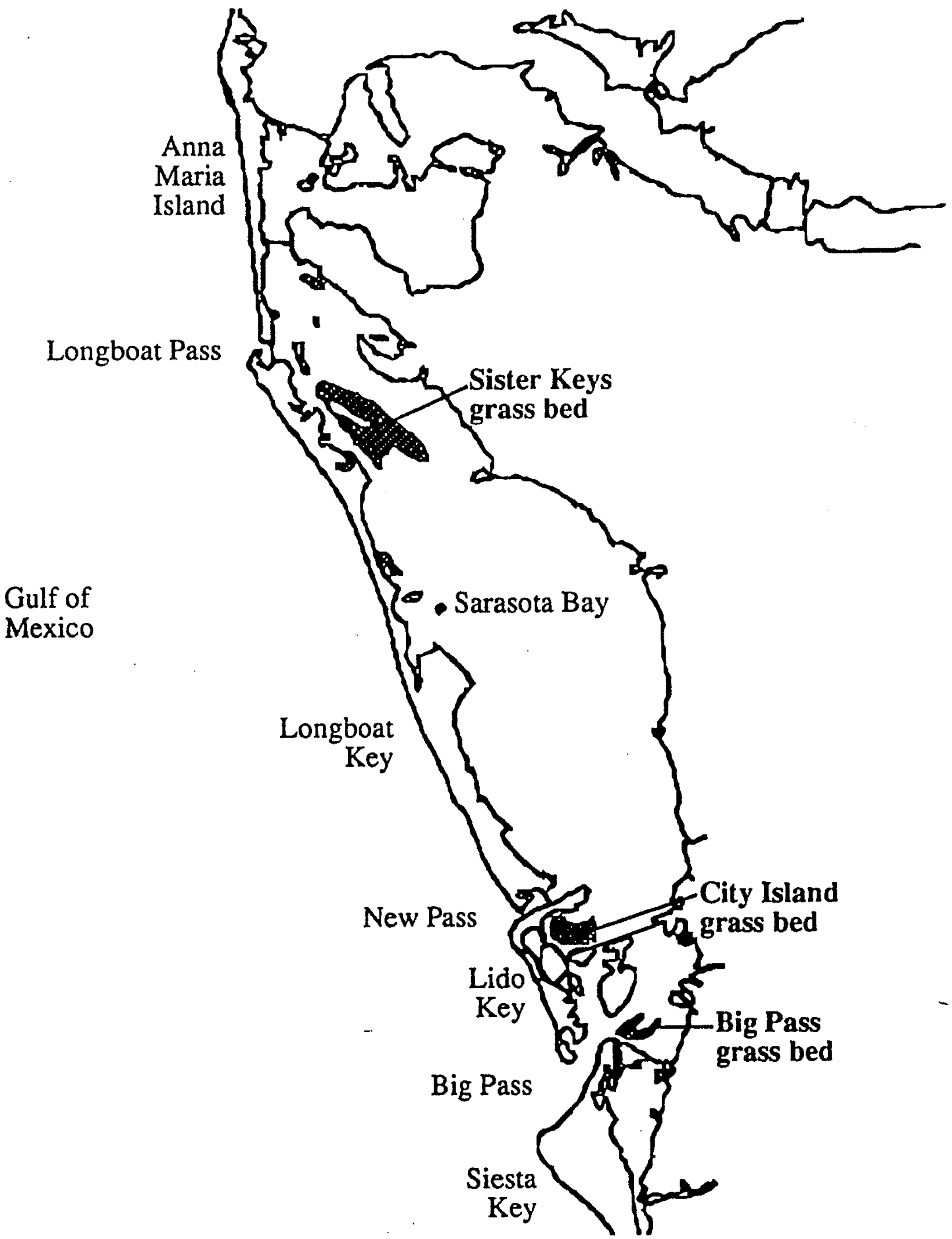
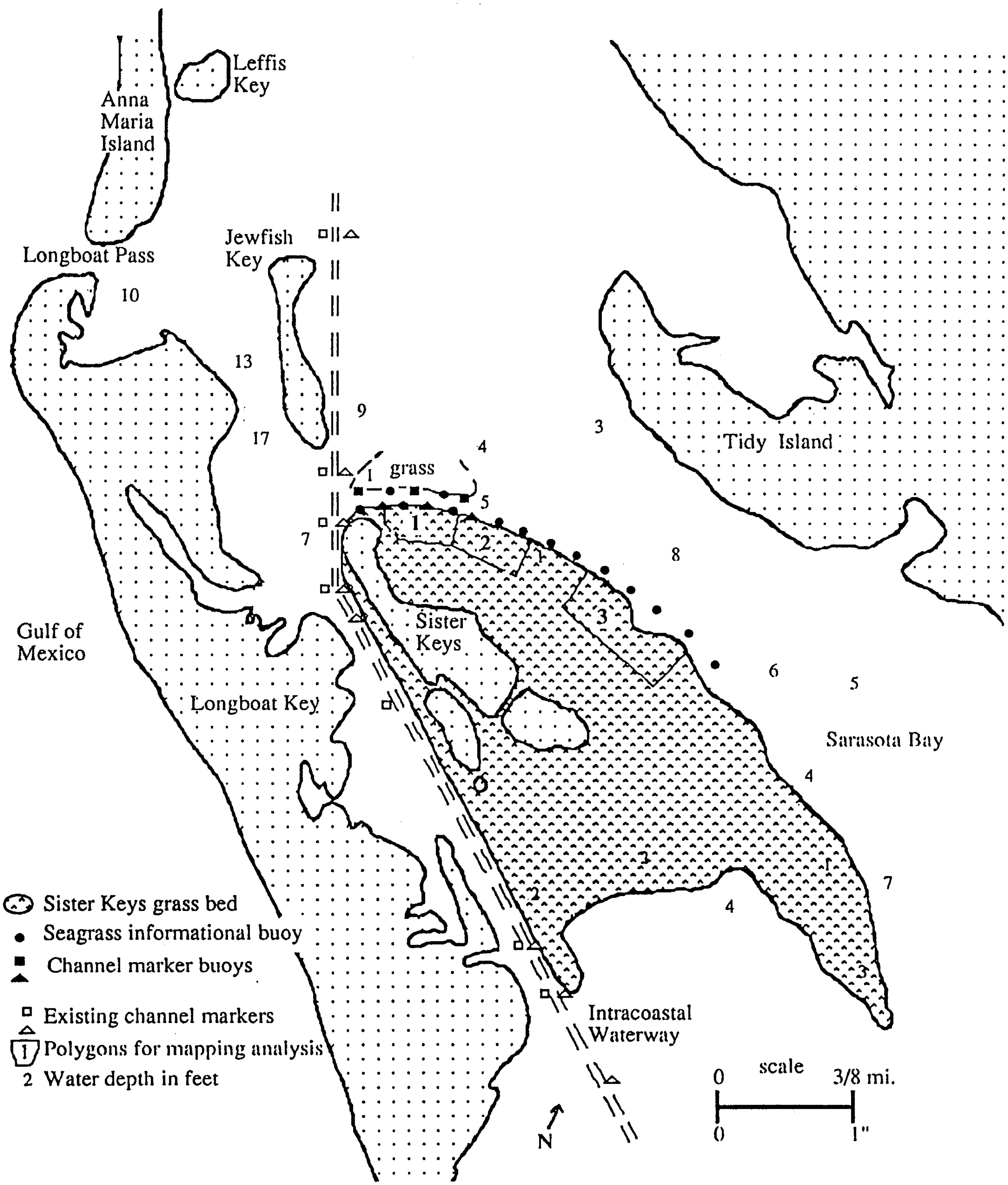


Figure 5. Sister Keys seagrass bed: buoy locations, marked channels, and water depths



also becomes more irregular, with large, bare, sandy patches interspersed with finger-like spits of grass poking out toward the deeper water. The southern boundary of the grass flat is the least well-defined. Extensive stretches of open water are interspersed with small grass bed islands. Water depth throughout the grass flat range from 1/2 to 2 feet at mean low water, with sporadic deeper holes. The edges are submerged by approximately 3 to 5 feet of water at mlw.

The grass meadow encompasses approximately 840 acres (Holderman and Freeman,1991). The dominant grass is *Thalassia*, with *Syringodium* and *Halodule* also present.

Although the site is not far from Longboat Pass, it is not a major thoroughfare for boaters. Most boaters travel north and south on the Intracoastal Waterway to the west of Sister Keys. The grass flats are used extensively by commercial as well as recreational fisherman. The nearest public boat ramp is about 1.3 miles away at Manatee County Coquina Bayside Park. The nearest houses and docks are not very close--about .4 mile away. Cannons Marina, on Longboat Key, is due west of the Sister Keys and maintains 25 rental motorboats.

Twenty buoys were installed-- fourteen informational seagrass buoys, three can channel marker buoys, and three nun channel marker buoys. The six channel markers and four information buoys were located at the northern edge, marking the five-foot deep channel between grass beds. The remaining ten informational buoys stretched southeastward following the curve of the grass flat edge, for almost 1 of its 2.6 miles. The buoys were about 300-350 feet apart. The buoys float in water depths ranging from about 2 to 10 feet.

2. City Island

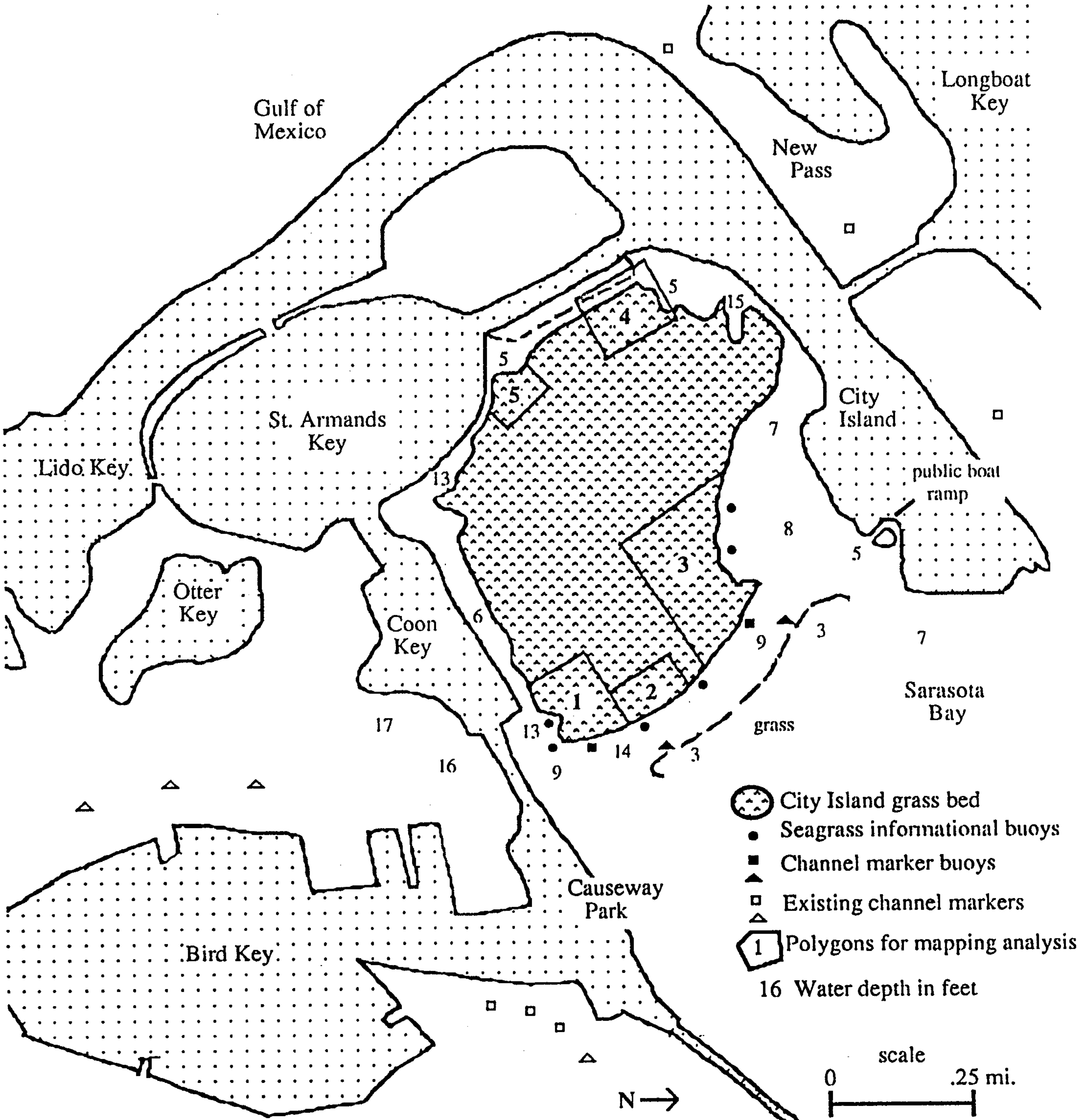
Tucked into a cove bounded by City Island on the north, Coon Key on the south, and Lido Key on the west, is an approximately 189 acre kidney-shaped grass bed. (See figure 6.) The eastern edge is bounded by a naturally deep (9-14 feet) and curved channel. The other adjacent channels have been created by dredging, in some cases to 15 feet deep. The spoil material from these channels created St. Armands Key, City Island, and Coon Keys. These areas were mangrove islands, grass flats, and open water prior to 1923 when John Ringling created a barrier island and an upscale residential area.

The predominant grass is *Thalassia*, with areas of *Halodule* and *Syringodium*. During the course of the study, large bare areas in the northwestern and central portion of the bed were found to be enlarging. *Thalassia* rhizomes are present in these bare areas, but no blades are growing. There is no apparent explanation for the loss of such a large portion of the grass bed. Water depths throughout the bed range from about 1/2 foot to three feet of water at low tide. There are a string of deeper holes in the western area of the bed.

A highly developed shoreline wraps around three sides of the channels adjacent to the seagrass meadow. Sarasota City-owned Ken Thompson Park, on the northern shoreline, includes a native-plant-landscaped Sarasota Bay Walk, and a popular public boat ramp located just to the northeast of the grass bed. Leasees of the city property along the southern shore include (from east to west), the Sailing Squadron, the Pelican Man's Sanctuary where injured birds are cared for, the Sarasota Outboard Club, the Ski-A-Rees water skiing program, Mote Marine Laboratory with docks for its research vessels, and the Sarasota Bay National Estuary Program offices.

The northwestern shoreline consists of a dozen or more large residential homes, mostly seawalled and with private docks. The western shoreline is a busy two-laned causeway

Figure 6. City Island seagrass bed: buoy locations, marked channels, and water depths



with a vegetated shoreline consisting primarily of black mangrove, Australian pine and Brazilian pepper. Prior to dredging channels, the grass bed fringing this shore probably once was connected to the grass bed under study. St. Armand's convex shore along the southwestern perimeter has numerous docks and is entirely seawalled. The rectangular, seawalled Coon Key creating the southern shore has several four story condominium buildings and more than 20 boat slips. The western portion of the Ringling Causeway, which links Lido Key with the mainland, bisects Coon Key.

This cove is a destination for fisherman (both commercial and recreational), water skiiers, and general pleasure boaters. Jet skiers and board sailors launch their craft at Causeway Park on Bird Key, east of the grass bed. Jet skiers, more often than board sailers, enter the grass bed.

Boat traffic in this area is moderate. In general, boaters use the area as: 1) a recreational destination, 2) as a thoroughfare to leave or return to their residential docks, 3) as a north-south thoroughfare from the public boat ramp on City Island to under the small fixed Ringling Causeway bridge between Coon Key and Bird Key, or 4) as a water ski practice and demonstration area.

Ten buoys were installed--six informational seagrass buoys, two can channel marker buoys, and two nun channel marker buoys. The six informational seagrass buoys and two can channel markers followed the curve of the eastern edge of the grassbed. The remaining two nun channel markers were located on the other side of the channel, adjacent to another seagrass bed. The buoys were about 500-550 feet apart. The buoys float in water depths ranging from about 3 to 10 feet mlw.

3. Big Pass

Directly north of Siesta Key is a flood tidal shoal created by tidally transported sediments through Big Pass. (See figure 7.) *Thalassia* and *Halodule* have taken root on much of this shoaled area.

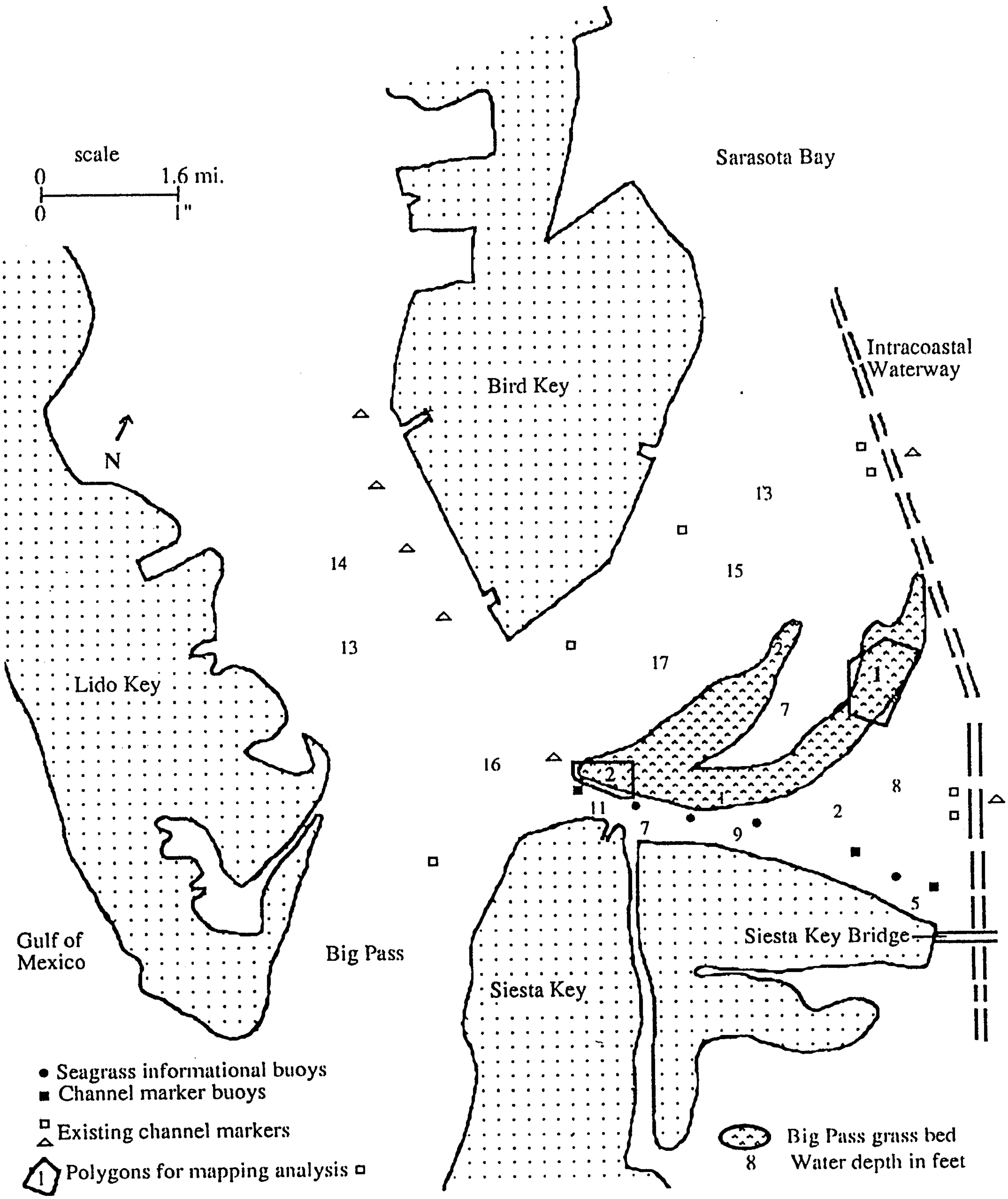
The shape of the grass bed is a distorted "V". The vertex is pointing west, and the two legs head eastward, and then northward. North of the grass flat is a deep, marked channel, which is the main route connecting the Intracoastal Waterway (ICW) to the Gulf of Mexico through Big Pass. The ICW passes several hundred feet to the east of the bed.

The approximately 68 acre bed is quite shallow at the western edge and at times sustains low breaking waves. Grasses are unable to survive such high energy and bare shoal areas shift along the western point. Gradually, as wave and current energy dissipates, grasses thrive. Water depths increase to five feet along the eastern tips. The grass flat also becomes more patchy along the deeper eastern edges.

Along the southern edge is a channel, generally 4-6 feet deep, but with both grassy and bare shoal areas. This approximately .75 mile long unmarked channel is a very popular shortcut between Big Pass and the ICW at the Siesta Drive bridge. On weekends, forty or more boats per hour may pass through this area.

Twenty-three seawalled residential properties are directly adjacent to this unmarked channel. The greater majority of houses have docks with fairly large boats moored to them. Two canals, each lined with seawalled residential properties with docks and large boats, join this unmarked channel about 300 yards from its western end. The eastern canal, Hansen Bayou, is a shortcut into Roberts Bay well-used by local boaters.

Figure 7. Big Pass seagrass bed: buoy locations, marked channels, and water depths



This bed is used by recreational and commercial fisherman. However, of the three beds studied, this bed was the least likely to be a destination for fishing or other activities, and most likely to be an edge of a fluid highway.

The closest public boat ramps-- at City Island, Centennial Park, and Selby Library-- are more than two miles away. A popular boat launching site, Hart's Landing, is about two miles away. Seven buoys were installed--four informational seagrass buoys and three can channel marker buoys--along the northern edge of the channel. The Siesta Key shoreline defined the southern channel edge. The buoys were unevenly spaced because of the short, linear nature of this channel. Buoys were placed closer together near the ends of the channel (about 250-300 feet apart) to make the channel path clear to boaters. The buoys float in water depths ranging from about 2 to 8 feet.

Pilot bed

A pilot bed was chosen to test variables prior to marking the other two beds. The City Island site was chosen as the pilot bed because of its easy accessibility both for boat observation research, helium balloon photography, and buoy installation. There were a variety of boating activities and a moderate amount of boating traffic. Additionally, there was a public boat ramp nearby, which was an ideal site for a sign.

Marker selection

Type

Two types of grass bed markers were considered: buoys and pilings. Costs and benefits were considered for both markers. The table below summarizes the advantages and disadvantages of each:

	ADVANTAGES	DISADVANTAGES
BUOYS	*inexpensive to install *can be easily removed, if necessary, at end of project *safe for boaters	*maintenance costs higher *easier to steal or vandalize *may harm seagrass *less familiar to local boaters
PILINGS	*low maintenance *familiar to local boaters	*unsafe to boaters *permanent *costly to install

Buoys were chosen because 1) boater safety was a priority and 2) problems of vandalism and harm to seagrasses could be eliminated with a careful design for buoy anchoring.

Manufacturer

Several buoy companies were contacted to compare information related to cost, longevity, and availability to customize messages.

Rolyan Manufacturing Company was chosen to produce the ten buoys installed at the pilot bed. Rolyan was selected because of price, ability to customize the buoys, and Sarasota County Parks and Recreation Department's years of positive experience with their buoys.

Rotocast buoys, however, were chosen to mark the second set of beds. The material of the Rotocast buoys, linear polyethylene, was expected to outlast the Rolyan buoys' acrylonitrile-butadiene-styrene under the strenuous conditions of constant sun and salt water. Although Rotocast would not customize the buoy message, the buoy installer was able to stencil the message with a nalgene marker at a reasonable cost.

A cost comparison of the two types of installed buoys is shown below:

	Cost of buoy	Installation cost	Total cost
Rolyan	$81.94	$102.95	$184.89
Rotocast	$65.71	$103.21	$168.92

Anchoring system

It was important to design an anchoring system that would be secure during storms, resist vandalism, and not damage the grass meadows. A system that appears to have accomplished all three is one in which a 30" screw anchor is screwed into the sandy bay bottom at least five feet from the edge of the grass bed. A polypropylene coated 5/16" cable is attached with thimble and two clips at the anchor and buoy ends. The anchoring system has failed only once during the almost two years since the first buoys were installed. (See figure 8.) A seagrass informational buoy which was located along the eastern end of the Big Pass flood tidal shoal channel disappeared. The buoy marked the narrowest point of the channel, and it is possible that a very large boat accidentally pulled it out.

Message

The set of buoys at the pilot bed had the words, "DANGER" across the top of the buoy, "AVOID SEAGRASS" right above the water line, and "SHOAL" running vertically next to the Coast Guard hazard symbol of an orange diamond. The results of the boater interviews (see appendix 1) indicated that boaters felt that the most persuasive argument for keeping boats away from grass beds was environmental information, rather than information relating to the safety of their craft. The second set of buoys reflected this information, and these buoys had "AVOID SEAGRASS" and "DANGER", each imprinted across the top and above the water line of the buoy. (See figure 9.)

Terns, gulls, cormorants, and other birds quickly discovered the buoys near the pilot bed were desirable perches between fishing forays over the grass bed. White stains began to obscure the message on several buoys and cleaning attempts eroded the vinyl lettering. To solve this problem, an inverted funnel was secured to the top of each new buoy to discourage birds from perching. The first set of buoys were retrofitted with the funnels.

BOATER EDUCATION

Boater interviews

Boater education was viewed as a pivotal component of the Seagrass Signage project. Familiarity with the audience was seen as the first step toward developing educational

Figure 8. Buoy and anchoring system

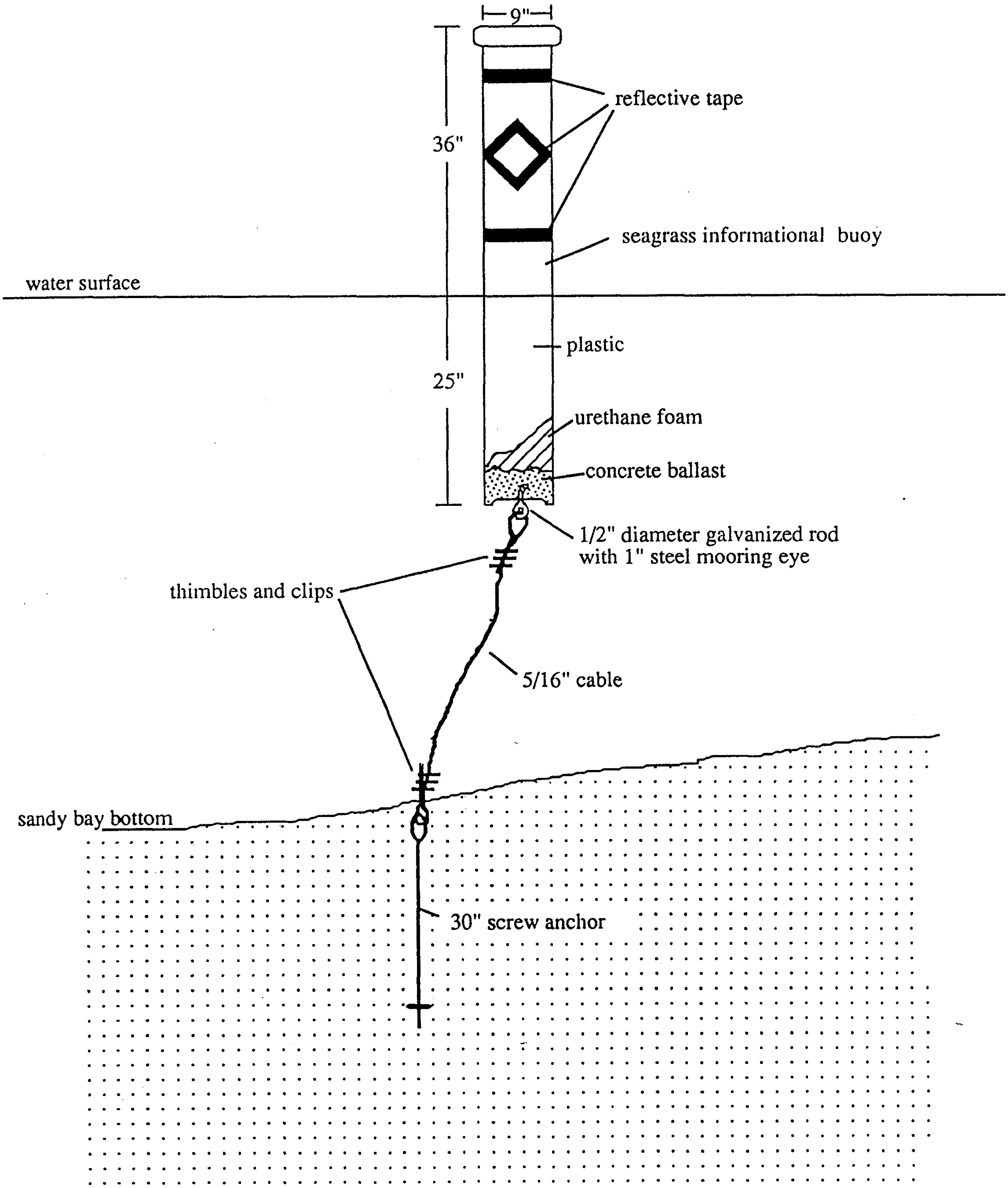
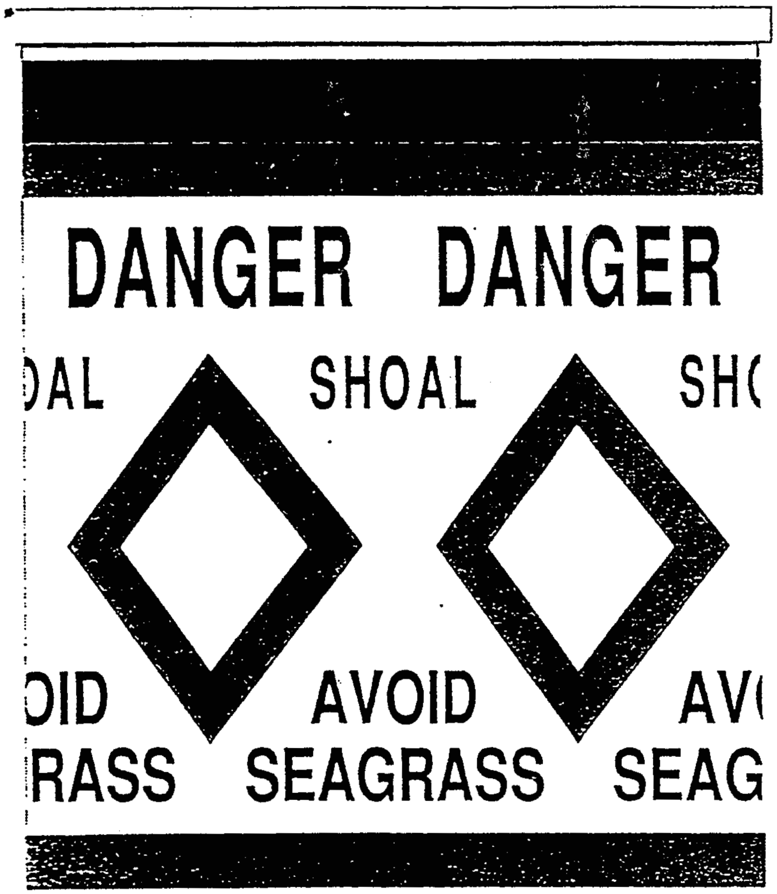
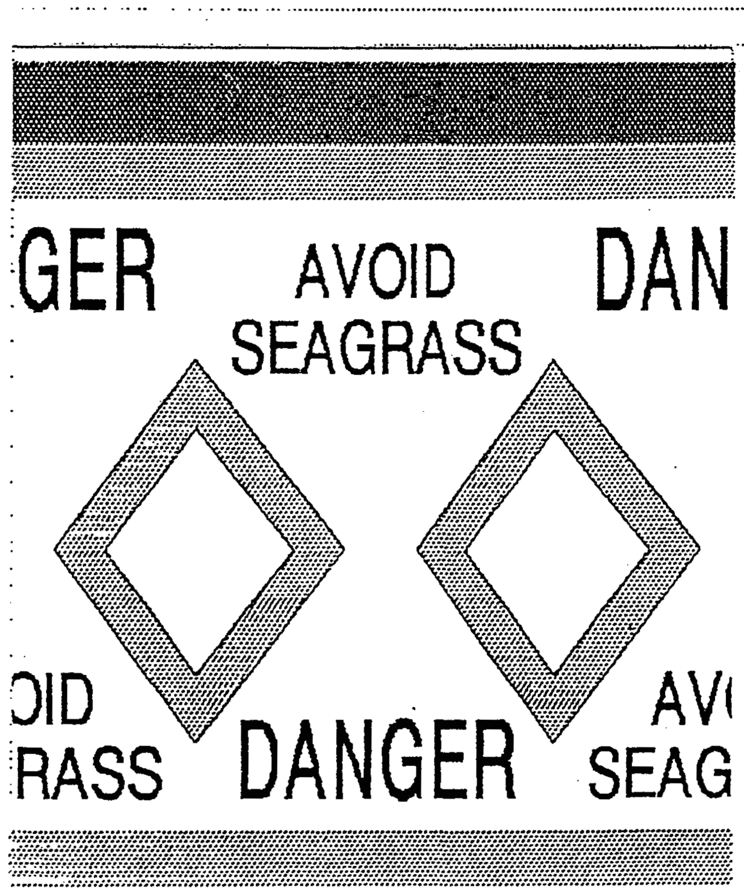


Figure 9. Buoy messages

City Island grass bed



Sister Keys and Big Pass grass bed



materials. Interviewing was selected as the most direct way to learn about boaters' actions, awareness, and attitudes. A full report of the interview findings is found in "Boater Interviews of the Seagrass Signage Demonstration Project" by Brian Israel in Appendix 1. Below is a summary of the methods and findings of the boater interviews.

During March, 1990, 243 boaters were interviewed by six New College students at four public boat ramps and at a boat show . The college students approached boaters requesting 5-10 minutes for the interview. There was no mention of any special interest in seagrass. Boaters answered the questions amiably.

The average boater who was interviewed was male, owned his boat, lived nearby, was a year-round resident, and enjoyed sport fishing.

Boater actions

Collecting data from self-reporting creates inherent distortion of "the facts." Most people tend to understate their errors or "wrong" behavior. However, attempts to reduce such distortion were made. Questions were all asked within a nonjudgmental, non-accusatory context. Inquiries were made about the boat, rather than the boater. And finally, the structure of questions suggested an acceptance of the reality of getting caught in a grass bed. Rather than asking, "Do you get caught in grass beds ?", the question was "how often do you get caught in grass beds?."

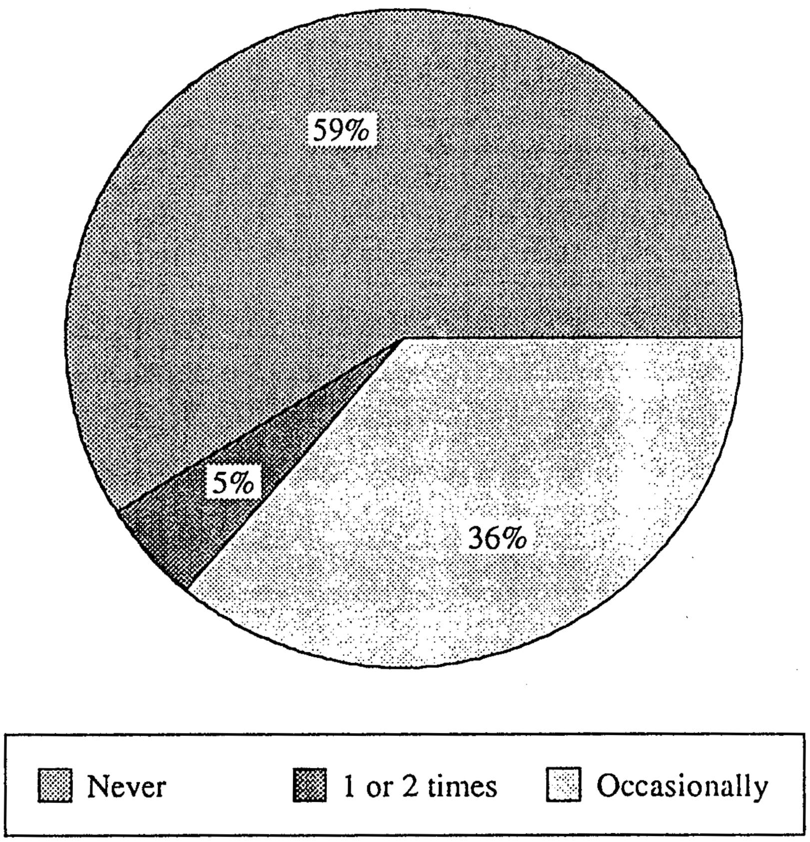
Almost half the boaters (41%) admitted to "getting caught" in grass beds. (See figure 10.) Although the term "getting caught" is purposefully nonjudgmental, it is also somewhat ambiguous. To interpret how the ambiguity would distort the data, first consider the range of boater actions which damage seagrass meadows.

In the most extreme case of damaging a grass bed, a boat cannot move after running hard aground into the bay bottom, and the boater, gunning the motor full throttle, attempts to escape. A large, deep trench is created. On the least-damaging side of the spectrum, a boater planes (increases speed until the boat hull sits very high in the water) with the propeller a foot or more above the grass flat and perhaps creates a subtle plume of turbidity in its wake. Between these two extremes are gradations of damage, depending on water depth, size and speed of the boat, size and location of motor, and escape strategy. Some boaters just graze the bay bottom surface, leaving a short intermittent, narrow, and shallow trail of plowed sand and cut seagrass blades and rhizomes. Other boaters have several inches of their propeller blades cutting through sediment and rhizomes for hundreds of feet, leaving a continuous two-foot-wide, three-inch deep trench carved out of the grass bed and a muddy, grass-strewn wake.

The term "getting caught" probably included the more damaging range of the spectrum of seagrass-damaging actions. The 41% reported, therefore, probably underestimates the number of boaters whose boat propellers touch grass blades and roots.

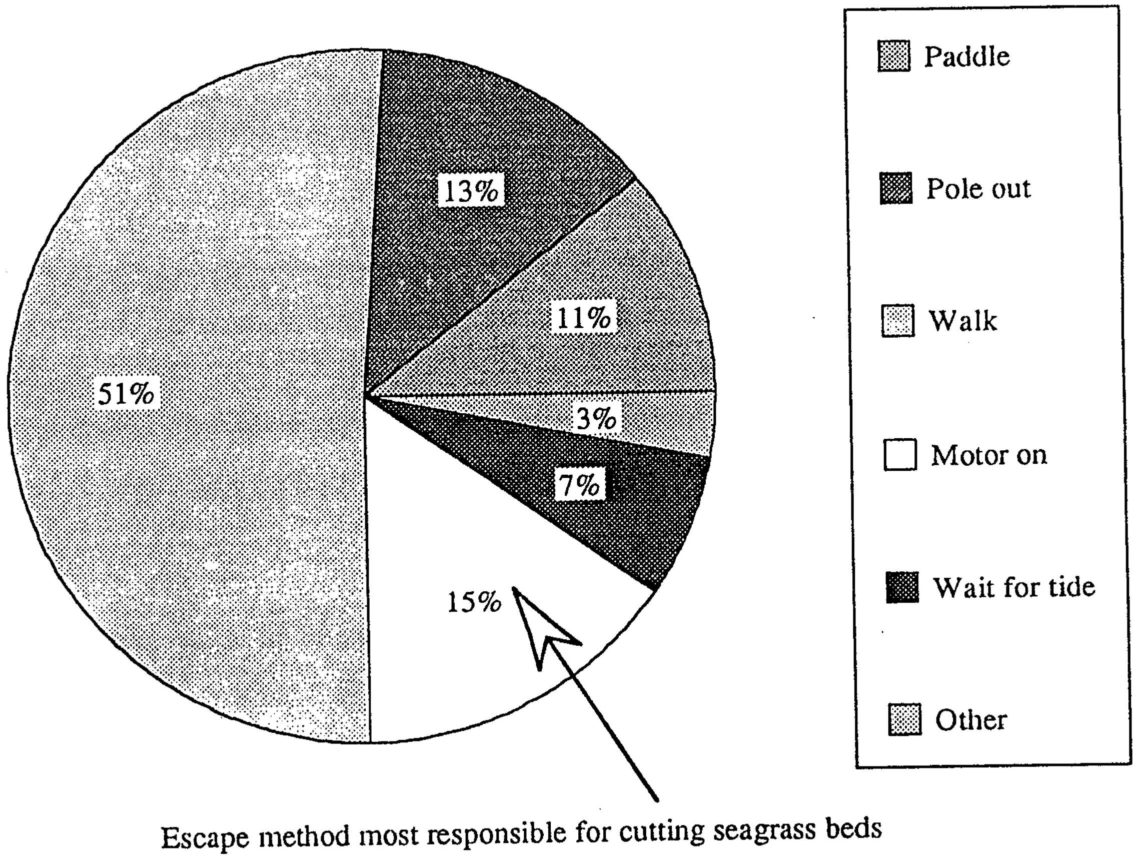
Data was collected about boater escape behavior through the question, "What do you find to be the most effective method for getting out of the seagrass beds?". (See figure 11.) At first glance, the responses are heartening. Only 15% of the boaters have their motors on (the method most likely to damage the grasses) when escaping from a seagrass meadow. Unfortunately, that small percentage of boaters who use their motors to escape are also more likely to get caught in a grass bed. That is, 66% of those who use their motor when escaping are likely to get caught in a grass bed, compared to 41% of the total interviewed.

Figure 10. Boaters caught in grass bed



On the average, how many times per outing does the boat get caught in grass beds?

Figure 11. Perceived "most effective release" method



Boater awareness

The question, "What conditions are most responsible for getting caught in the grass beds?" was asked. The responses varied (see figure 12), but could be grouped into three categories: 1) boaters who were unaware of the existence of the grass flat, 2) boaters who knew the grass bed was there, and 3) boaters who may or may not have known about the grass flat. Fifty-eight percent of boaters seemed to be unaware of the grass beds' existence; 39% knew the bed was there but thought they could avoid getting caught; and 7% may or may not have known about the grass flat, but because of wind or fog could not navigate around it.

It would seem that those boaters who ran aground because they did not know the flats were there would benefit by the presence of channel or grass bed markers. Conversely, it may be that markers would not only be ineffective for those boaters who enter seagrass meadows intentionally, but it may actually attract them. Thus, the two boater populations, the naive and the experienced, may behave differently once the buoys are in place. As Israel states (Israel, 1990), " .. a large number of people are intentionally entering the grass flats....While seagrass education for these boaters might be helpful, it is more likely that a different management technique should be developed for people who are actively using the flats." This notion will be further discussed in the discussion and recommendations section.

There was no causal relation found between general familiarity or lack of familiarity with Sarasota Bay and the incidence of getting caught in seagrass beds.

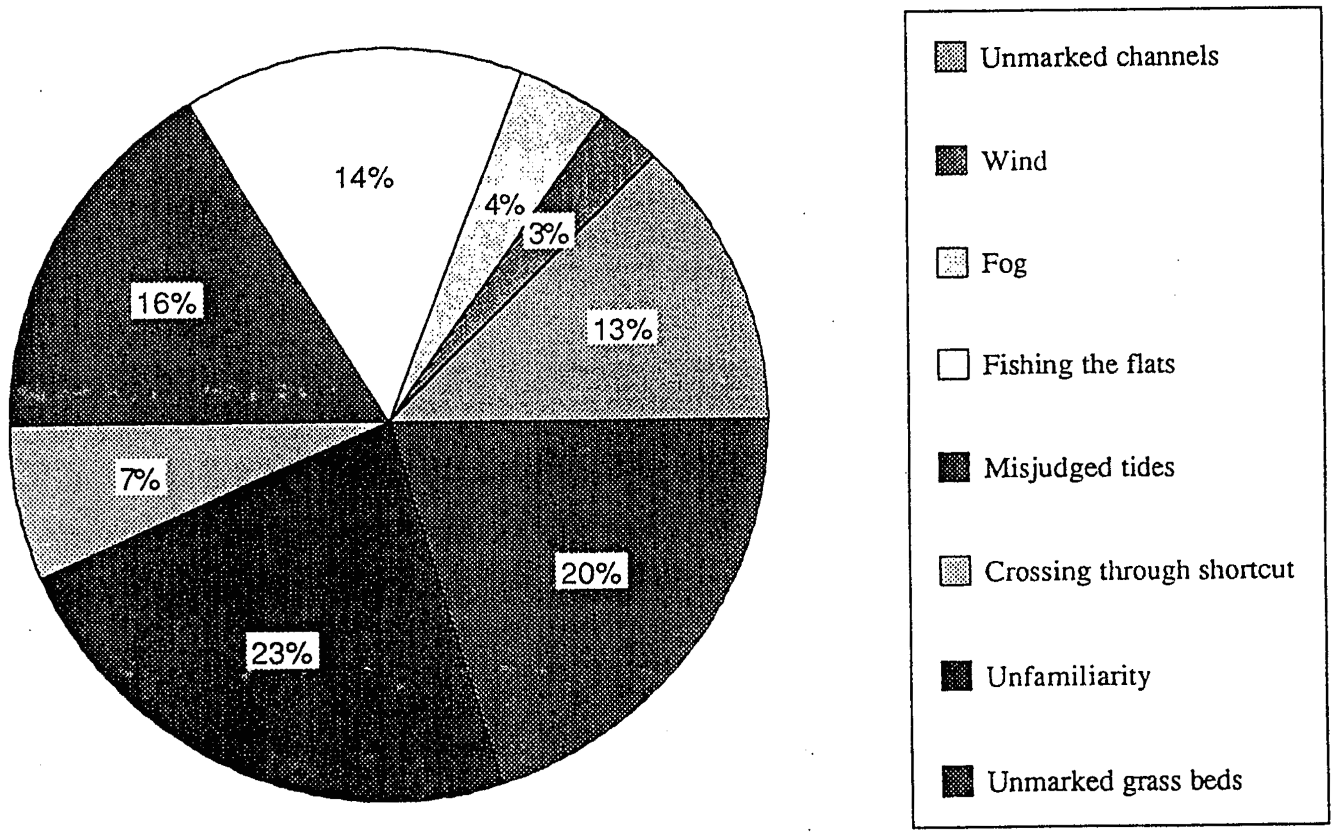
However, some light was shed on the nature of the act of injuring seagrasses. A question was asked "What do you think your role as a boater should be in protecting the bay?". A small minority, 9%, answered that avoiding seagrass beds or staying in the channel were priority responsibilities. These "seagrass protectors" also reported that they got caught in grass beds a greater percentage of the time (48%) than the total boater-interviewed population(41%). In other words, self-reporting "seagrass protectors" were more likely to get caught in seagrass meadows than the total interviewed population. (See figure 13.)

This seemingly counter-intuitive information might be explained by recognizing the often subtle nature of prop dredging a grass flat. Sometimes, the boat slows almost imperceptibly and the sound of the motor changes pitch slightly when a propeller is in contact with a grass bed. Unless the boater is experienced, very perceptive, and aware of the presence of a grass bed, the entire event of prop dredging seagrass might go unnoticed. Experienced boaters and those concerned about seagrasses are most able to recognize when their propeller is slicing seagrass, and alter their behavior accordingly.

Boater attitudes

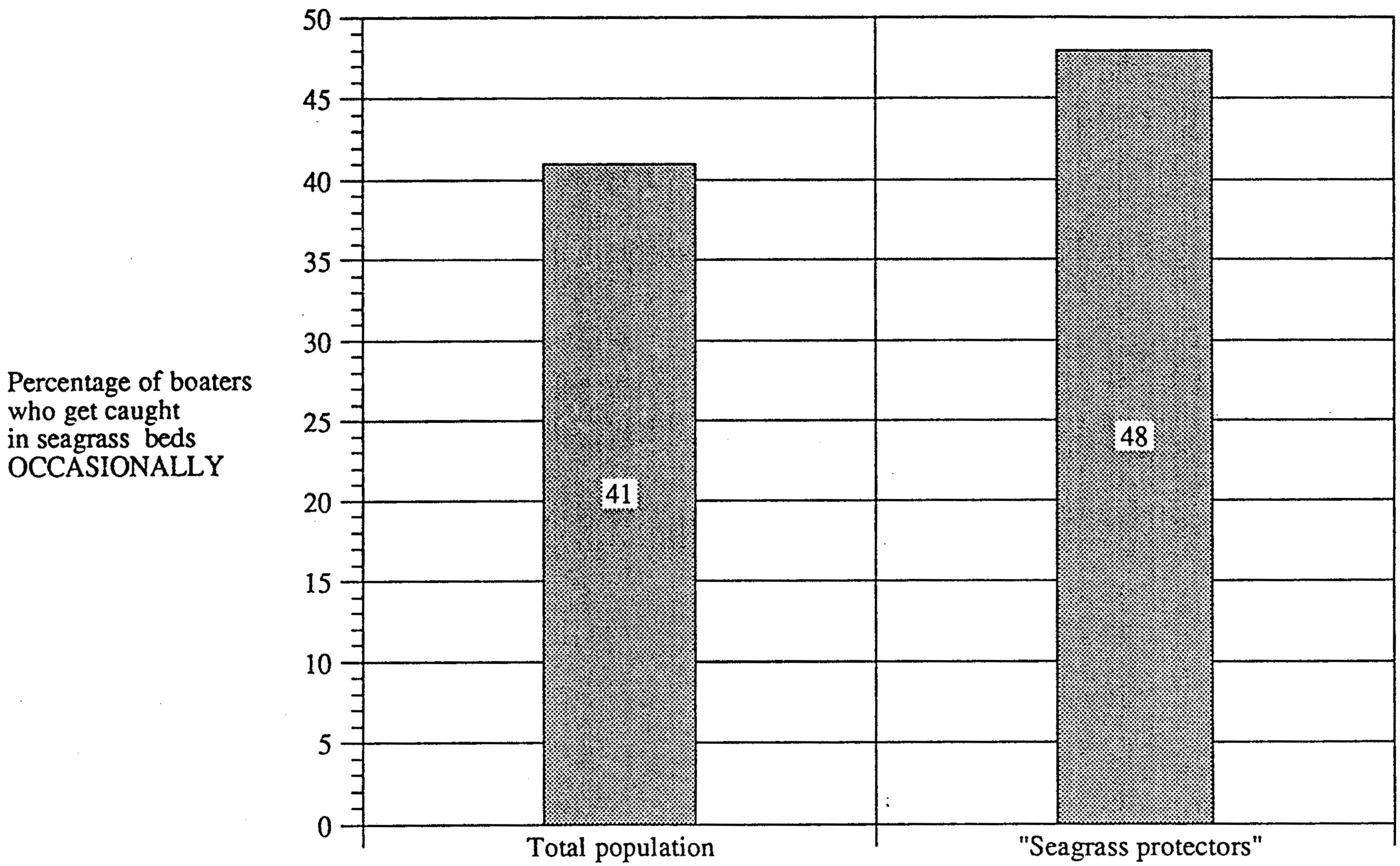
Boaters' attitudes were examined by asking several different questions. One question concerned the most effective argument for protecting a grass flat. Another questioned the boaters' sense of the overall condition of the bay. A third asked about the perceived most pressing problem. Boaters' attitudes demonstrated that education should focus on the environmental damage to seagrasses which boaters cause, rather than emphasize the damage to boats, possible inconvenience, or legal implications of prop dredging. More than 50% of the respondents thought that information about ecological damage would be effective. Surprisingly, only 11% of the people felt that threats of punishment or fines would be effective in keeping boaters out of seagrass areas.

Figure 12. Conditions for getting caught



What conditions are most responsible for getting caught in the grass beds?

Figure 13. "Seagrass protectors" who get caught in grass beds



Brochure

In December, 1990 a folded three-panelled brochure was printed. It is printed on recycled paper with a dark green ink. (See appendix 2.) There are two title panels, one on each side, each aimed at a different audience. The side headed "Boaters Guide to Seagrass" was face up at boater-related events and locations (i.e. boat-ramp signs, marinas). The other side's title panel, "Seagrasses: Luxuriant Bay Meadows", was visible at distribution points which attracted a general audience, rather than boaters specifically.

The environmental benefits of seagrasses are described, as well as the shrinking acreage of grasses and the role motorboat propellers have in their decline. Practical information is given via graphics and text about how to avoid grass bed and what to do if you run into one.

Slide presentation

A fifteen-minute slide show for boaters was assembled. The presentation discussed the nature of seagrasses, their ecological function, and their shrinking acreage regionally as well as in Sarasota Bay. Motorboat propellers were pinpointed as one small but significant cause of seagrass decline. Boaters learned about ways to avoid seagrass and what to do if they were caught in a seagrass meadow. The message was strong that boaters should be responsible for protecting the underwater resource that they are fortunate enough to enjoy.

Boat console decals

Adhesive backed, laminated stickers were designed to be affixed to the consoles of motorboats. The group targeted for these decals were the naive boat renters.

The decal described techniques to avoid grass bed and instruction on what to do if the boat is hitting bottom. (See appendix 3.)

Boat ramp signs

Figure 14 is a copy of the sign. The 36" by 48" painted, 3/4" exterior plywood board has vinyl lettering and graphics. A plexiglass box bolted to the post can hold more than 100 brochures.

The sign was designed to be graphic and engaging. The message uses humor in teaching techniques to avoid grass beds and offering instruction on proper escape procedures, if one does run aground.

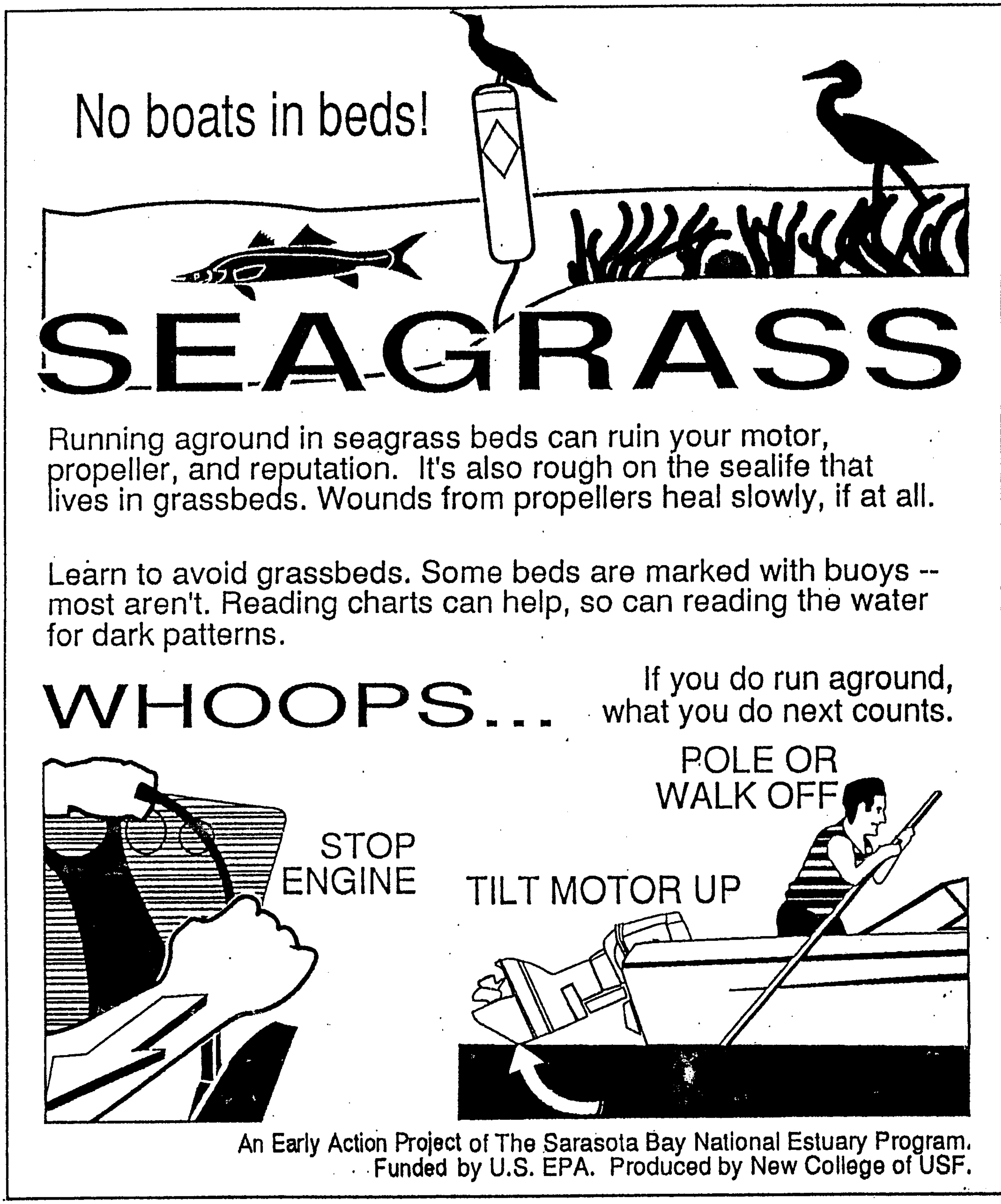
MONITORING EFFECTIVENESS

Two approaches were utilized in trying to obtain a fuller understanding of the effectiveness of the seagrass signage program. One involved mapping the actual damage to the grass meadows from motorboat propellers, and the other focused on boater behavior changes.

Mapping the propeller cuts

The mapping process was dependent on obtaining high resolution, true vertical, low altitude aerial photographs of the three study sites for a period of time before and after the buoys were installed. This task proved to be quite a challenge, as wind speed, sun angle, water clarity, air clarity, and tidal factors all had to be simultaneously within a narrow range

Figure 14. Boat ramp sign



of acceptability in order to take the aerial photographs. Budget constraints were tight, and added to the challenge.

Initially, photographs available from several different agencies were examined for possible use for mapping the propeller cuts. Existing photographs were neither recent enough nor detailed enough to map the propeller cuts.

The first effort in obtaining photographs of the prop cuts used a relatively inexpensive system of a radio controlled camera suspended from a helium balloon. Dr. Alfred Beulig, a New College biology professor, offered his equipment and expertise in the field. In January, 1990, five rolls of film were shot of the eastern edge of the City Island grass bed. The photographs were rich in detail. However, the logistics of the field work and the difficulty of compiling a complete mosaic of the grass bed proved too complex to make use of this technique.

The next step was to commission an affordable aerial photographer. The project's budget did not allow the hiring of a state-of-the-art aerial photographer. In total, three aerial photographers were commissioned each performing with increasing success.

Two sets of images of each site were taken. One at 1500 feet altitude, the other at 3500 feet. Aerial photographers were instructed to overlap each image with the adjacent one so that the entire portion of a selected grass flat edge was photographed. Attempts were made for each photograph to contain the edge of the grass bed along with as much of the interior of the flats as was possible per frame.

The first set of photographs was taken through the open door of a fixed wing airplane with a Haselblad camera, wide angle lens(50 mm), on VHC color high contrast film on a 2 1/4" by 2 1/4" format.

The second and third set of photographs were taken through a window on the floor of a fixed wing plane. This allows for more control for the vertical camera angle. The second and third set of photographs were taken with a Pentax 657 camera, wide angle lens (75 mm), on VHC color high contrast film on a 2 1/4" by 2 3/4" format.

The images were enlarged (11" x 14" and 8" x 14") and printed on matte and "F" surface Kodak paper ranging in scale from approximately 1:800 to 1:1440.

A majority of the photographs were taken so as to allow mapping and comparing of prop cuts from one time frame to the next. However, due to sun glare, patches of turbid water, interference from boat wakes, and inadvertent omission of photographing areas of grass beds, some sections were not able to be mapped.

Polygons defined the boundaries of those areas of grass beds which were mapped. (See results sections for maps of polygons.) A polar compensating planimeter was used in calculating the acreage of each polygon.

Three prints of the same polygon photographed during fourteen months (December 14, 1990, November 21, 1991, and April 18, 1992) were inspected for propeller cuts which were not evident on the previous photograph. The path of the new propeller cuts were traced from the photographic prints with a black latex ink onto prepared acetate. Propeller cuts were counted, measured for length, and qualitatively analyzed for angle of entry. Calculations compared number of new cuts/ acre/ month, average length of cuts, and total linear footage of propeller cuts per month in each polygon and each grass bed. (See appendix 7.)

The information for the Big Pass and Sister Keys grass beds compares information about propeller cuts before and after buoys were installed. The data concerning the City Island grass bed provides only post-buoy information. It offers insights on boat/grass bed interactions over time after an area has been marked.

The intent was to shoot the first set of aerial photographs in the spring of 1990. After interviewing several aerial photographers, a company which specialized in aerial photography was contracted to shoot the pilot grass meadow south of City Island. In an effort to save money, "as vertical as possible" was the standard requested instead of "true vertical." The photographs were first taken on May 23,1990, but were unacceptable. It became evident that true verticals were necessary. No adequate set of photographs were taken during the spring of 1990. The dates of photography were the same as the Big Pass and Sister Keys. Along the western edge of the bed some different dates of photography were used for comparison. (See figure 15.)

Boater observation study

The boater observation studies were conducted at two different grass meadows. The first site was the City Island grass bed; the second was the bed near Big Pass north of Siesta Key.

Eleven New College students were trained to observe and record the behaviors of boaters at the City Island site. Aboard an anchored canoe, one or two observers spent three hours per session observing and recording information concerning the boat, the boater, the path of the boat, the speed of the boat, and the boater's interaction with the markers and the grass flat. (See appendix 4 for blank data sheet.) Two hundred and two observations were recorded, from 5/5/90 through 6/3/90 before the buoys were installed. One hundred sixty-five observations were recorded from 6/23/90 through 3/7/91 after the buoys were installed. The data were entered by three people, one of whom was an observer during the study, during the course of a month. Results were cross-tabulated for chi square and significance using SPSS software.

Three New College alumni were trained to observe and record the behavior of boaters at the Big Pass site. Each observed the boats from the same point on the shore, a dock approximately halfway along the length of the channel. Information recorded was very similar to that recorded at the City Island site. (See appendix 4). One difference between the methodology of the two sites was that during the "before" observations, the grass flat edge was marked with crab-trap-like buoys. This allowed observers to be certain where the edge of the grass bed was, without creating conspicuous markers for boaters. We had learned at the City Island site, that it was difficult to know exactly where the grass flat edge was, and "before" data collection on grass bed entry was, therefore, somewhat distorted.

Two hundred ninety-five observations in February and March, 1991 were made before the buoy markers were installed. Two hundred eleven observations were made in February, March, and June, 1992, after the buoys were installed. Results were cross-tabulated for chi square and significance using SPSS software.

Figure 15. Dates of buoy installation and aerial photography

Grass bed location	Buoy installation dates	Dates of aerial photography
City Island	June 9-10, 1990	May 23, 1990*; December 14, 1990; June 19, 1991*; November 21, 1991; April 18, 1992
Sister Keys	December 9-10, 1991	December 14, 1990; November 21, 1991; April 18, 1992
Big Pass	December 11, 1991	December 14, 1990; November 21, 1991; April 18, 1992

*Photographs taken on these dates were used only for City Island's polygon 5.

RESULTS

MARKERS

In total, 37 buoys were installed in Sarasota Bay. All but one of the buoys remain in place at the end of this study. The one missing buoy (#6) was marking the channel near the Big Pass grass bed. It was an informational buoy next to the most eastward green can buoy. The buoy was anchored near a small patch of grass, which constricted the passage of the channel. Presumably boater displeasure with its placement, expressed by cutting the cable, or a very large boat accidently running over it and pulling out the anchor, was responsible for its disappearance.

Barnacles and other sessile marine creatures attached themselves and grew on the submerged portion of the buoys. The additional weight raised the water line on the buoy. However, the message was still visible.

EDUCATION

Brochures

One thousand brochure copies were initially distributed through boat ramp signs, slide show presentations, Sarasota Bay Project programs, marine-related fairs, festivals and other events. The Sarasota County Department of Natural Resources gave a brochure to each new dock permitee. A second printing produced 2,000 copies in July, 1991; a third printing in March, 1992 created an additional 5,000. In June, 1992 another 10,000 copies were printed and the majority of the brochures were distributed to those who registered their boats in person in offices in Manatee and Sarasota Counties .

Slide Shows

Slide shows were presented to nine boater groups and, in total, 515 boaters were addressed. (See appendix 5).

Although pre- and post-tests concerning the effectiveness of the education program were not administered, it is worthwhile to subjectively describe the reactions of those attending the slide show presentations. The groups responded positively to the 15 minute presentation, and often discussed seagrass and related subjects for 20 for more minutes thereafter. What was striking was the typical boaters' lack of knowledge about seagrasses. It appeared that many boaters (exclusive of fishermen) focus on the water's surface and above, rather than below. Once informed that they as boaters could make a difference, there was an expressed sense of concern, and of responsibility for avoiding and protecting grass beds. Many people discussed the general quality of the bay and felt that this was something they could do as bay users to improve the bay.

Decals

Nine marinas in the Sarasota Bay study area rent, in total, 116 boats. Each marina was contacted and all were willing to accept the decals and apply them to their boats. (See appendix 3.) One thousand decals were printed, and about 300 have been distributed at slide presentations, through marinas, and other boat-oriented distribution points.

Boat ramp signs

Two boat ramp signs were installed. One was installed at the City Island public boat ramp. The other was installed at the Coquina Bayside Park public boat ramp on Anna Maria Island in Manatee County. It is the closest public boat ramp to the Sister Keys' seagrass bed.

Lacking a technique for assessing the effectiveness of the sign, results can't be reported. One can speculate that the shorter scars after buoy placement at Sister Keys may be the result of the boat ramp sign.

At City Island, about eight months after the sign was installed, it was tossed in the bushes by contractors renovating the boat ramp and the County's seagrass protection sign (which seemed less effective than the original) was erected. The original sign has recently been reinstalled after months of bureaucratic wrangling.

MAPPING PROPELLER CUTS

The data

Figure 15 details the dates of the photographs used for mapping comparison as well as the dates of buoy installation.

Figure 16 summarizes the results of the mapping data analysis for sections of the Big Pass flood tidal shoal and the Sister Keys grass beds. The data focuses on 13.67 acres of the Big Pass grass bed and 42.69 acres of the Sister Keys bed.

The grass beds were mapped by dividing each bed into polygons, based upon which areas of photographs had readable prop cuts. (See appendix 7.) Photographs of Big Pass permitted mapping of two polygons. Polygon 1 (4.90 acres) is near the eastern tip of the grass flats; polygon 2 (8.77 acres) is at the western corner. The two polygons are very different in relation to the buoyed channel. Polygon 2 is adjacent to the buoyed channel. However, polygon 1 is closer to the Intracoastal Waterway. This difference must be considered in interpreting the results of the mapping.

Figure 17 summarizes the results of the mapping data analysis for sections of the City Island grass bed. The data is for 53.87 acres. The area was divided into five polygons, three on the marked, eastern edge and two on the unmarked, western edge.

Possible distortions in the data

Before examining the mapping data, four differences between the pre- and post-buoys time periods should be considered. The pre-buoy mapping period spans 11 months from December to November; the post-buoy period spans five, from November to April.

A Florida Department of Natural Resources boating survey in Manatee County done in 1988-89 found that there was no statistical difference in the numbers of boats in upper Sarasota Bay from season to season (pers. communication, Weigle). However, variability in boat traffic between weekends and weekdays indicates a difference in the boating population from season to season (pers.communication, Weigle). Seasonal residents and tourists boat in winter and early spring. So, numbers of boaters throughout the year were similar, but probably the less familiar and experienced boaters were plying the bay waters during the post-buoy period. This would tend to under-report the usefulness of the buoys.

FIGURE 16. Summary of mapping data results for Big Pass and Sister Keys grass beds

LOCATION	AREA (ACRES)	NUMBER OF NEW PROP CUTS BEFORE*	NUMBER OF NEW PROP CUTS AFTER*	NUMBER OF NEW CUTS/ MONTH/ACRE BEFORE	NUMBER OF NEW CUTS/ MONTH/ACRE AFTER	NUMBER OF NEW CUTS/ MONTH/ACRE (% change)	AVERAGE LENGTH OF CUTS (ft) BEFORE	AVERAGE LENGTH OF CUTS (ft) AFTER	AVERAGE LENGTH OF CUTS (ft) (% change)	LINEAR PROP CUT FOOTAGE/ MONTH BEFORE	LINEAR PROP CUT FOOTAGE/ MONTH AFTER	LINEAR PROP CUT FOOTAGE/ MONTH (% change)	GRAZING, OR NEARLY PARALLEL, ENTRY BEFORE	GRAZING, OR NEARLY PARALLEL, ENTRY AFTER	GRAZING, OR NEARLY PARALLEL, ENTRY (% change)
BIG PASS															
POLYGON 1	4.9	40	16	.74	.65	(- 12. 2%)	50	56	(+12. 0%)	181.8	179.2	(-1. 4%)	7.5%	6.3%	(-16. 0%)
POLYGON 2	8.77	49	10	.51	.23	(-54. 9%)	68	82	(+20. 6%)	302.9	164.0	(-45. 9%)	36.1%	16.6%	(-54. 0%)
BIG PASS Total of polygons	13.67	89	26	.59	.38	(-35. 6%)	61.55	72.68	(+18. 1%)	484.73	342.20	(-29. 4%)	25.9%	12.9%	(-50. 2%)
SISTER KEYS Total of polygons	42.69	103	52	.22	.24	(+11.1%)	105.46	78.62	(-25.5%)	1063.45	695.0	(-34.7%)	30.0%	27.2%	(-9.2%)

* "BEFORE" throughout this table means the 11 months (December.1990-November. 1991) before the buoys were installed.
* "AFTER" throughout this table means the 5 months (November, 1991-April, 1992) after the buoys were installed.

FIGURE 17. Summary of propeller cut mapping data results for City Island grass bed

LOCATION	AREA (ACRES)	NUMBER OF NEW CUTS / ACRE/ MONTH			AVERAGE LENGTH OF CUTS (FEET)			LINEAR PROP CUT FOOTAGE/MONTH		
		17 months*	22 months*		17 months	22 months		17 months	22 months	
BUOYED AREA	33.8	0.10	0.16	**(+61.1%)**	100.3	89.0	**(-11.3%)**	339.0	481.3	**(+42.0%)**
NON-BUOYED AREA**	20.1	0.12	0.33	**(+180.5%)**	121.5	103.0	**(-15.2%)**	293.1	683.2	**(+133.1%)**

* Throughout this table "17 months" and "22 months" refer to the number of months after the buoys were installed. The 17 month period is from June, 1990 to November, 1991 and the 22 months refers to the next five months from November, 1991 to April, 1992.

**Mapping for one polygon in this section was done from photographs which were shot on dates different than the other polygons. Photography dates for Polygon 5, along the non-buoyed western edge, were May 23, 1990, December 14, 1990, and June 19, 1991.

Secondly, the tides during the eleven month pre-buoy period are fairly evenly distributed between low morning tides and low evening tides. But during the post-buoy period, low morning tides predominated. Low tide conditions probably increase the chances of propeller cutting, and again, this factor would underestimate the effectiveness of the buoys.

Thirdly, the second set of photographs, taken on November 21, 1991, were the least revealing of known propeller cuts. Some prop cuts visible in the first and third sets of photographs were obscured in the second set, most likely by drift algae. Therefore, if skewed in one direction, the amount of pre-buoy cuts were under-reported and post-buoy cuts over-reported. This factor, too, would underestimate the effectiveness of the seagrass buoys.

Finally, fish are less likely to be found on the flats in the cold winter months. Therefore, anglers are less likely to fish the flats during the cold months which was the post-buoy period. In this case, it would overestimate the effectiveness of buoys.

Data interpretation

A comparison of the propeller cut mapping data of Big Pass and Sister Keys offers evidence that the buoys are indeed reducing damage to the grass flats. In both beds the overall amount of propeller cuts, measured in total linear footage, has decreased. The reduction is a significant one-third less linear footage in Sister Keys after the buoys than before. In Big Pass' polygon 2 (adjacent to the buoyed channel) the reduction is 45.9%. However, in polygon 1 of Big Pass, far from the seagrass-buoyed channel, the decrease in total linear propeller footage is a mere 1.4%.

What is puzzling is the difference in how the reduction occurred between the two beds. After marking the Sister Keys flat, there were more but shorter propeller cuts than there were before the buoys were in place. However, in the Big Pass flat, in both polygons, there were fewer but longer prop cuts after the buoys were installed than before.

Possible explanations for these differences may be found by looking at the characteristics of the beds--the activities in or near them, boat traffic volume, and the boater population. The Big Pass grass bed is surrounded by busy boating thoroughfares funnelling boaters from around the bay to and from the gulf. Boaters probably have a wide variety of boating skills and differing familiarity with the area. The channel marked with seagrass buoys is quite narrow (300-400 feet or less). Although the bed is used by both sport and commercial fisherman, the great majority of boaters are using the channel as a short cut between the gulf and the bay.

The channel by Sister Keys grass bed is less trafficked than Big Pass. However, it is a destination for both commercial and recreational fishermen. Those boaters very familiar with the area know there is a grass bed, although prior to putting in the buoys, had few reference points to guide them safely through the open water east of the grass bed. The novice boater not using a chart and exploring the back side of Sister Keys may be unaware of the grass flats' existence.

In summary, the assumptions are:

BIG PASS	SISTER KEYS
*many boaters	*fewer boaters
*boater population with wide range of experience-- from novice to expert	*boater population generally more experienced
*not necessarily locally knowledgeable	* generally boaters with local knowledge

In Sister Keys, the increase in the number of new cuts/ acre/ month may be explained by the fact that more experienced boaters are being attracted to the area, perhaps to fish. However, their skilled boating practices offer less damaging ways to escape the bed.

A credible explanation for the large decrease in the number of new prop cuts/acre/month in polygon 2 of Big Pass grass bed, is that the buoys are helping define the channel for the more naive and unfamiliar boaters and thus reducing entry into the bed.

However, the reasons for the increase in the average propeller length in both polygons 1 and 2 of the Big Pass bed is unclear. Possible explanations may include the fact that this bed is at an extremely busy boater intersection in an area which at first appearance is open water. Once in the grass bed, boaters may see the other edge of the grass bed (which at any point is only several hundred feet away) and decide to continue on their course to reach open water again.

In both beds, nearly parallel, or grazing cuts (subjectively interpreted as those trails left by boaters inadvertently grazing near the beds' edges, while attempting to stay within the channel) decreased. The largest reduction of nearly parallel entries was in Big Pass' polygon 2.

It appears that the buoys function differently near different grass beds, and in different portions of the same grass bed. Buoys marking channels which are high volume thoroughfares may prevent the most naive boaters from entering into adjacent grass beds. In less trafficked channels near grass beds which are boating destinations, the buoys seem to attract more experienced boaters.

The data (both the number of new cuts/acre/month and the total linear prop cut footage/ month) for the City Island flats demonstrates that over time boaters did not become more adept in heeding the buoys' warnings to avoid the grass bed, either in the marked or unmarked portions. However, the City Island grass bed was the pilot bed, and boaters informally reported that the configuration of the buoys was confusing. Based upon this grass bed, it is difficult to draw any definitive conclusions about how boaters respond to the buoys over time.

Over time, the decrease of the average length of the prop cuts, in both marked and unmarked areas of the City Island bed, perhaps indicates that even though buoys are attracting boaters, they are becoming more skilled in grass bed escape procedures. This may be due to boater education efforts and/or due to more experience in getting caught in grass flats.

Phenomena of interest

In several sections of the grass beds, interesting features were observed. In the December, 1990 photos of the western edge and the November, 1991 photos of the eastern edge of the City Island bed, circular patterns about 250 feet in diameter were visible. These were probably the signatures of commercial fishermen, after their nets had been pulled along the bottom of the grass bed. No trenches in the grasses nor any other evidence of scarring appeared in the subsequent photographs.

In the Big Pass bed, six or seven huge and deep depressions were observed in the grass bed. Many of them were sausage shaped. They all had white bare patches of shallower sand around one side of the hole. One of the largest, at the western tip, was approximately 100 feet long by 20 feet wide and about five feet deep in December,1990. At that time, the sand around the blowout was (at its widest) 60 feet by 95 feet . Eleven months later the sand covered 100' x 110' feet, and five months after that, it was 120' x 85'. The sand is migrating with the tides and covering up increasingly larger areas of seagrass.

One hypothesis is these large blowouts are from commercial boat towers who dislodge boats which are stuck in the grass bed by hydraulically blasting away a portion of the grass bed from underneath the grounded vessel. If this is the case, such practices are extremely damaging to the grass bed and should be stopped.

An extremely large area of the northwestern and the central portions of the City Island bed is almost devoid of seagrasses. Although there has been no noticeable change in the extent of these patchy areas during the almost two years of photography for this project, there is significant change between photographs taken in December, 1988 and June,1990. No explanation is offered for the disappearance of an estimated one-eighth of the grass bed.

BOATER OBSERVATION STUDIES

Detailed results of the boater observations studies at Big Pass and City Island are included in Appendix 8. A summary and comparison of the two studies follow.

Several flaws in study design were evident upon completion of the City Island observations, so the research team decided to conduct a second observation study at Big Pass. The second study used fewer observers, a single on-shore observation point, a more compact study area, and crab trap floats to clearly define the grass bed edge during the pre-buoy observation period. The results of the Big Pass study are more clear-cut. The more ambiguous City Island results support the Big Pass conclusions. City Island observations were divided into four zones, with only zone B completely marked with buoys. Zones A and C were partially marked and zone D was without markers. The data varied from zone to zone, leading to complex results.

At both sites the boats observed were primarily average-sized inboard and outboard motorboats. Jet skis composed 15% of the observations at City Island, and only 7% at Big Pass. Wind and human-powered craft accounted for less than 4% of the boats observed. On the average, the Big Pass boats were larger and carried more passengers.

At Big Pass the percentage of boats entering the grass bed increased significantly after installation of the buoys, from 0.7% before to 9.0% after (significance .0000). Significant post-buoy increases in boat entries were observed in zones C and D of the City Island grass bed, with a marginally significant (.07) increase in zone B as well. This is clear evidence that seagrass buoys bring more boats onto the bed.

At Big Pass there was a significant decrease in grazing or nearly-parallel boat entries after the buoys were placed (63.6% before, 33.3% after) This supports the idea that buoys do reduce the number of boats intending to stay in the channel but entering the grass bed accidentally.

The City Island data show an increase in nearly-parallel grass bed entries along the buoyed edge, but this result is questionable, due to the inability of the observers to see the grass bed edge prior to placement of the buoys. Observers at City Island considered all parallel boat activity prior to buoy placement to be over deep water. No parallel entries were reported in the before-buoy observation period. Correcting this flaw was the primary reason for conducting the Big Pass observation study.

The Big Pass data show a significant increase in fishing activity in or near the grass bed after the placement of the buoys. Before the buoys were placed, 2.7% of the observed boaters were fishing, compared to 5.7% of the observed boaters which were fishing after the buoys (significance .0087). There is also a significant increase in the number of recreational fishermen actually entering the grass bed after the buoys are placed. Before the buoys, no fishermen were observed entering the bed, and after the buoys 81.8% of the fishermen in the area entered the grass bed (significance .0178).

At City Island, the number of recreational fishermen entering the grass bed in the marked zone B jumped from 10% to 25% after the buoys were installed. Recreational fishermen are the group most likely to be attracted by seagrass buoys.

The Big Pass data show no significant change in either the use of motors to exit the grass bed or the position of the boat propeller while over the grass bed. The study design hoped to show boaters being more careful over the grass bed after placement of the buoys, either by tilting their propellers up or using trolling motors or poles to move over the grass. There was no evidence of this.

At Big Pass, 37.5% of the boaters who entered the grass bed slowed down or stopped to look at the buoys first. At City Island, 26.7% of those who entered the grass bed slowed down near the buoys first. Further, at Big Pass 19% of the boaters who changed their course near the markers turned to enter the grass bed. At City Island 25.8% of the boats entering the grass bed in zone B changed their course near a buoy in order to enter. The buoys are causing some boaters to change course and slow down, but a disturbing number of those boaters are slowing and turning to enter the grass bed.

The observation study shows clearly that seagrass information buoys bring more boats onto the grass beds and significantly increase recreational fishing on the grass bed. There was no evidence that the buoys led to more careful boater behavior over the grass beds such as tilting the motor up or using trolling motors or poles over the grass. While many boats slowed or changed course near the markers, a fifth of them turned to enter the grass bed. The most positive outcome observed was that accidental grazing or near parallel entries to the grass bed were significantly reduced after buoys were placed at Big Pass.

DISCUSSION

EDUCATION

Boater interviews revealed that about 40% of boaters occasionally get caught in local grass beds. Further, boaters who enter prop cut beds can be categorized into two groups: 1) naive, accidental enterers, and 2) experienced boaters who are aware of the grass bed yet still enter it. Educational materials should focus on these two very different audiences. Both groups require information about the presence and ecological importance of seagrasses, how to avoid grass flats, and least-damaging escape methods.

Reactions to the slide shows presented to boating clubs offer strong evidence that a small amount of education changes boaters' attitudes. Hopefully, that change will be translated into more careful boat operation over and near seagrasses.

Every group contacted--private boating groups, marinas, and public agencies-- were very cooperative in distributing educational materials. Through their outstanding cooperation two simple messages: 1) seagrasses are valuable; and 2) here are ways boaters can protect grass beds, were successfully disseminated. With a little effort, boater education on seagrass can be continued and expanded.

SYNTHESIS OF MAPPING AND BOATER OBSERVATION STUDIES

Synthesizing the results from both the mapping and boater observation studies, a strategy emerges for a bay-wide marking system that will most effectively protect seagrass beds. The results of mapping prop cuts Big Pass and Sister Keys demonstrated that the buoys' overall effect was to decrease total linear prop cut footage. In the portion of the Big Pass bed which is closest to the newly marked channel, the percentages of boats slicing through grass meadows were reduced after buoy installation. At both beds, the buoys aided boaters who inadvertently strayed into shallow waters and grazed the edge of the grass bed, particularly in poylgon 2 of the Big Pass bed.

Both boater observation studies showed, however, that buoys attracted boaters into the beds. At Big Pass and City Island, recreational fishermen accounted for much of the increase in enterers. The Sister Keys' mapping data demonstrated that there were more new prop cuts/acre/month after the buoys compared to than before, also supporting the notion that buoys attract more anglers into seagrass meadows.

For some boaters, the buoys acted as guides for safe passage through the channels . For others, they functioned as magnets to the grass beds, not as barriers.

Our results, therefore, are mixed. Overall linear footage of propeller cuts decreased after buoys were place, but the number of boats entering the grass beds clearly increased. The buoys attracted more boats to the grass bed, but cumulative cutting decreased.

Buoys were more effective as channel markers than as markers of seagrass beds. The buoys' best results were at the western section of Big Pass, essentially marking a previously unmarked channel. Here both the number of new cuts and the total linear footage of cuts decreased significantly after placement of the buoys.

There were no measurable positive secondary effects of the buoys informing boaters about the location of the seagrass. Boaters who did enter the flats did not change their exiting styles (i.e. exit with their motors off and propellers tilted upward).

The final result is that the seagrass buoys were successful in reducing damage by boat propellers to grass beds. However, it is disconcerting that in so doing, more boaters were attracted to the beds. Armed with the above information, one could refine the marking system to a potentially more successful system. Perhaps if conventional channel markers were used instead of seagrass buoys the number of boats entering the bed accidentally would be reduced without encouraging anglers and other boaters to purposefully enter the bed. This hypothesis should be tested using similar aerial photography analysis, and a boater observation study, before instituting this marking system bay-wide.

OVERALL EFFECTIVENESS OF SEAGRASS SIGNAGE PROJECT

Figure 18 shows the hypothetical extrapolated impact boats and buoys have on two entire seagrass beds over the course of a year. Taking the results of the number and length of scars measured in our test polygons, acreage and miles of annual seagrass lost to cuts were extrapolated for the entire bed at Sister Keys and Big Pass. The assumptions were that prop cuts were 1) uniformly distributed across the area of each bed, 2) uniformly distributed during the course of a year, and 3) an average of 18 inches in width. An additional assumption included that future years will have the same boating activity as in the study years.

Before the buoys were installed, approximately 1.0% - 2.0% of the two grass beds studied were sliced away by propeller blades last year. After the buoys, about 0.6%- 0.7% of the grass beds were destroyed by spinning boat propellers. The buoys at Sister Keys presumably will prevent about 19% of the prop cuts over the course of a year, and the buoys at Big Pass presumably will prevent 24% of the prop cuts during a year. Buoys prevented about one-fifth to one-quarter of propeller cuts which would otherwise occur. The overall effectiveness might be rated "fair".

Other management techniques which promise to be more effective, including prohibiting combustion-motorized boats, must be seriously considered.

Figure 18. Extrapolated impacts boats and buoys have on two seagrass beds over the course of a year

LOCATION	LINEAR MILEAGE OF SEAGRASSES LOST DUE TO PROP CUTS (miles)		SEAGRASS AREA** LOST DUE TO PROP CUTS acres, (% of total bed)		SEAGRASS AREA SAVED/YEAR WITH BUOYS acres, (%of total bed)	PERCENT OF PROP CUTS REDUCED EACH YEAR BY BUOYS
	BEFORE*	AFTER	BEFORE	AFTER		
Big Pass (total acreage)	7.59	5.77	1.38 (-2.0%)	1.05 (-1.5%)	0.33 (0.49%)	24%
Sister Keys (total acreage)	44.3	36.0	8.05 (-0.95%)	6.55 (-0.78%)	1.50 (0.18%)	19%

*"Before" throughout this table means the 11 months (December, 1990- November, 1991) before the buoys were installed.
"After" throughout this table means the 5 months (November, 1991- April,1992) after the buoys were installed.

**Acreage was calculated assuming the prop cuts averaged 18 inches in width.

RECOMMENDATIONS

MARKERS

1. Clearly mark channels near grass beds with conventional channel markers, **not** seagrass informational markers. Mark the channel, **not** the grass bed edge.

2. Mark those channels which are adjacent to propeller damaged grass beds, especially those that have cuts that are roughly parallel to the channel. This will guide novice and unfamiliar boaters through the deeper water and deter them from accidentally entering shallow grass bed.

3. The marked channel should be wide enough to allow boat traffic to pass safely and, if possible, provide a buffer zone of deep water beyond the marked channel and along the grass bed edge for anglers who want to fish near the flats. (See figure 19.) In this way, anglers will be able to fish the flats, without entering the bed to fish and without risking getting hit by boats travelling in the channel.

4. Remove the buoys near City Island as soon as possible. The mapping analysis shows that boaters are damaging the flats more as the buoys remain longer.

5. Use conventional channel markers to clearly mark the north-south channel to the east and to the west of the City Island bed. This would be an excellent site for further monitoring.

6. The buoys at Big Pass and Sister Keys at some point should be removed and replaced with conventional channel markers. They are not damaging the area, but conventional markers may be more effective.

7. Use buoy markers instead of posts when marking selected channels. Buoys are safer for boats.

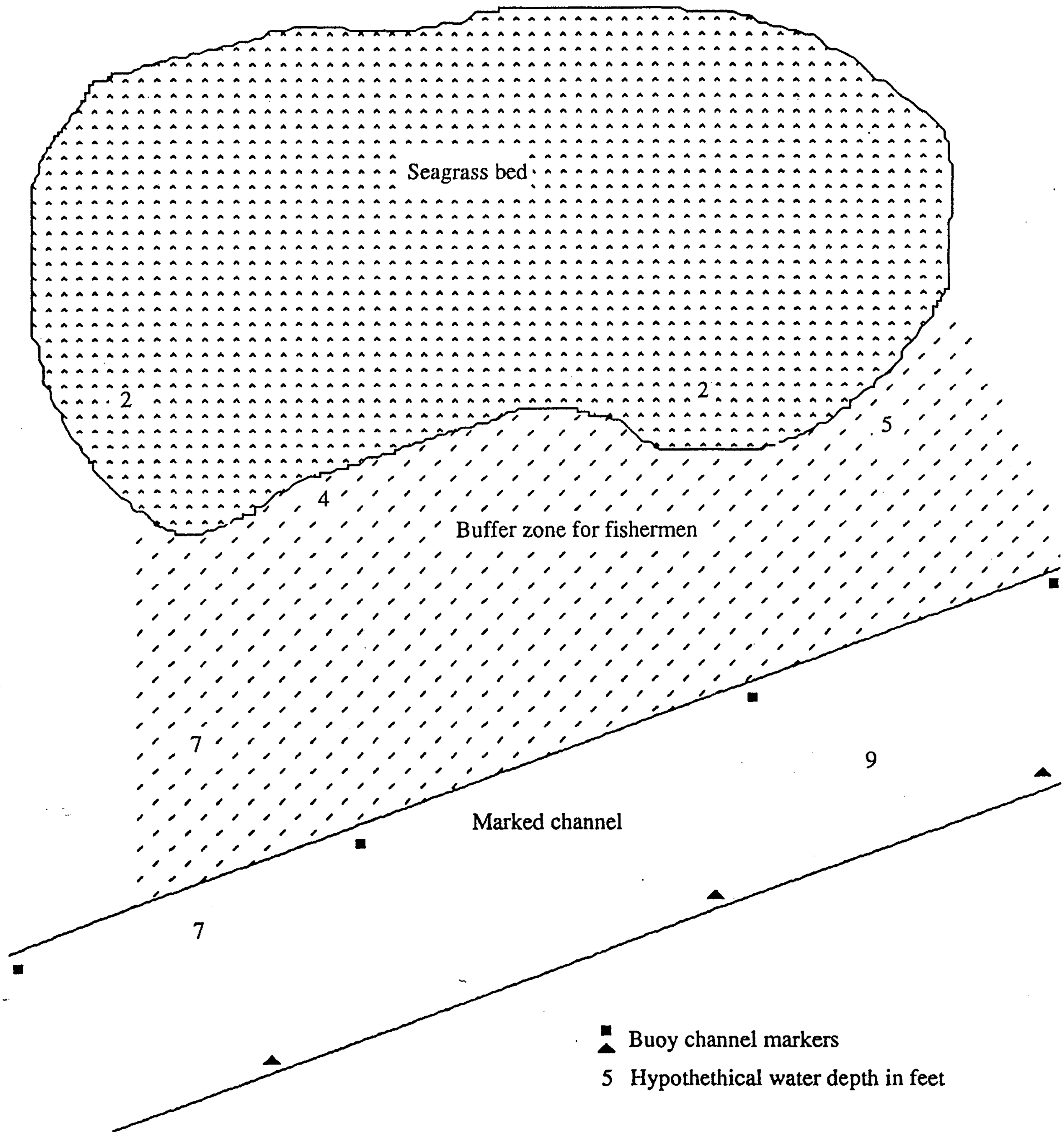
MONITORING

1. Monitor the effectiveness of the channel markers to determine if propeller cuts are significantly reduced. Aerial photography, one or two times per year, for several years is recommended. Mr. Frank Sargent, remote sensing analyst at the DNR Marine Research Lab in St. Petersburg is currently mapping seagrass beds for the state. His office is developing state-of-the-art techniques on seagrass bed photography and mapping. DNR should be asked to add City Island, Big Pass, Sister Keys and other selected grass beds with adjacent channels targeted for marking to add to their mapping efforts.

2. a. Chose a pilot grass bed to prohibit watercraft with internal combustion motors. Craft in the grass flats propelled by trolling motors, poling, paddling, and drifting would be allowed. Simultaneously enhance enforcement efforts. Monitor the bed with aerial photography to determine the effectiveness of this management technique.

b. Select Sister Keys grass flat as the pilot to prohibit watercraft with combustion motors and monitor the effects. This bed is an ideal candidate for a trial motorized-boat prohibition. It is the largest *Thalassia* grass flat in Sarasota Bay, is severely propeller scarred, and the Township of Longboat Key is in the final stages of buying the islands in

Figure 19. Recommended channel marking near grass beds



order to protect them from development. Sister Keys are currently in the media and momentum is high to preserve their resources.

Consult with groups who have successfully closed grass beds to watercraft with combustion motors, including:

-The Florida Department of Natural Resources has very successfully closed the grass bed at Weedon Island State Preserve since October, 1990. Keith Thompson, park manager, reports that the program is enormously successful, with a 95% reduction in propeller cuts since closure (pers. communication, Keith Thompson). Thompson states that areas where 3-4 new propeller cuts occurred daily, there are now 10-15 new cuts annually. Thompson also emphasizes that both a pre-closure and on-going education program is critical to success.

-Pinellas County commissioners have recently adopted an ordinace to prohibit motorized watercraft in a portion of the grass flats in Fort Desoto Park. Commercial fishermen were involved throughout the decision-making process.

EDUCATION

1. Continue boater awareness through on-going education to boaters in general. Educate the novice boater as well as the experienced anglers.

2. Utilize the following strategies in education:
   a. Work with Coast Guard Auxiliary and Power Squadrons and other boating clubs to incorporate seagrass information into their classes and/or newsletters.
   b. Ask Coast Guard Auxiliary Flotillas to distribute seagrass information with their volunteer vessel examinations .
   c. Work with recreational and commercial fishing groups to educate their membership.
   d. Work with local newspaper fishing columnists to educate readership.
   e. Distribute seagrass brochures to all boaters during annual registration.
   f. Distribute seagrass brochures to bait shop and marinas throughout the bay.
   g. Work with local and state governments to distribute brochures to every homeowner with a newly permitted dock in the Sarasota Bay area and every new homeowner with an existing dock.
   h. Install boat ramp signs at every public boat launching ramp to Sarasota Bay.
   i. Work with marina operators who rent boats to educate novice boaters and/or those unfamiliar with this area in seagrass avoidance and safe grass bed escape practices.
   j. Aid boat dealers and boat mechanics in trying to market trolling motors to flats anglers.

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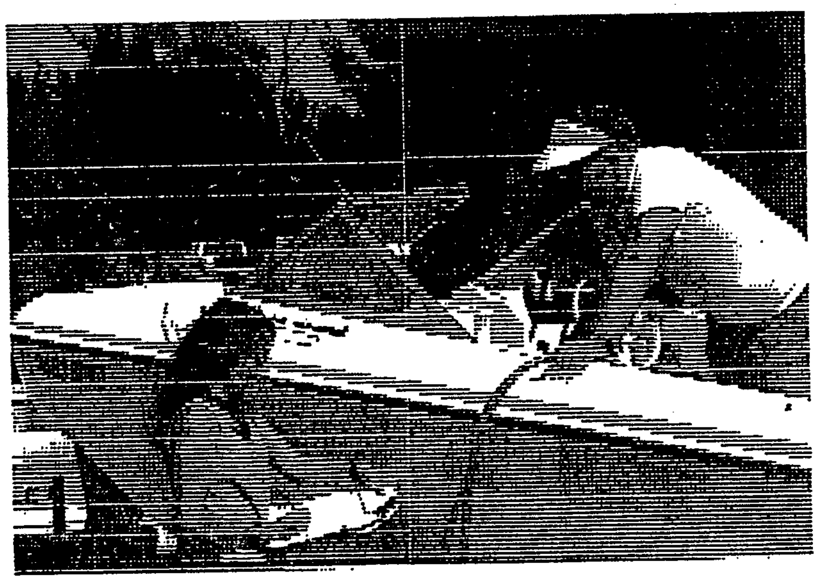
Appendix 1. Boater interview report

BOATER INTERVIEWS

OF THE SEAGRASS SIGNAGE PROJECT



Environmental Studies Program
New College

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BOATER BRIEFS -- EXECUTIVE SUMMARY

1.) Of the 243 boaters interviewed at local boat ramps, 156 people are sport anglers. This represents 64 percent of the interviewed population.

2.) Most boaters (63 percent) feel that the condition of Sarasota Bay has deteriorated. Only 5 percent feel that the bay's condition has improved.

3.) According to self-reports, most boaters do not run aground ("get caught") in seagrass beds. Only forty one (41) percent admitted to getting caught "occasionally," while fifty nine (59) percent never get caught.

4.) The lack of channel and seagrass markers account for the largest number of boats (30 percent) running aground in the beds. Misjudged tides account for 15 percent of the boats running aground, and fishing the flats account for about 13 percent, according to interviewed boaters and based upon the number or responses.

5.) A small minority (15 percent) of boaters feel that using the boat's motor is the most effective method for escaping a grass flat. It is thought that motor release methods are responsible for many of the large scars visible from aerial photographs. Most people (51 percent) simply walk their boats to deeper water.

6.) Still, a larger percentage of people using the motor release method admit to getting caught in grass beds than the general population. While only 41 percent of the general population run aground, two thirds (67 percent) of those using the motor release method run aground.

7.) The data suggests an important distinction between general and specific familiarity. While a general awareness of Sarasota Bay seemed inconsequential in terms of the rate of seagrass interaction, a specific familiarity with the location, function, or importance of seagrasses seems to decrease the occurrence of running aground in the grass flats.

8.) Boaters indicate that an ecologically-oriented education effort would be more effective in protecting seagrass habitat than all other messages combined -- including danger to boat, inconvenience, legal implications, fine or punishment, and others.

9.) When asked to describe their responsibility in protecting the bay, half of the boaters said that they should not litter. The next closest responses were "safe or careful behavior" which received support from twenty seven (27) percent of the boaters, and "awareness and practice of rules" which received support from ten (10) percent of the boaters.

PREFACE:

Increasingly, it seems, environmental concerns are being portrayed within a nasty polemic. In our own community, for example, we witness controversies which dubiously separate economics and environments; progress and conservation; or culture and nature. Forced to play the game of either/or, citizens become confused or frustrated as neither choice -- in and of itself -- offers real relief or security.

The only reasonable response, of course, is dialogue. Clearly, it is the responsibility of all interested people to engage in activities which we have traditionally avoided. Environmentalists must accept and think about growth. Developers must accept and think about natural areas. The dependencies of each upon the other offer us a very real opportunity for sincere and open discourse.

The Seagrass Signage Project, as part of the National Estuary Program, is pursuing the stated goals of protecting and restoring lost habitat of Sarasota Bay. The problem that the signage project addresses is interesting in that it involves individual decisions and actions in a highly specific situation. As part of this project -- and in order to nurture an essential dialogue concerning the future of Sarasota Bay -- we have conducted this boater interview.

Public education, attitude shifts, and behavioral changes must be grounded with the boaters themselves. Our goal throughout the interview project has been to understand boater actions, attitudes, and awareness with regard to Sarasota Bay's fragile grass beds. But more interesting and complicated are the various relationships between these factors. How does boater familiarity, for example, correlate with undesirable seagrass interactions? Or, how does a demonstration of concern for the health of the bay effect one's interactions in the bay, or one's perceived role in protecting the bay? As we shall see, these questions become increasingly more complex and provocative as we pursue their answers.

As well, we have gathered demographical and biographical data of our interviewees. This will allow us to speculate as to the specific groups which are most likely to interact with seagrass beds. Limitations of this type of causal procedure will be discussed; but it is important to point out that extreme caution is required when offering causal relationships.

Through the data collected and the interview process itself, we hope to contribute to an ongoing conversation specifically interested in Sarasota Bay, and generally interested in the creation of a sustainable society.

INTRODUCTION:

Two hundred and forty three (243) interviews were conducted from March 4 to March 18, 1990 at the following locations:

City Island....................68 interviews
Sarasota Boat Show....................65 interviews
10th Street Boat Ramp....................58 interviews
North Coquina Boat Ramp....................34 interviews
Causeway Park....................18 interviews

Our interviewers were the following New College students:

Lisa Milot....................59 interviews
Catherine Molteno....................56 interviews
Carrie Carrel....................54 interviews
Deborah Graves....................46 interviews
Dayna Ayers....................16 interviews
Brian Israel....................12 interviews

Professional consultation and guidance contributed extensively to this report and included the following special people:

Ruth Folit; Coordinator of the Seagrass Signage Demonstration Project for the National Estuary Program.
Julie Morris; Coordinator, Environmental Studies Program at New College.

We received additional consultation for the project from Professor Natalie Rosel; Division of Social Sciences at New College.

METHODS:

The interview procedure was straightforward. We approached boaters at boat ramps as they were either exiting or entering the water. The one exception involved the interviews conducted at the Sarasota Boat Show on City Island. Interviewers approached boaters based upon availability alone; no particular population was targeted.

It is important to state that our population is skewed because of our interview procedure. This interview cannot be understood as a survey of boaters in general, given that the interviewees were mostly approached at boat ramps. Boaters not interviewed are those who use marinas, private docks, and boat rental docks.

Boaters were asked to answer a few questions, and promised that the interview should only last from five to ten minutes. If we were asked as to our purpose, we explained that we were New College students conducting a survey of boaters using Sarasota Bay. At this point, interviewers did not mention any interest in seagrass beds.

The interviews were analyzed using Double Helix 2.0, a relational data processing program. Graphs were created with Microsoft Excel; and all word processing was done on Microsoft Word 4.0. All computer work was done on USF/New College Macintoshes. The interviews themselves, Helix documents, and additional information are available at the New College Environmental Studies Program.

This report includes four sections:

I. **Boater Briefs** -- This is a quick, one-page executive summary which abstracts the conclusions of the discussion.

II. **Discussion** -- The discussion section offers an interpretive journey through the data. It suggests conclusions as to the meaning of the study; and provides readable pie and column graphs.

III. **And Other Fancy Stuff** -- This appendix section takes a closer and comparative look at five different points: conditions for running aground, escape behaviors, majority groups, boating activity, and boat size.

IV. **Data** -- This section provides the reader with tallied data, including numbers and percentages. Also provided is a data table of all 243 interviews.

DISCUSSION -- RUNNING AGROUND IN SEAGRASS BEDS:

The primary intent of the interview project was to learn about boaters. In order to think about practical policies for seagrass management, we need to know more about the actions, awareness, and attitudes of Sarasota Bay users.

I. ACTIONS -- How many people are reporting that they run aground, or get caught, in seagrass beds? How accurate and reliable are these responses? And what specific groups, if any, seem to be more likely to run aground in the grass beds?

II. AWARENESS -- How familiar are boaters with Sarasota Bay, in general -- and seagrass habitats, in specific? What is the relationship, if any, between a boater's familiarity with the bay and a boater's actions toward the bay?

III. ATTITUDES -- Are boaters worried or concerned about the condition of Sarasota Bay? What management techniques do boaters themselves feel would be successful?

There is one question in particular which seems to connect all three categories. How can we change attitudes in order to effect behavior? Our study suggests that the answer involves familiarity and ecological awareness of seagrasses. While ecological information will not alter the behavior of every boater, it is encouraging to learn that such an approach is both appropriate and necessary. Planners, managers, and environmentalists can use this information when designing educational material and formulating environmental policy.

ACTIONS:

Boaters were asked, "On the average, how often per outing does the boat get caught in seagrass beds?" This question provides much of weight and material for any interpretive inquiry into the interview responses. As with any data gathering, one must ask about the reliability and validity of the received information.

While we expect that the honesty of the boaters is reasonably assured, we must accept the tendency to positively self-report. There are three factors which we hope increased the reliability, or honesty, of the responses.

I. Firstly, all questions preceding the "running aground" question were value-neutral and requested only biographical or demographical information. The question, then, was asked within a non-judgemental, non-accusatory context.

II. Secondly, we inquired only about the boat and not about the boater. The words "how many times does the boat get caught..." highlights the accidental qualities of getting caught in shallow water. The phrasing of the question, we hope, was much less antagonistic than something like, "How many times do **you** get caught..."

III. Thirdly, the structure of the question suggested an expectation and acceptance of the reality of getting caught. Rather than asking "Do you get caught," we asked "How often?" This format, we think, provides for greater ease and comfort for the boater when self-reporting behavior.

In addition, we must accept the possibility that boaters' responses are based upon selected memory. We have therefore attempted to improve the reliability of the data through a dichotomous presentation of the information. While boaters were offered the opportunity to report the specific number of times caught per outing (see below), the data processing has depended only upon the distinction between getting caught OCCASIONALLY and getting caught NEVER. While boaters may mistakenly report the specific number of times he or she runs aground, the boater is unlikely to mistake "getting caught occasionally" for "getting caught never."

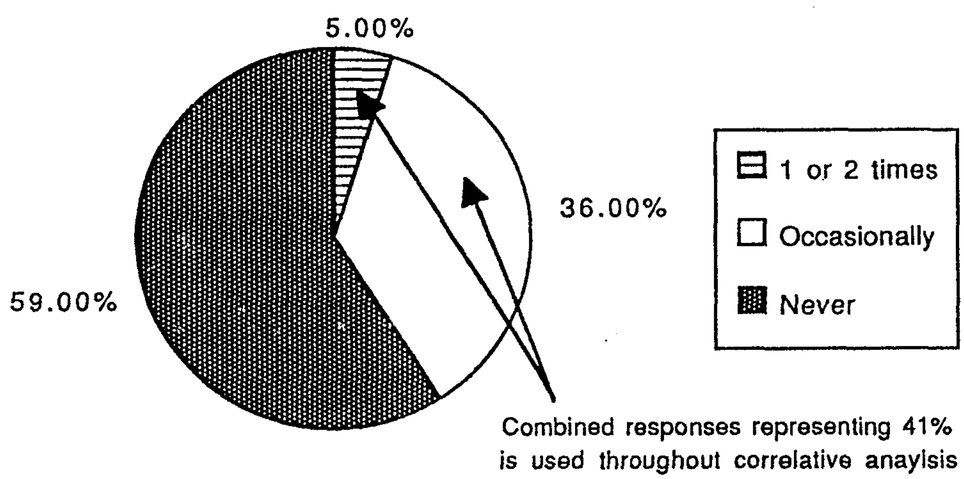
The full interview question reads as follows:

On the average, how often per outing does the boat get caught in seagrass beds?

A) More than 4 times per outing
B) 3 or 4 times per outing
C) 1 or 2 times per outing
D) Occasionally
E) Never

No boater reported that he or she gets caught in the beds "3 or 4 times per outing" or "more than 4 times per outing." Five (5) percent said that they get caught "1 or 2 times per outing" and thirty six (36) percent said that they get caught "occasionally." Meanwhile, fifty nine (59) percent said that they "never" get caught in seagrass beds. For the purpose of statistical analysis, we have combined the responses "1 or 2 times" and "occasional" to provide more approachable comparisons. Our study found, then, that forty one (41) percent of all boaters get caught occasionally, while fifty nine (59) percent never get caught.

On the average, how many times per outing does the boat get caught in grass beds?



Does the question ask what we think it is asking; that is, how valid is the question? There is at least one important point of confusion concerning the validity of this question.

Can we establish that interviewees in fact understood the question? How does the boater interpret "get caught"? It is plausible that a boater may not think of all seagrass interaction as "getting caught" or "running aground." At all points prior to being forced to a complete stop, "getting caught" may be a varied and ambiguous term. This represents a limitation in the study which should be considered in future boater research. This problem, however, is itself qualified by the fact that the room for ambiguity is small. Because "getting caught" is such a direct and unsubtle term, we feel confident that boaters generally understood the expression as "running aground."

The real limitation of our study, then, is that we inquired only about one of many possible types of seagrass interaction. We have not asked about the frequency and/or effect of mud-churning, local turbidity, and subtle prop dragging. Given that damage to the habitat probably occurs in such cases, it is a recommendation to future studies that they should inquire as to a greater scope of seagrass interactions.

Although this question threatens the specific validity of the data, it only decreases our perception of the scope of the problem. That is, boaters are not being unfairly portrayed because of the above point; rather, prop scarring and boaters are made to appear less of a problem than may be the case. For this reason, we will maintain the validity of the question; but we will qualify it by saying that it pertains to only one type of habitat alteration.

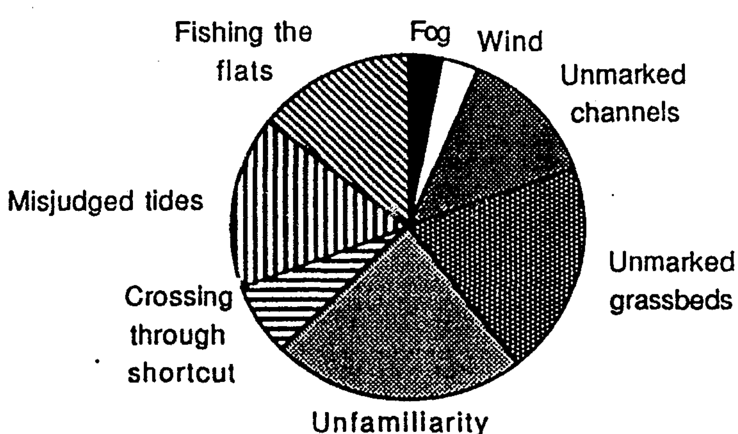
Forty one (41) percent of the boaters interviewed report that they get caught in seagrass beds occasionally, while fifty nine (59) report that they never get caught. While this means that a minority of the people are getting caught in grass beds, it is a large and formidable minority. Furthermore, with record growth in Southwest Florida, and the subsequent increase in boater registrations, the base number of boaters using Sarasota Bay increases dramatically. With this alarming numerical surge, the forty one (41) percent figure becomes ominous. Clearly, the percentage calculation must be qualified by the recognition that the boater population is large and growing, and forty percent of a large number indicates a large number of prop scars.

What do these boaters know about Sarasota Bay? In general, are people aware of serious management problems facing the bay's future? Are boaters knowledgeable about the location, function, and fragility of seagrass flats? And, most interestingly, does a knowledge about Sarasota Bay indicate any possibility that a boater will cause less prop scars?

AWARENESS:

Intuitively, it seems that awareness or familiarity should be directly related to the number of times one is caught per outing -- if you are familiar with an area, you are more likely to avoid dangerous or harmful practices. Accordingly, when asked directly, "What conditions are most responsible for getting caught in the grass beds," fifty (50) percent of the total number of responses regarded issues of familiarity, including unmarked channels, unmarked grass beds, and general unfamiliarity. Of the boaters responding, thirteen (13) percent blamed unmarked channels, twenty one (21) percent blamed unmarked grass beds, and twenty four (24) percent blamed general unfamiliarity to be a causal condition responsible for getting caught in the grass flats. Other responses were as follows: four (4) percent of the boaters blamed fog; three (3) percent blamed wind; seven (7) percent said that they get caught while crossing through a shortcut; seventeen (17) percent of the boaters misjudge the tides; and fifteen (15) percent of the boaters get caught while fishing the flats.

Conditions for Getting Caught

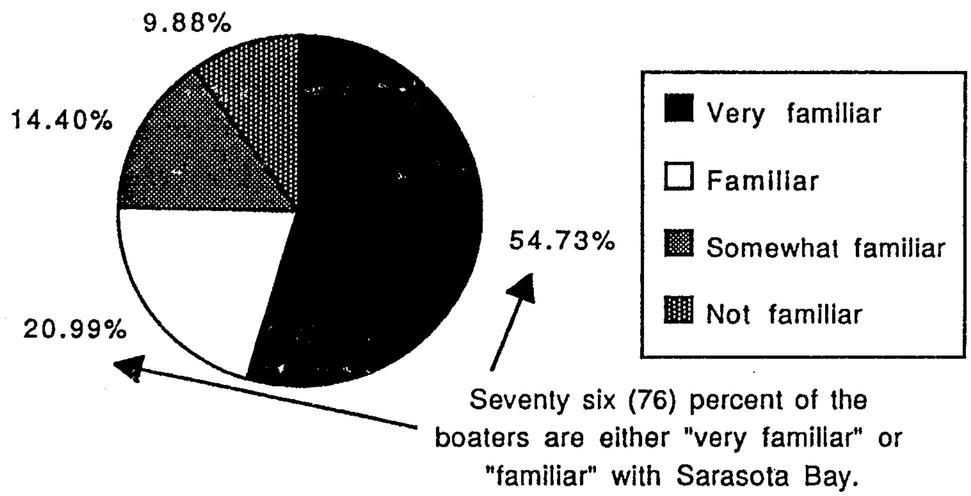


(Note: percentage representation based upon number of responses)

(See line and column graph in Appendix 1 for more details.)

These connections, however, become somewhat less convincing when we examine the responses to the following question: "How familiar are you with Sarasota Bay?" Seventy six (76) percent of the boaters claimed to be "very familiar" or "familiar," while fourteen (14) percent claimed to be only "somewhat familiar" or "not familiar." With only ten (10) percent of the boaters who were absolutely unfamiliar with Sarasota Bay, why do we have over forty percent getting caught in grass beds?

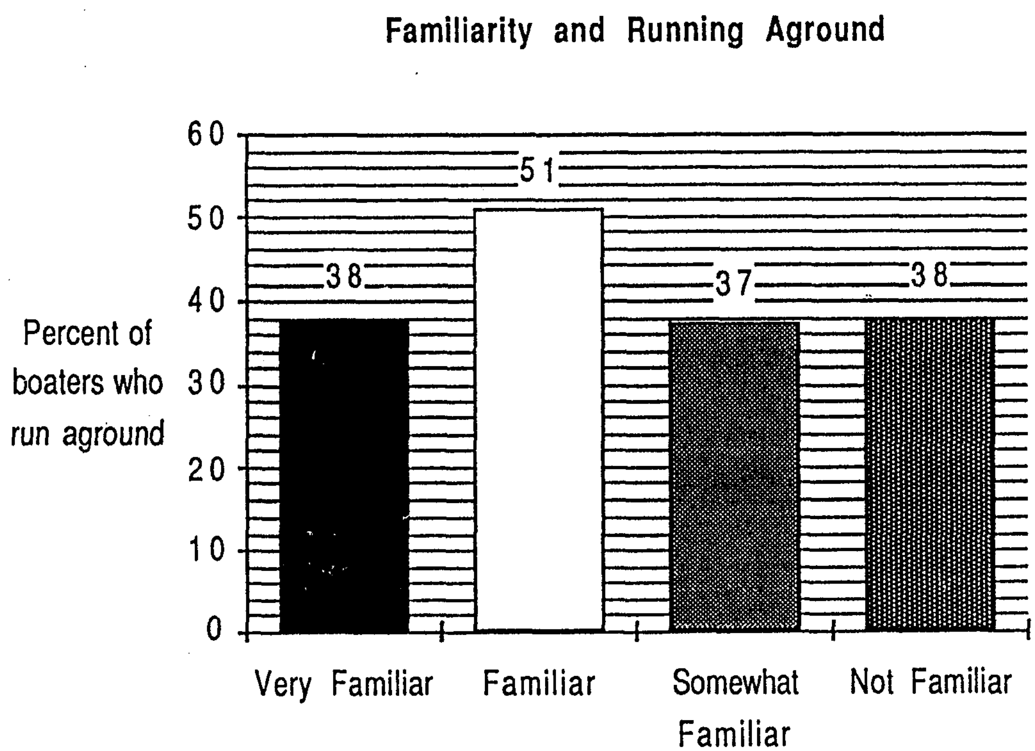
How familiar are you with Sarasota Bay?



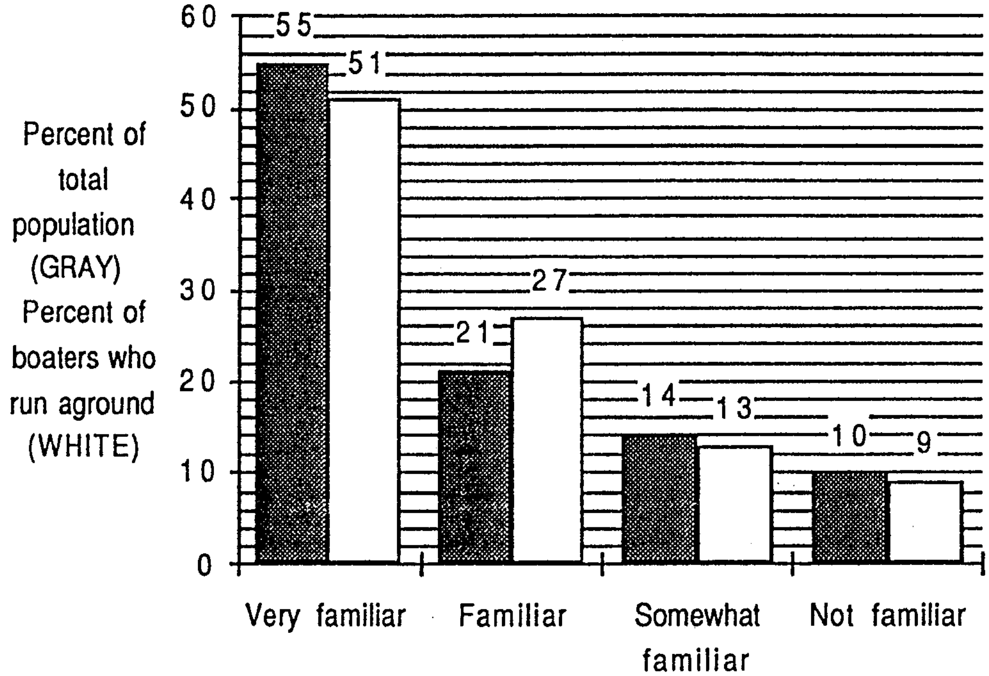
The correlative data between familiarity and caught/outing reveals less causal evidence than anticipated. The results, in fact, are bewildering. We asked the following question of the data: What percent of those who are familiar with Sarasota Bay get caught in grass beds? One would expect that as familiarity increased, times caught per outing would decrease. As the graph below shows, there are four groupings to demonstrate degree of familiarity: very familiar, familiar, somewhat familiar, and not familiar.

All but one "familiarity" group reported about thirty eight (38) percent occasional interaction with the beds. That is, about thirty eight (38) percent of the boaters who are "very familiar," "somewhat familiar," and "not familiar" reported getting caught in grass beds.

Over half (51 %) of the boaters, however, who are "familiar" with Sarasota Bay get caught in the grass beds.. This immediately calls to question any assumption that there is a linear relationship between self-reported familiarity with Sarasota Bay and self-reported rate of occurrence of seagrass interaction.



When we reverse the method of correlation, we find the same idiosyncrasy. For this correlation we ask the question, "What percentage of those getting caught in seagrass beds report that they are familiar with the bay?" As above, the percentage of boaters who are "familiar" increases when we select for getting caught occasionally, and every other group decreases. While boaters who are familiar with Sarasota Bay account for twenty one (21) percent of the total interviewed population, they account for twenty seven (27) percent of the population who are getting caught in grass beds.



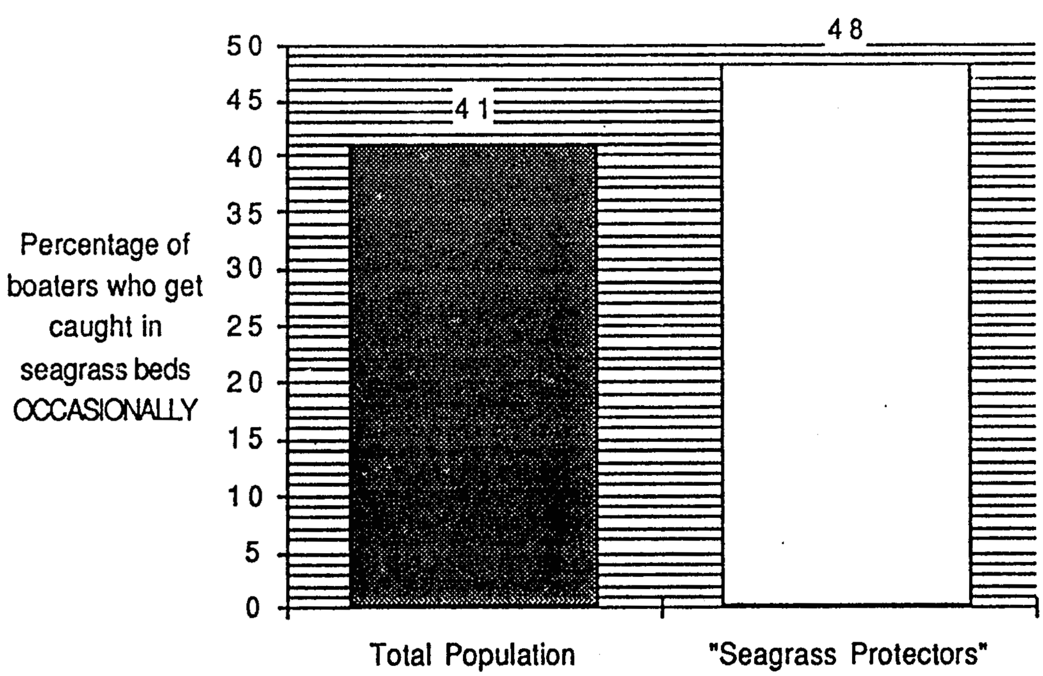
There is no expected increase in rate of occurrence as degree of familiarity decreases. General familiarity with Sarasota Bay seems to have no immediate or understandable relationship with getting caught in grass beds.

It then becomes important that we think seriously about the meaning of familiarity, especially in terms of the contexts within which it was asked. When asked "How familiar are you with Sarasota Bay," boaters were referring to a general familiarity, indicating overall experience and general knowledge of the bay area. All the questions up to and including this question were very general and suggested no interest in the specifics of seagrass beds or shallow water.

However, when boaters were asked "What conditions are most responsible for getting caught in the grass beds," interviewees had began focusing on the situation of running aground. The question about conditions responsible for running aground, then, involved a concrete situation in which boaters could account for specific personal experiences and/or offer perceptions of the problem.

Because of these very different contexts, a discrepancy between familiarity as a causal condition, and familiarity as self-reported knowledge about the bay, is less significant. In other words, we may still maintain the integrity of the boaters' report that familiarity is a major causal condition in the undesirable interaction with grass beds. The important qualification is that we understand familiarity in specific terms with regard to grass beds. While general familiarity with the Sarasota Bay is not causally related to seagrass interaction (in our study), specific seagrass familiarity or awareness is relevant.

Additionally, there is correlative evidence to conclude that specific, seagrass-oriented familiarity is a relevant issue in this aspect of Sarasota Bay management. When we asked boaters, "What do you think your role as a boater should be in protecting the bay?", we find that 21 people (or 9%) feel that avoiding seagrass beds or staying in the channel are a priority responsibility. For the sake of creating a label, we will call these nine (9) percent *seagrass protectors.*



As it turns out, 10 of these people (48% of the seagrass protectors) get caught in seagrass beds. The reason that this is worth remarking is that only forty one (41) percent of the total population get caught in seagrass beds. In other words, a higher percentage of boats are running aground in grass beds by people who feel that protecting the habitat is their responsibility, than by the total population. Even though the sampling size and percentage differences are small, the fact that the percent of those getting caught went up when we selected for seagrass protectors is interesting. It seems, in one sense, counter-intuitive to believe that seagrass protectors would get caught more often than others.

One explanation, however, offers a reasonable account for the data. People approached the question about running aground within a non-judgemental and non-didactic context. By the time they were asked about their responsibility toward the bay, however, boaters had been passively educated (or at least reminded) about the experience of running aground in grass beds. Problems and issues facing the bay had also been discussed. Boaters, then, had been forced to think about seagrass interaction. This increased familiarity (either as a introduction or as a reminder) with the issues of running aground may have provided the catalyst for a change in behavior. That is, boater attitude improved as a reaction to the interview itself. Admittedly, the evidence is inconclusive. Nonetheless, it is plausible, if not likely, that boaters' attitudes (and, we hope, behavior) was influenced by this limited example of seagrass education.

The conclusion of this section -- that familiarity of seagrass beds is an important factor -- should be qualified by the statement that a large number of people are intentionally entering the grass flats. Fifteen (15) percent of the boaters interviewed blamed fishing the flats, and seventeen (17) percent blamed misjudged tides, as a primary causal condition for running aground. It is assumed that these numbers represent a population which is very knowledgeable about the seagrasses, and are active users of the beds. While seagrass education for these boaters might be helpful, it is more likely that a different management technique should be developed for people who are actively using the flats.

ATTITUDE:

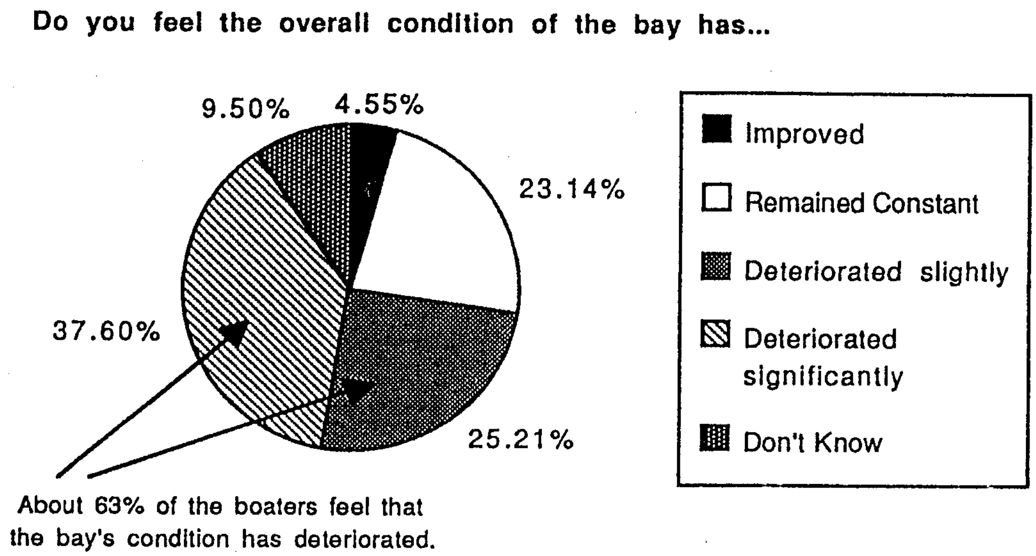
What are boater attitudes toward seagrass beds and Bay management? Boater attitudes were inquired from a number of different questions including perception of bay's condition and problems, perception of boater's role, and perception of successful management possibilities. Of particular interest here is the following question: What advice can we extract from the boaters which will help when thinking about boater education projects? Boater education refers specifically, in this case, to the content or message of all educational material (e.g. the message on seagrass buoys, the messages on large signs at boat ramps, the content of brochures, the focus of public speaking and publicity, etc).

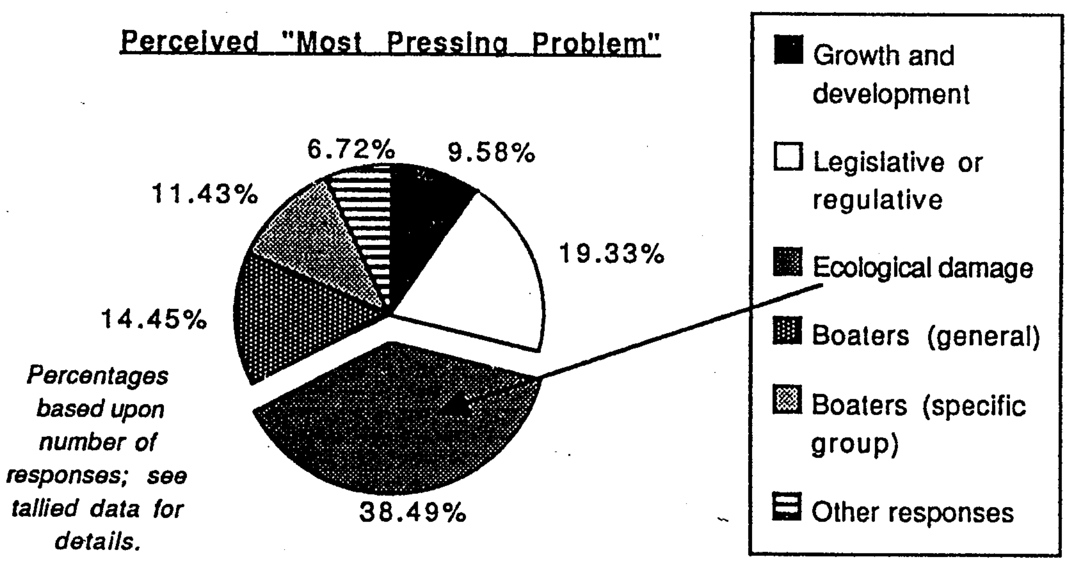
Boaters' attitudes indicate that education should focus on seagrasses and ecological damage, as opposed to damage to boats, possible inconvenience, or legal implications. This conclusion is supported from three separate and unconnected directions.

I. First is the obvious benefit of increasing specific familiarity with seagrasses. Seagrass information (including locations of grass beds and channels) is important given the relationship between familiarity and prop scarring, as discussed above. Specific seagrass unfamiliarity was reported as the major cause for getting caught in the beds.

II. Second, there is a stated concern for the well-being of the bay. Nearly sixty three (63) percent of the boaters feel that the bay has deteriorated, either slightly (25 %) or significantly (38 %).

It would be somewhat presumptuous to assume that all boaters who recognize deterioration are also concerned or worried about the future health of the bay. Still, the relationship between recognizing a problem and being concerned about that problem seems secure enough to assume that at a large portion of the boaters do sincerely care about the condition of Sarasota Bay. This conclusion is further suggested by the high percentages of people worried about ecological problems when reporting perceived problems of Sarasota Bay.

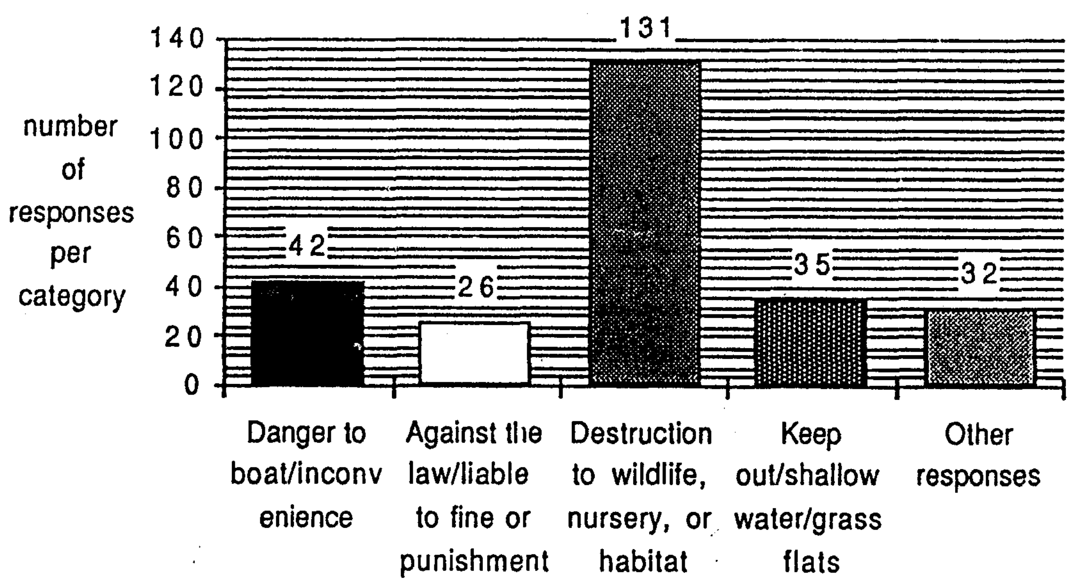

Do you feel the overall condition of the bay has...
9.50%
4.55%
23.14%
37.60%
25.21%
Improved
Remained Constant
Deteriorated slightly
Deteriorated significantly
Don't Know
About 63% of the boaters feel that the bay's condition has deteriorated.

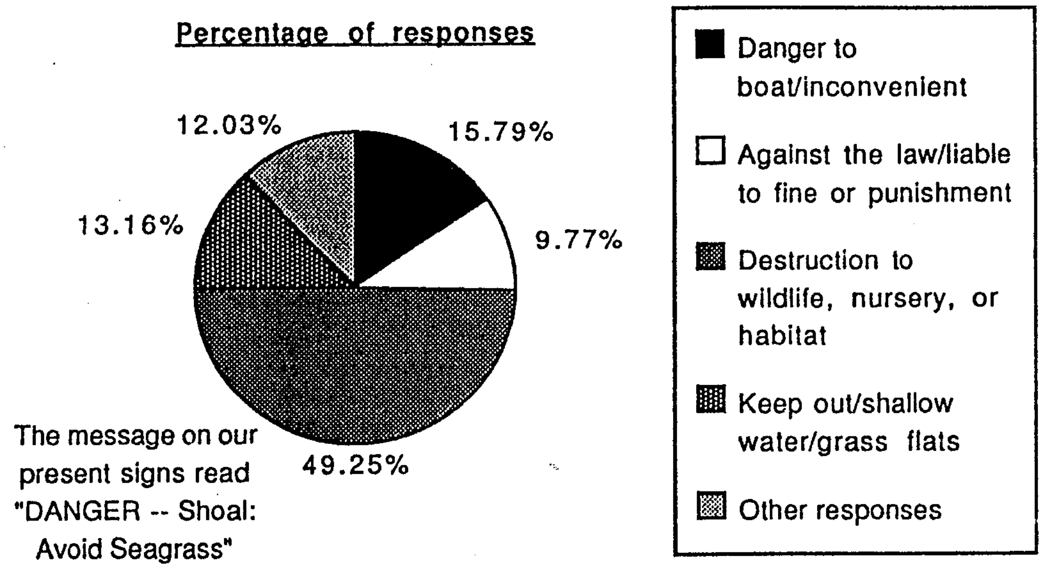

Perceived "Most Pressing Problem"
6.72%
9.58%
11.43%
19.33%
14.45%
38.49%
Growth and development
Legislative or regulative
Ecological damage
Boaters (general)
Boaters (specific group)
Other responses
Percentages based upon number of responses; see tallied data for details.

III. The third reason why education should concern ecological or environmental issues regards our "scenario" question. By far the most complicated question of our interview, boaters were asked to respond to a hypothetical scenario in which they were responsible for placing signs around seagrass beds. The question asked interviewees to design the most effective sign possible. They were told that the sign should read, "Please do not enter the grass bed area because..." Interviewers emphasized that the boater was to respond by considering only the message that would be most effective and persuasive to the largest number of people; and the boater should not worry about which argument he or she personally found most convincing.

One hundred and thirty one (131) people responded by saying that the sign should regard ecological, habitat, wildlife, nursery, or grass destruction. This means that nearly fifty (50%) of all responses focused on ecological issues. Meanwhile, only thirty (30) people mentioned damage to boat; and only twelve (12) people thought that mentioning the possible inconvenience would be effective. These two together represent only sixteen (16) percent of all the responses.

"Most effective argument" for protecting a grass flat





Other possible approaches to boater education and seagrass signs received little support. The straight forward "Keep out" and "Shallow water" possibilities attracted only thirteen (13) percent of the responses. Presently the message on our buoys read, "DANGER -- Shoal: Avoid Seagrass."

One big surprise was that only eleven (11) percent of the people (or 10% of the responses) felt that threats of punishment or fines would be effective in keeping people out of protected areas.

Boaters, it seems, will respond better to ecological information. The data demonstrates that seagrass familiarity will effect interaction; that a majority of boaters are concerned about the well-being of the bay; and that a majority of the boaters feel that ecological "arguments" would be most persuasive in convincing other people to protect a specified area. Those interested in restoring lost habitat and protecting that habitat which remains should focus boater education around ecological information.

...And Other Fancy Stuff: Appendix 1

Conditions for Running Aground

Boaters indicate that signs marking either channels or grass beds would be effective. Twenty one (21) percent of the boaters stated that a lack of grass bed markers is a primary condition for getting caught in the beds; and thirteen (13) percent blamed a lack of channel markers. These two combined account for almost thirty (30) percent of all the responses.

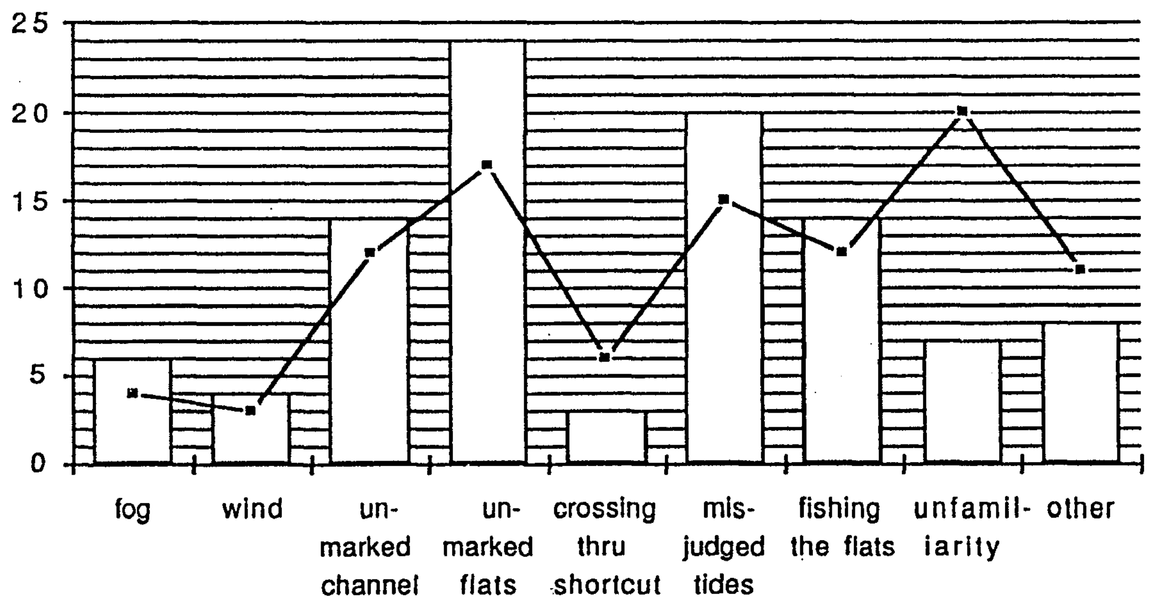
Not surprisingly, boaters who have actually run aground in the grass flats, give more specific reasons for getting caught. The number of people who said general "unfamiliarity" dropped from 46 to 9 when we exclude people who never run aground.

People who run aground are more supportive than the total population of placing signs or markers in the grass beds and channels. Thirty eight (38) percent of the responses of boaters who run aground stated that a lack of markers is a primary condition for getting caught in the flats.

It is also important to recognize the percentage of people who blame "misjudged tides" or "fishing the flats" as a primary conditions for running aground. Generally, we can assume that these boaters are familiar with the seagrass beds, and have entered them intentionally; therefore suggesting that markers would be ineffective for this population. Given that these conditions account for thirty four (34) percent of the responses of people who do in fact run aground, managers should consider strategies other than markers for preventing scars from these boaters.

The line graph below tracks the percentage of responses based upon the total population. For comparison, the white columns demonstrate the percentage of responses based upon boaters who run aground.

Conditions for Running Aground
(Percentages based upon number of responses)

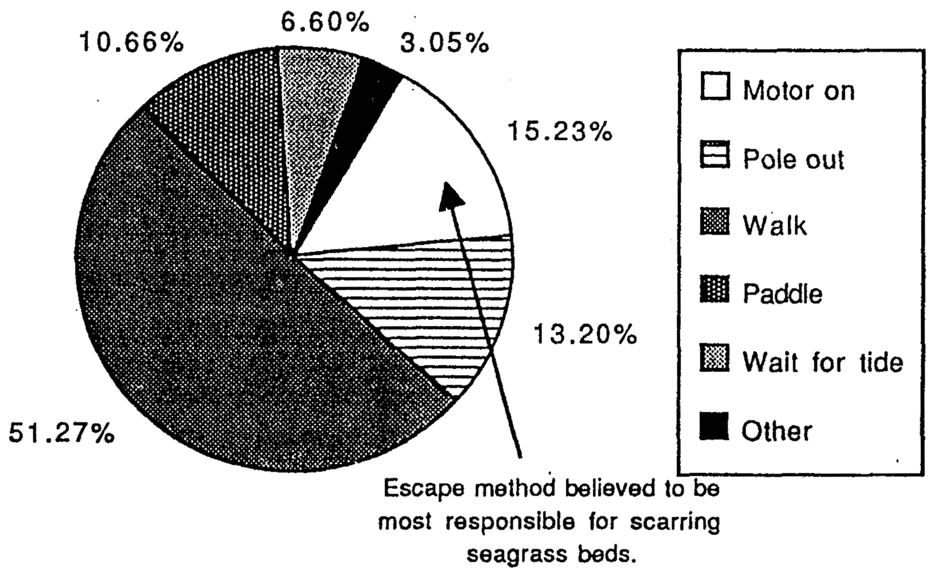


Escape Behaviors

Escape behavior is an important aspect of seagrass interaction. How a boater chooses to get out of a grass bed will often determine the extent and degree of scarring. Only fifteen (15) percent of the boaters use their motor when escaping a grass flat. It is assumed that this choice will alter the habitat to a much greater degree than walking (51 percent), paddling (11 percent), or poling (13 percent) out of the area.

While these figures are very encouraging, it is important to note that these percentages are especially vulnerable to inaccuracies due to the desire to positively self report.

Perceived "Most Effective Release" Method



Interestingly, escape behavior choices are highly related to the likelihood of getting stuck in the grass beds. While only forty one (41) percent of the total population get caught in the beds, over sixty six (66) percent of those who use their motor when escaping get caught in the beds. The data suggests that people who are more likely to "power" out, are also more likely to get caught in the grass beds. The sample of this group is so small, however, that it is difficult to gain conclusive information.

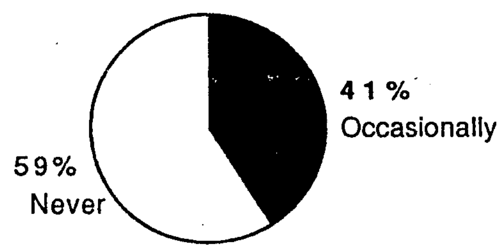
...And Other Fancy Stuff: Appendix 3

Majority Groups

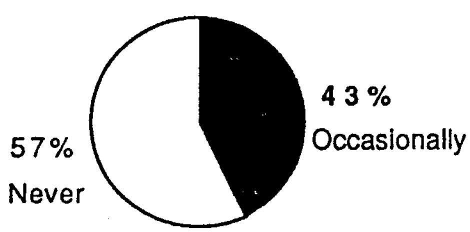
Our interview population, chosen from local boat ramps, is heavily skewed. Eighty two (82) percent are male, ninety three (93) percent own their boats, eighty two (82) percent are full year residents, and sixty four (64) percent are sport anglers. With the exception of sport anglers, there was no significant increase or decrease in rate of seagrass interaction based upon these groups. The following pie graphs allow for a comparison of the percentages of boaters who run aground, based upon the four majority groups.

TOTAL POPULATION

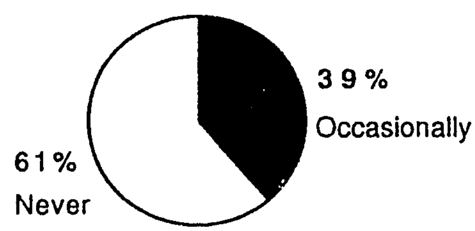
How many times per outing does the boat get caught in grass beds?



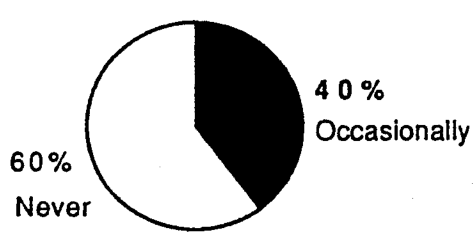
SEX: Male



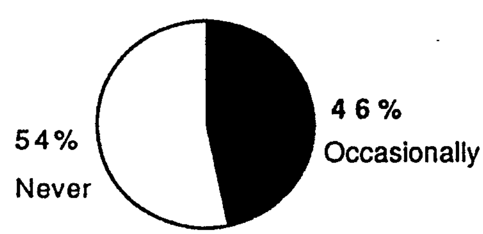
OWNERSHIP: Owner



RESIDENTIAL: Resident



ACTIVITY: Sport Angler



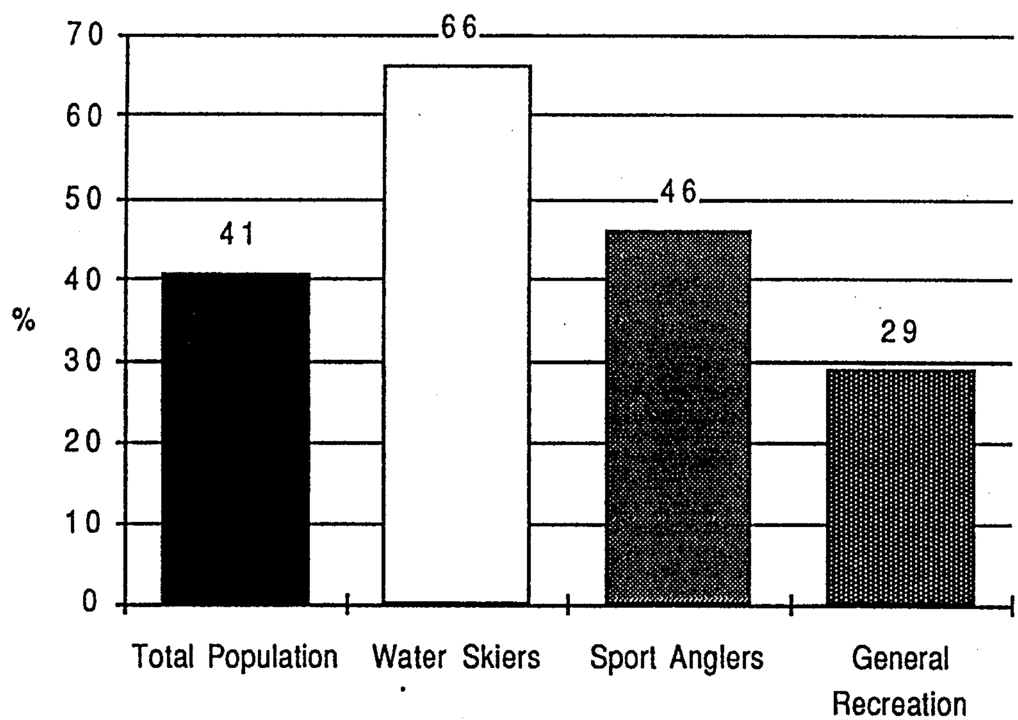
...And Other Fancy Stuff: Appendix 4

Boating Purpose (Activity)

Water skiers seem to have the highest percentage of participants who get caught in grass beds (66 %). This should be qualified by the recognition that our sampling size of water skiers was somewhat small at only thirteen (13) percent of the population. Sport anglers have the second highest rate of occurrence at forty six (46) percent getting caught in seagrasses. As indicated in Appendix 3, sport anglers account for sixty four (64) percent of the interviewed population.

Of the people who participated in general recreation (24 % of population), twenty nine (29) percent get caught occasionally in seagrass beds. (Note: The "general recreation" figure was derived by taking the total number of people who said "general recreation" and subtracting those who said they participate in any other activity. Given that nearly all of the boaters said that they participated in "general recreation," we hope to have made this category more meaningful by excluding other activities.)

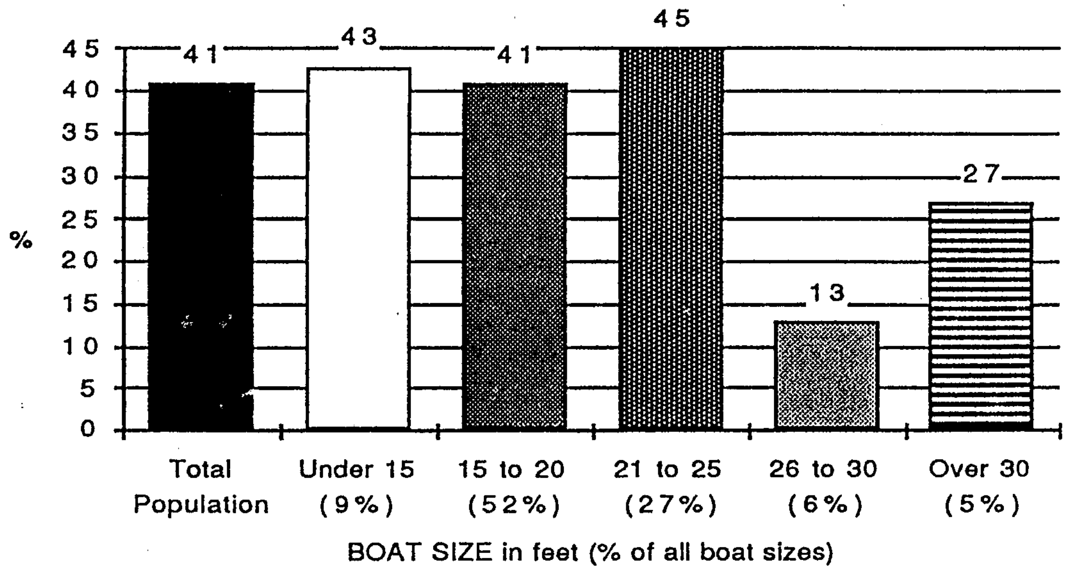
Percentage of Boaters who Run Aground
(Based upon Reported Activity)



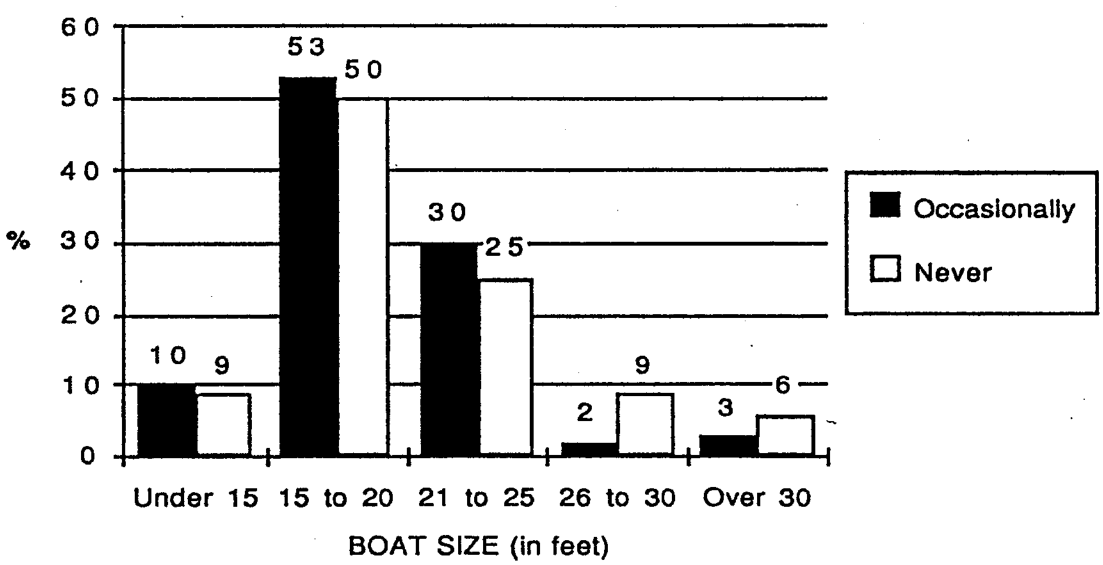
...And Other Fancy Stuff: Appendix 5

BOAT SIZE

Over half (52 %) of the boaters interviewed use boats which are between 15 and 20 feet. Of these boaters, forty one (41) percent get caught occasionally. Of the boats between 21 and 25 feet, forty five (45) percent run aground. Of the boats less than 15 feet, forty three (43) percent run aground. For boats larger than 25 feet, the sampling size was too small to be meaningful.



Notice below that the small and medium size boats (up to 25 feet) account for a larger percentage of the boats which run aground than those which never run aground. Conversely, the larger boats account for a larger percentage of the boats which never run aground. This is may be because larger boats (over 26 feet) rarely venture beyond the marked channels.



1.) Is boat entering or exiting the water? Note: "Otherwise" indicates that the boater was approached either while washing the boat or while attending the Sarasota Boat Show.

Percentage of boaters ENTERING the water	51
Percentage of boaters EXITING the water	45
Percentage otherwise	4

2.) Is interviewee the operator or passenger?

Percentage of boat OPERATORS	57
Percentage of boat PASSENGERS	24
Percentage of BOTH	19

3.) Is the sex of the interviewee male or female?

Percentage of MALE boaters interviewed	82
Percentage of FEMALE boaters interviewed	16

4.) Age category:

	Number	Percent
Under 21	10	4
Between 21 and 30	56	24
Between 31 and 40	58	24
Between 41 and 50	53	22
Between 51 and 60	26	11
Between 61 and 70	22	9
Between 71 and 80	10	4
Over 80	2	1

5.) Is boat owned, rented, borrowed, or other?

Percentage of boaters who OWNED their boat	93
Percentage of boaters who RENTED their boat	0
Percentage of boaters who BORROWED their boat.	3
Percentage of boaters who replied "OTHER"	4

5.1) If owned, for how many years?

Owned under one year (% of # owned)	23
Owned one to four years (% of # owned)	45
Owned four to eight years (% of # owned)	17
Owned over eight years (% of # owned)	12

6.) Boating purpose (answer all that are appropriate)?

	Number	Percent
Fishing -- sport	156	64
Fishing -- commercial	9	4
Water skiing	32	13
Bird, wildlife observation	5	2
Business	9	4
General recreation	57	24
Other activities	4	2

7.) Boat size?

	Number	Percent
Number of boats LESS THAN 15 FEET	23	9
Number of boats 15 - 20 FEET	126	52
Number of boats 21 - 25 FEET	65	27
Number of boats 26 -30 FEET	15	6
Number of boats OVER 30 FEET	11	5

8.) Residential status (Sarasota/Manatee county)?

	Number	Percent
Full year resident	200	82
Seasonal	26	11
Tourist	5	2
Temporary	2	1
Full year resident in neighboring county	10	4

9.) How often is boat utilized in the Sarasota area (months/year)?

	Number	Percent
Boat used approximately 12 months per year	129	56
Boat used approximately 09 months per year	44	19
Boat used approximately 06 months per year	28	12
Boat used approximately 03 months per year	30	13

9.1) How often is boat utilized in the Sarasota area (days/month)?

	Number	Percent
Boat used OVER 20 days per month	9	4
Boat used between 10 and 19 days per month	35	15
Boat used between 5 and 9 days per month	81	35
Boat used between 1 and 4 days per month	104	45

10.) How familiar are you with Sarasota Bay?

	Number	Percent
Very familiar	133	55
Familiar	51	21
Somewhat familiar	35	14
Not familiar	24	10

11.) Which part of the bay are you most familiar?

Note: Due to idiosyncrasies in the method of this question, the data is unreliable. Some people were refered to a map, while others were not. Therefore the answers are neither comparable nor meaningful.

12.) On the average, how often per outing does the boat get caught in seagrass beds?

Percent caught MORE THAN 4 times per outing	0
Percent caught 3 or 4 times per outing	0
Percent caught 1 or 2 times per outing	5
Percent caught OCCASIONALLY	36
Percent caught NEVER	59

13.) What conditions are most responsible for getting caught in the grass beds?

	Number	Percent
Fog	8	4
Wind	6	3
Unmarked channels	28	15
Unmarked grassbeds	39	21
Crossing through shortcut	13	7
Misjudged tides	34	18
Fishing the flats	28	15
Unfamiliarity	46	25
Other	24	13

14.) What do you find to be the most effective method for getting out of seagrass beds?

	Number	Percent
Motor on -- forward	13	7
Motor on -- reverse	17	9
Pole out -- forward	22	11
Pole out -- reverse	4	2
Walk	101	51
Paddle	21	11
Wait for tide	13	7
Other	6	3

15.) Do you feel that the overall condition of Sarasota Bay (in terms of fishing, wildlife, water quality, etc) has:

	Number	Percent
Improved	11	5
Remained constant	56	23
Deteriorated slightly	61	25
Deteriorated significantly	91	38
Don't know	23	10

Note: The following three questions (16, 17, and 18) allow the interviewee an oportunity for open-ended responses. Our data processing program has been written to accept up to four different comments, thus allowing for a more accurate and complete analysis.

The PERCENT value, however, refers to percentage of PEOPLE, not percentage of responses. For example, 30 percent of those interviewed feel that pollution is a pressing problem facing the bay. This type of procedure allows us to examine more closely the concerns of boaters; rather than the mathematical relationship of a variety responses. The sum of the percentages values, then, will exceed 100, as the dividing figure is the number of responders, not responses.

This is also to the case for questions number 6 (Boating purpose), and 13 (conditions for getting caught).

16. What do you feel is the most pressing problem facing Sarasota Bay? Who is responsible? What is the best response to the problem?

Boaters generated a total of 38 different responses. These responses have been categorized and tallied as follows:

	Number	Percent
[1] Growth and Development:		
Over Development/Construction	23	10
Over population in Sarasota	12	5
Too Many People/Boats on Bay	22	9
[2] Legislative or Regulative:		
Inadequate Legislation	37	15
Inadequate Enforcement	17	7
Over Regulation/Enforcement	2	1
Inadequate Commissioners or Gov't	40	17
Open Midnight Pass	37	15
More and/or Clearer Markers	5	2
More Channels and/or Dredging	4	2
Lack of Facilities (ramps, docks, etc)	10	4
[3] Ecological Damage:		
Pollution	73	30
Sewage Dumping	57	24
Storm Water Run-Off	25	10
Insufficient Water Flow in Bay	12	5
Destruction of Habitat	3	1
Death of Species (e.g. Manatee)	8	3
Insufficient Fish for Fishing	11	5
Impact Caused by Seawalls	2	1
Destruction of Seagrass Beds	1	0
[4] Boaters (general):		
Boaters speeding	13	5
Need Safety License or Course	23	10
Boater Garbage/Litter	20	8
Lack of Respect toward Bay	11	5
Lack of Knowledge of Bay	19	8
[5] Specific Group or Practice:		
Jet Skis	3	1
Water Skiers	2	1
Speed Boats	3	1
Drinking or Drunk Boaters	3	1
Large Recreation Yachts	4	2
Commercial Fishing (netters, etc)	23	10
Sport Fishing (too much, etc)	7	3
Tourists	13	5
Coastal Residences	10	4
[6] Other Responses:		
Unsure "I don't know"	9	4
No Problems "Bay looks great"	13	5
Not Enough People	1	0
Other	17	7

17.) What do you think your role as a boater should be in protecting the bay?

	Number	Percent
Boater Oriented Responses:		
Cautious, Careful, Safe Behavior	64	27
Awareness/Practice of Laws & Rules	24	10
Don't Speed	21	9
Help Other People	3	1
Bay Oriented Responses:		
Respectful Attitude/Action toward Bay	21	9
Greater Awareness of Bay	14	6
Correct/Better Use of Bay	10	4
Don't Litter	121	50
Pick-up Litter	6	2
Stay in Channel	4	2
Avoid Seagrass Beds	17	7
Protect Specific Animal (e.g. manatee)	8	3
Other Responses:		
Vote for Better Politicians	7	3
Report Violations/Problems	12	5
Pay Money (licenses, fines, etc)	7	3
No Role	13	5
Other	13	5

18.) Imagine the following scenario.... [Boaters were described a situation in which they were responsible for designing a sign for seagrass beds. It was pointed out that frequent scarring is threatening to impose severe damage to the beds and the bay.]

Interviewees were asked to complete the sentence "Do not enter the grassbed area BECAUSE..." How would you finish the sentence SO AS TO INFLUENCE AS MANY PEOPLE AS POSSIBLE."

	Number	Percent
Ecological Damage:		
Destruction/Damage to Wildlife	33	14
Destruction/Damage to Nursery	19	8
Damage to Habitat/Ecology/Grass Bed	79	33
Utility or Convenience:		
Threatens Future Use of the Bay	14	6
Danger to Boat	30	13
Inconvenient "You'll Get Stuck"	12	5
Against the Law	1	0
Liable to Fine/Punishment	25	11
Other Responses:		
Keep Out	16	7
Shallow Water -- Grass Flats	19	8
Only Sport Anglers Allowed in Grass Area	5	2
Threats of Violence	3	1
Signs are Useless	8	3
No Response	20	8

19.) Which of the following arguments for protecting the seagrass beds (or any wildlife) do you personally find most persuasive?

	Number	Percent
All species have an equal right to exist	20	9
Protect the bay for the sake of our children and our children's children	57	26
Present economic (fishing, recreation, and tourism) opportunities require that we take care of the bay	52	24
We are profoundly connected to nature. We must accept responsibility for our actions	91	41

The Data Display

Number	Date	Location	Intrviewr	Enter/exit	Operator	Sex	Age	Owner	Yrs ownd	Activity			Size	Draw	Resident?	Mo/Yr	Da/Mo	Familiar	Caught/ Outing	Why Caught			Release	Condition	Major Problems				Your Role?				Scenario Response				Ethics
2	3/18/90	Causewa	Lisa	1	2	1	2	4	0	1	6	0	0	0	1	1	4	2	4	0	0	0	0	4	1	29	21	22	1	2	0	0	1	0	0	0	4
3	3/18/90	Causewa	Lisa	1	1	1	3	1	1	1	3	6	2	2	1	1	3	3	4	4	0	0	3	2	11	6	4	0	7	5	0	0	3	0	0	0	4
4	3/18/90	Causewa	Lisa	1	2	2	3	1	9	1	3	6	2	6	1	2	4	3	5	9	0	0	9	2	14	8	7	0	1	0	0	0	2	0	0	0	4
5	3/18/90	Causewa	Lisa	1	2	1	2	1	1	6	0	0	2	0	5	0	4	2	5	0	0	0	0	2	35	0	0	0	7	4	0	0	4	0	0	0	4
6	3/18/90	Causewa	Lisa	1	1	1	3	1	1	6	0	0	2	2	1	1	4	1	5	8	0	0	0	2	23	10	0	0	9	3	0	0	5	2	0	0	1
7	3/18/90	Causewa	Lisa	1	2	2	2	1	2	6	0	0	2	2	1	1	4	2	5	8	0	0	5	4	16	4	25	0	1	2	0	0	2	6	0	0	2
8	3/18/90	Causewa	Lisa	1	1	1	2	1	2	1	6	0	2	2	1	1	4	1	5	4	0	0	0	4	11	22	19	0	5	0	0	0	2	0	0	0	4
9	3/18/90	Causewa	Lisa	1	1	1	2	1	1	1	3	0	2	2	1	1	2	1	4	1	0	0	1	4	7	0	0	0	7	0	0	0	7	0	0	0	2
10	3/18/90	Causewa	Lisa	1	1	1	2	1	1	1	6	0	2	2	1	0	0	2	5	8	0	0	0	2	22	19	0	0	7	0	0	0	6	0	0	0	4
11	3/18/90	Causewa	Lisa	1	1	2	3	1	2	1	2	0	2	1	1	3	2	1	5	8	0	0	5	3	29	15	13	0	12	7	8	1	3	2	0	0	4
12	3/18/90	Causewa	Lisa	1	1	1	1	2	0	1	6	0	2	0	1	4	4	2	4	4	0	0	6	3	11	0	0	0	7	0	0	0	2	6	5	0	3
13	3/18/90	Causewa	Lisa	1	1	1	2	1	1	6	0	0	2	0	1	3	3	2	3	6	0	0	5	2	3	0	0	0	7	0	0	0	5	0	0	0	2
14	3/18/90	Causewa	Lisa	1	1	1	2	1	2	1	0	0	2	3	1	1	3	3	5	0	0	0	0	2	32	0	0	0	10	0	0	0	5	0	0	0	4
15	3/18/90	Causewa	Lisa	1	1	1	3	1	3	2	0	0	4	3	1	1	2	1	5	0	0	0	5	3	16	11	0	0	1	0	0	0	6	0	0	0	3
16	3/18/90	Causewa	Lisa	1	1	2	2	1	0	6	0	0	1	1	1	3	3	2	5	0	0	0	0	3	2	38	0	0	5	16	0	0	5	0	0	0	4
17	3/18/90	Causewa	Lisa	1	1	1	3	1	2	1	0	0	2	2	1	1	3	1	5	8	0	0	5	4	36	33	0	0	7	10	0	0	2	4	0	0	2
18	3/18/90	Causewa	Lisa	1	2	2	2	1	1	6	0	0	2	2	1	0	4	4	5	6	0	0	0	2	35	0	0	0	16	7	16	0	6	5	0	0	4
19	3/18/90	Causewa	Lisa	1	2	2	4	1	1	1	6	0	3	3	1	1	3	1	5	8	0	0	0	4	12	0	0	0	7	6	0	0	8	0	0	0	4
20	3/11/90	Boat	Brian	1	1	1	7	3	0	1	6	0	2	2	2	4	4	4	4	7	0	0	6	4	7	6	0	0	1	4	7	0	5	0	0	0	4
21	3/11/90	Boat	Brian	1	1	3	3	1	2	6	0	0	2	2	1	2	4	1	4	8	0	0	5	2	3	31	4	0	1	0	0	0	5	0	0	0	3
22	3/11/90	Boat	Brian	1	1	1	4	1	2	1	3	0	3	3	1	1	3	2	3	4	3	0	5	3	7	6	0	0	7	0	0	0	6	0	0	0	4
23	3/4/90	No Coq	Brian	1	1	1	4	1	2	1	6	0	2	2	3	4	4	3	4	4	0	0	5	2	11	21	0	0	3	0	0	0	5	0	0	0	4
24	3/4/90	No Coq	Brian	1	2	1	3	1	2	1	0	0	3	2	1	1	1	1	4	7	0	0	3	2	29	0	0	0	1	0	0	0	5	0	0	0	4
25	3/4/90	No Coq	Brian	2	1	1	5	1	2	4	6	0	1	1	1	1	3	3	5	0	0	0	0	4	12	6	5	0	5	12	1	0	5	0	0	0	4
26	3/11/90	Boat	Brian	1	1	1	2	1	2	6	0	0	4	4	1	3	4	1	5	0	0	0	0	3	11	1	5	0	3	7	0	0	5	0	0	0	4
27	3/11/90	Boat	Brian	1	1	1	2	1	2	1	0	0	2	2	1	1	3	1	5	0	0	0	1	3	13	1	0	0	1	2	0	0	5	0	0	0	4
28	3/8/90	Boat	Brian	1	1	1	6	1	0	1	6	0	2	2	1	1	4	3	5	0	0	0	6	3	11	20	5	0	4	7	0	0	5	2	10	0	4
29	3/8/90	Boat	Brian	0	3	3	4	[illegible]	0	1	6	0	0	0	3	0	0	4	4	2	0	0	8	5	11	16	12	22	1	6	0	0	5	0	0	0	4
30	3/11/90	City	Brian	2	1	1	3	1	1	1	6	0	1	0	1	1	3	3	5	0	0	0	0	4	24	11	5	0	7	0	0	0	5	0	0	0	4
31	3/8/90	City	Dayne	2	1	1	6	1	4	1	0	0	1	1	1	1	1	1	5	0	0	0	6	4	12	0	0	0	1	0	0	0	5	0	0	0	4
32	3/8/90	City	Dayne	1	1	1	4	1	2	0	0	0	4	2	1	4	4	1	5	7	0	0	0	4	12	11	29	30	0	0	0	0	7	0	0	0	3
33	3/8/90	City	Dayne	2	1	1	2	1	3	1	6	0	1	1	1	1	1	1	5	8	0	0	8	3	14	11	13	36	15	0	0	0	8	0	0	0	0
34	3/8/90	City	Dayne	1	2	1	3	4	2	6	0	0	3	2	5	0	0	3	5	0	0	0	0	3	22	19	0	0	1	3	0	0	5	0	0	0	3
35	3/8/90	City	Dayne	3	1	1	3	4	1	5	6	0	2	1	1	1	1	3	5	0	0	0	0	4	12	21	22	0	3	1	0	0	8	0	0	0	3
36	3/8/90	City	Dayne	2	1	1	4	1	3	1	0	0	2	2	2	4	0	2	3	4	2	6	5	3	29	30	16	36	7	12	0	0	0	0	0	0	3
37	3/8/90	Boat	Dayne	3	1	1	6	1	2	4	6	0	5	3	1	3	2	1	5	0	0	0	0	4	11	12	6	0	7	0	0	0	5	0	0	0	3
38	3/8/90	City	Dayne	2	1	1	7	1	2	1	0	0	2	2	1	2	4	1	5	0	0	0	0	3	29	0	0	0	15	0	0	0	0	0	0	0	0
39	3/8/90	City	Dayne	2	1	1	3	1	2	2	0	0	2	2	1	1	2	1	4	6	0	0	3	4	11	1	24	4	13	7	0	0	6	0	0	0	4
40	3/8/90	City	Dayne	1	1	1	3	1	1	1	0	0	2	3	1	1	3	1	4	6	0	0	3	4	11	1	13	3	7	2	0	0	12	0	0	0	3
41	3/8/90	Boat	Dayne	3	1	1	6	1	1	1	0	0	3	3	1	1	3	3	5	0	0	0	0	5	14	7	0	0	10	7	0	0	5	0	0	0	3
42	3/8/90	Boat	Dayne	3	1	1	2	1	3	1	0	0	2	2	1	1	2	1	5	0	0	0	0	3	1	38	0	0	8	0	0	0	8	0	0	0	3
43	3/8/90	Boat	Dayne	3	1	1	3	1	1	6	1	0	3	0	1	2	2	1	4	8	0	0	8	3	36	27	18	4	1	7	0	0	6	0	0	0	3
44	3/8/90	Boat	Dayne	3	3	3	3	1	2	6	0	0	4	4	1	2	3	1	5	0	0	0	0	1	35	0	0	0	9	0	0	0	13	0	0	0	2
45	3/8/90	City	Dayne	1	1	1	4	1	3	1	6	0	4	3	1	1	4	1	5	8	0	0	5	4	11	7	1	0	7	0	0	0	2	0	0	0	2
46	3/8/90	City	Dayne	2	1	1	2	4	0	5	6	0	3	3	1	1	2	1	4	7	0	0	5	4	12	20	5	0	6	0	0	0	2	0	0	0	0
47	3/4/90	10th	Deborah	1	1	1	2	1	1	3	6	0	2	1	1	1	3	3	5	0	0	0	0	2	11	24	26	4	7	14	0	0	5	0	0	0	3
48	3/4/90	10th	Deborah	1	1	1	2	1	2	1	6	0	3	2	1	2	4	1	5	4	3	8	5	4	14	7	0	0	16	0	0	0	13	0	0	0	1
49	3/4/90	10th	Deborah	1	1	1	4	1	1	6	0	0	3	2	1	1	3	3	5	4	0	0	2	5	14	7	6	36	7	9	1	0	3	2	12	0	1
50	3/4/90	10th	Deborah	1	2	2	2	1	1	6	0	0	3	0	1	3	3	4	4	6	0	0	1	5	11	4	36	0	7	6	0	0	10	0	0	0	2
51	3/4/90	10th	Deborah	1	1	1	2	1	1	5	0	0	2	2	1	1	3	1	5	4	0	0	5	2	25	0	0	0	1	0	0	0	6	0	0	0	1
52	3/4/90	10th	Deborah	2	2	2	3	1	1	1	6	3	2	2	1	1	3	4	5	0	0	0	0	3	20	21	0	0	1	0	0	0	8	0	0	0	2
53	3/4/90	10th	Deborah	3	1	1	1	1	1	1	3	6	2	2	1	1	3	1	4	4	1	0	6	4	17	21	22	0	10	6	0	0	13	0	0	0	4
54	3/4/90	10th	Deborah	2	1	1	5	1	3	1	0	0	3	3	1	3	4	1	5	5	0	0	5	2	16	20	12	6	7	2	0	0	2	0	0	0	1
55	3/4/90	10th	Deborah	2	2	1	2	1	3	1	3	6	3	3	1	1	4	3	4	4	3	6	2	4	3	12	21	4	7	0	0	0	5	1	0	0	4
56	3/4/90	10th	Deborah	2	2	2	4	1	2	6	0	0	3	3	1	4	4	1	5	8	0	0	0	5	9	0	0	0	1	0	0	0	10	0	0	0	3
57	3/4/90	10th	Deborah	2	1	1	2	1	1	1	3	6	2	2	1	1	3	2	5	6	0	0	2	2	20	5	36	0	7	0	0	0	10	0	0	0	4
58	3/4/90	10th	Deborah	1	1	1	2	1	1	3	0	0	3	3	1	3	3	1	4	8	0	0	5	3	22	19	0	0	14	13	0	0	10	0	0	0	2
59	3/4/90	10th	Deborah	1	1	1	2	1	1	6	0	0	2	2	1	2	3	1	5	8	0	0	6	4	7	0	0	0	6	10	0	0	6	0	0	0	3
60	3/4/90	10th	Deborah	1	1	1	3	1	2	1	3	6	2	2	1	2	2	1	5	8	0	0	5	2	3	0	0	0	15	0	0	0	13	0	0	0	3
61	3/4/90	10th	Deborah	2	2	2	4	1	1	1	6	0	2	2	1	1	4	2	5	6	0	0	7	2	9	10	0	0	7	16	0	0	6	13	0	0	4
62	3/4/90	10th	Deborah	1	2	2	3	1	1	3	6	0	2	0	1	2	3	1	5	8	0	0	5	1	28	18	19	0	16	0	0	0	7	0	0	0	1
63	3/4/90	10th	Deborah	1	2	2	3	1	1	3	0	0	2	0	1	1	3	2	4	0	0	0	2	4	11	7	6	0	7	0	0	0	12	0	0	0	1
64	3/4/90	10th	Deborah	1	1	2	2	1	2	3	6	0	3	0	1	2	3	4	5	0	0	0	0	2	24	1	12	4	11	0	0	0	5	0	0	0	2
65	3/4/90	10th	Deborah	1	2	1	7	1	3	6	0	0	3	0	2	3	0	4	4	1	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
66	3/9/90	City	Deborah	2	2	2	7	1	3	1	0	0	2	2	2	3	2	3	4	1	0	0	2	3	29	0	0	0	2	0	0	0	8	0	0	0	3
67	3/9/90	City	Deborah	2	2	1	6	1	2	1	0	0	2	2	2	4	2	4	4	4	0	0	2	1	29	0	0	0	6	0	0	0	14	1	0	0	3
68	3/9/90	City	Deborah	2	1	1	8	1	3	1	0	0	2	2	2	3	3	1	4	4	0	0	5	1	37	29	4	0	1	17	12	0	14	0	0	0	3
69	3/9/90	City	Deborah	1	2	1	2	1	2	1	0	0	2	2	1	2	2	1	5	4	6	8	3	4	37	31	23	4	4	18	0	0	2	1	0	0	3
70	3/9/90	City	Deborah	1	1	1	2	1	2	1	4	6	1	2	1	1	4	1	4	7	9	0	6	4	11	12	21	36	1	6	0	0	5	2	0	0	4
71	3/9/90	City	Deborah	2	2	1	8	1	2	1	6	0	3	2	2	4	2	4	4	2	0	0	5	2	35	0	0	0	7	0	0	0	5	1	0	0	2
72	3/9/90	City	Deborah	2	1	1	6	1	2	1	0	0	2	1	2	4	3	2	4	4	0	0	5	4	27	11	26	0	7	0	0	0	12	0	0	0	3
73	3/9/90	City	Deborah	2	2	2	6	1	4	1	0	0	2	1	2	4	2	1	5	6	7	0	5	2	7	29	18	8	7	1	3	0	12	10	0	0	2
74	3/11/90	City	Deborah	0	2	1	4	1	4	1	7	0	2	3	1	1	3	2	5	8	0	0	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
75	3/11/90	City	Deborah	2	1	1	2	1	4	1	6	0	2	3	1	1	3	1	4	6	0	0	1	4	11	12	20	0	1	2	7	10	12	5	0	0	4
76	3/11/90	City	Deborah	1	2	1	3	1	4	1	3	6	2	2	1	2	3	2	4	4	0	0	5	2	11	6	22	0	13	16	0	0	13	5	0	0	1
77	3/11/90	City	Deborah	1	1	1	3	1	2	1	6	0	2	1	1	1	3	1	4	3	4	6	7	4	7	6	0	0	1	7	6	10	13	0	0	0	3
78	3/11/90	City	Deborah	2	2	1	4	1	2	1	0	0	3	2	1	1	4	1	4	5	7	0	3	2	3	0	0	0	7	0	0	0	12	0	0	0	1
79	3/11/90	City	Deborah	2	1	1	2	1	2	1	9	0	2	2	1	2	2	1	4	4	0	0	5	4	11	12	0	0	7	10	0	0	10	0	0	0	3
80	3/11/90	City	Deborah	2	1	1	3	1	1	1	6	0	1	1	1	1	2	3	3	6	7	8	4	3	37	29	12	6	5	0	0	0	13	10	0	0	2
81	3/11/90	City	Deborah	3	1	1	3	1	2	1	6	0	2	2	1	1	3	1	5	9	0	0	2	2	11	12	0	0	4	7	18	0	8	0	0	0	4

The Data Display

Number	Date	Location	Intrviewr	Enter/exit	Operator	Sex	Age	Owner	Yrs around	Activity			Size	Draw	Resident?	Mo/Yr	Da/Mo	Familiar	Caught/ Outing	Why Caught			Release	Condition	Major Problems				Your Role?				Scenario Response				Ethics
82	3/11/90	City	Deborah	2	1	1	3	1	2	6	0	0	2	2	1	1	3	1	5	0	0	0	7	1	3	31	8	19	8	17	7	0	12	0	0	0	3
83	3/11/90	City	Deborah	1	2	1	1	1	1	3	6	0	2	0	1	2	3	2	4	4	0	0	5	3	6	38	0	0	15	0	0	0	13	0	0	0	2
84	3/11/90	City	Deborah	1	1	1	3	1	2	1	3	6	3	1	1	1	2	1	4	8	0	0	5	4	12	13	0	0	5	4	0	0	6	0	0	0	2
85	3/11/90	City	Deborah	2	2	1	2	1	2	1	3	6	2	2	1	2	3	1	4	4	0	0	5	4	20	21	4	36	5	1	0	0	13	0	0	0	2
86	3/11/90	City	Deborah	1	1	1	2	1	2	1	3	6	2	2	1	1	2	1	4	4	0	0	5	4	11	7	4	0	7	16	0	0	12	0	0	0	4
87	3/11/90	City	Deborah	1	2	1	1	1	2	1	0	0	2	0	1	0	4	1	4	4	0	0	5	2	11	6	4	0	7	0	0	0	10	0	0	0	3
88	3/11/90	City	Deborah	2	1	1	1	1	3	1	0	0	1	2	1	2	4	3	4	5	6	0	3	2	37	36	0	0	7	10	0	0	14	0	0	0	3
89	3/11/90	City	Deborah	2	2	2	2	1	2	1	6	7	3	3	1	1	3	1	5	0	0	0	0	2	35	0	0	0	6	0	0	0	2	0	0	0	4
90	3/11/90	City	Deborah	2	1	1	3	1	2	1	3	6	2	2	1	2	4	1	4	8	9	0	5	3	11	12	4	5	3	10	0	0	0	0	0	0	2
91	3/4/90	10th	Catherine	1	1	1	4	1	2	1	6	0	2	1	1	1	4	2	4	7	0	0	1	3	2	24	7	0	7	0	0	0	14	0	0	0	4
92	3/4/90	10th	Catherine	2	1	1	3	1	2	1	0	0	2	2	1	1	4	1	4	7	0	0	1	3	24	11	0	0	7	5	0	0	13	0	0	0	3
93	3/4/90	10th	Catherine	1	1	1	3	1	1	1	6	0	3	2	1	1	4	2	4	3	0	0	7	4	3	31	0	0	1	7	2	0	6	0	0	0	4
94	3/4/90	10th	Catherine	2	2	1	3	1	1	1	6	0	2	2	1	1	2	1	4	3	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3/4/90	10th	Catherine	2	2	1	1	1	1	1	0	0	3	3	1	3	2	1	5	0	0	0	3	3	3	1	0	0	7	0	0	0	6	0	0	0	4
96	3/4/90	10th	Catherine	2	2	2	4	1	1	1	0	0	2	3	1	1	3	1	5	0	0	0	5	4	20	11	21	0	7	0	0	0	7	0	0	0	4
97	3/4/90	10th	Catherine	2	2	2	3	1	2	6	0	0	2	2	1	3	3	1	4	4	0	0	5	2	35	0	0	0	7	0	0	0	6	0	0	0	4
98	3/4/90	10th	Catherine	2	2	1	3	1	2	1	3	6	2	3	1	1	4	1	4	3	0	0	5	3	14	7	2	3	16	0	0	0	5	0	0	0	0
99	3/4/90	10th	Catherine	1	1	1	2	1	2	1	3	6	3	2	1	1	3	2	5	3	0	0	7	4	7	14	0	0	7	0	0	0	10	0	0	0	5
100	3/4/90	10th	Catherine	1	1	1	4	1	2	6	0	0	2	3	1	1	4	1	4	3	0	0	2	2	3	0	0	0	1	17	0	0	3	0	0	0	5
101	3/4/90	10th	Catherine	1	1	1	4	1	4	1	6	0	2	2	1	1	3	1	5	9	0	0	7	3	11	20	4	0	6	7	0	0	13	0	0	0	4
102	3/4/90	10th	Catherine	1	2	2	4	1	3	1	6	0	3	2	1	2	2	1	5	3	0	0	5	3	12	6	0	0	2	7	0	0	6	5	0	0	4
103	3/4/90	10th	Catherine	2	1	1	6	1	2	6	0	0	4	2	1	1	4	2	5	9	0	0	5	4	11	12	13	0	7	0	0	0	5	0	0	0	3
104	3/4/90	10th	Catherine	1	2	1	2	1	0	6	0	0	2	2	1	0	0	1	5	7	0	0	2	3	35	0	0	0	7	1	0	0	6	0	0	0	3
105	3/4/90	10th	Catherine	2	1	1	1	3	0	4	0	0	3	2	1	0	0	1	5	7	0	0	5	4	11	7	0	0	8	7	0	0	2	0	0	0	2
106	3/4/90	10th	Catherine	1	1	1	4	1	1	1	0	0	3	4	1	2	3	1	5	9	0	0	8	2	13	7	0	0	7	0	0	0	5	0	0	0	2
107	3/4/90	10th	Catherine	1	1	1	3	1	3	1	0	0	3	2	2	1	2	4	5	1	0	0	5	5	35	0	0	0	0	0	0	0	5	0	0	0	4
108	3/4/90	10th	Catherine	2	2	2	3	1	2	1	6	0	2	2	1	2	4	2	5	0	0	0	5	2	18	4	0	0	7	0	0	0	7	0	0	0	4
109	3/11/90	Boat	Catherine	0	1	1	5	1	4	6	0	0	3	2	1	3	4	1	4	4	0	0	5	4	2	13	1	12	15	0	0	0	4	0	0	0	2
110	3/11/90	Boat	Catherine	0	1	1	4	1	3	1	6	0	3	2	1	1	4	1	5	0	0	0	5	4	7	0	0	0	5	2	0	0	14	0	0	0	5
111	3/11/90	Boat	Catherine	0	1	1	4	1	4	6	0	0	3	2	1	1	4	1	5	0	0	0	5	4	11	18	19	0	1	0	0	0	7	0	0	0	2
112	3/11/90	Boat	Catherine	0	1	1	4	1	2	2	3	6	3	3	1	1	3	1	3	4	6	0	1	5	35	0	0	0	3	1	0	0	5	4	0	0	5
113	3/11/90	Boat	Catherine	0	1	1	4	1	4	1	0	0	4	3	1	1	4	1	5	0	0	0	5	3	11	31	7	0	16	0	0	0	5	0	0	0	4
114	3/11/90	Boat	Catherine	0	1	1	5	1	4	6	0	0	5	4	2	4	4	3	5	0	0	0	2	2	1	12	13	6	11	0	0	0	3	0	0	0	2
115	3/11/90	Boat	Catherine	0	1	1	4	1	3	1	4	6	3	2	1	2	4	2	4	4	0	0	5	3	1	2	13	12	7	0	0	0	7	0	0	0	3
116	3/11/90	Boat	Catherine	0	1	1	4	1	4	6	0	0	2	2	1	2	3	1	5	9	0	0	7	3	7	13	12	4	1	5	7	0	5	0	0	0	0
117	3/11/90	City	Catherine	2	2	2	2	1	2	1	6	0	1	1	1	1	4	4	4	7	0	0	6	1	19	30	0	0	7	0	0	0	5	0	0	0	1
118	3/11/90	City	Catherine	2	1	1	1	1	1	1	0	0	1	2	1	1	3	2	4	7	0	0	5	4	37	3	30	19	7	0	0	0	5	6	0	0	3
119	3/11/90	City	Catherine	2	1	1	4	1	4	1	6	0	2	2	1	1	4	1	5	0	0	0	2	2	18	36	0	0	15	7	0	0	6	0	0	0	4
120	3/11/90	City	Catherine	0	1	1	3	3	0	3	6	0	2	3	1	4	4	1	5	4	0	0	6	4	11	23	19	0	5	7	0	0	5	0	0	0	5
121	3/11/90	City	Catherine	0	1	1	5	1	4	1	0	0	3	2	1	1	4	2	5	0	0	0	3	4	11	12	6	0	7	0	0	0	3	0	0	0	2
122	3/11/90	City	Catherine	0	1	1	4	1	3	1	0	0	3	2	1	1	4	2	5	0	0	0	6	4	3	31	36	4	16	0	0	0	11	0	0	0	4
123	3/11/90	City	Catherine	2	1	1	2	1	1	1	0	0	2	0	1	1	4	1	4	7	0	0	6	0	7	0	0	0	7	6	0	0	2	0	0	0	2
124	3/11/90	City	Catherine	1	1	1	2	1	2	3	6	0	2	3	1	3	3	1	5	0	0	0	5	3	6	38	0	0	16	0	0	0	11	0	0	0	4
125	3/18/90	City	Catherine	0	1	1	6	1	2	6	0	0	3	3	1	3	4	1	5	0	0	0	6	2	38	0	0	0	7	0	0	0	3	0	0	0	4
126	3/18/90	City	Catherine	2	2	2	4	1	1	2	6	0	1	2	1	1	4	3	5	0	0	0	0	5	11	1	0	0	7	0	0	0	1	9	0	0	4
127	3/18/90	City	Catherine	2	1	1	4	1	2	1	3	6	3	2	1	2	4	2	4	3	0	0	5	4	12	13	1	0	7	3	0	0	3	0	0	0	0
128	3/18/90	City	Catherine	1	1	1	3	1	2	6	0	0	4	2	1	2	4	1	4	6	0	0	5	4	11	12	4	0	10	0	0	0	1	0	0	0	4
129	3/18/90	City	Catherine	1	2	2	3	1	1	1	6	0	3	2	1	1	4	1	5	0	0	0	0	5	11	12	0	0	7	0	0	0	7	0	0	0	3
130	3/18/90	City	Catherine	1	2	1	2	1	2	6	0	0	2	2	1	1	4	3	5	3	0	0	5	2	35	0	0	0	7	18	0	0	6	0	0	0	0
131	3/18/90	City	Catherine	2	2	1	4	1	2	1	6	0	3	2	1	2	4	2	4	3	0	0	5	3	14	7	0	0	18	1	0	0	2	0	0	0	0
132	3/18/90	City	Catherine	2	1	1	4	1	3	1	0	0	3	2	1	1	3	1	4	3	0	0	5	3	11	6	0	0	7	0	0	0	3	0	0	0	0
133	3/18/90	City	Catherine	0	1	2	5	1	2	1	6	0	2	2	1	1	4	1	5	9	0	0	6	3	37	11	20	0	7	0	0	0	3	0	0	0	4
134	3/18/90	City	Catherine	1	1	1	4	1	2	1	6	0	3	2	1	1	4	1	5	3	0	0	5	2	11	6	0	0	7	10	0	0	5	0	0	0	4
135	3/18/90	City	Catherine	0	1	1	2	1	2	1	6	0	1	1	1	1	4	1	5	7	0	0	5	2	30	7	36	0	15	0	0	0	5	0	0	0	0
136	3/18/90	City	Catherine	2	2	2	2	1	2	1	0	0	2	2	1	2	3	1	5	0	0	0	5	3	11	20	36	0	8	0	0	0	5	0	0	0	1
137	3/18/90	City	Catherine	1	1	1	4	1	3	1	6	0	3	2	1	1	3	1	4	2	0	0	5	5	12	6	20	0	7	5	0	0	3	0	0	0	0
138	3/18/90	City	Catherine	1	1	1	2	1	1	7	0	0	4	2	1	4	2	1	5	3	0	0	5	4	11	12	13	7	0	0	0	0	5	0	0	0	1
139	3/18/90	City	Catherine	2	1	1	1	1	3	1	3	6	1	2	1	1	4	1	5	6	0	0	5	4	12	6	0	0	6	0	0	0	4	0	0	0	3
140	3/18/90	City	Catherine	1	2	2	3	1	2	1	6	0	2	2	1	2	4	2	4	3	0	0	5	4	11	14	7	0	7	1	6	0	3	0	0	0	2
141	3/18/90	City	Catherine	2	1	1	5	1	2	2	6	0	2	1	1	2	4	1	5	3	0	0	5	4	2	33	24	16	7	0	0	0	5	0	0	0	4
142	3/18/90	City	Catherine	1	1	1	3	1	3	2	6	0	2	2	1	1	4	1	4	6	0	0	5	4	12	13	6	0	1	7	2	0	5	0	0	0	2
143	3/18/90	City	Catherine	1	2	2	3	1	4	2	6	0	3	2	1	3	4	1	5	9	0	0	5	4	14	7	0	0	7	0	0	0	2	0	0	0	0
144	3/18/90	City	Catherine	1	2	1	4	1	1	6	0	0	2	2	1	3	4	2	5	0	0	0	6	4	7	14	6	0	7	5	0	0	5	0	0	0	2
145	3/18/90	City	Catherine	2	1	2	4	1	2	1	6	0	2	2	1	1	4	1	4	4	0	0	5	4	1	30	11	5	7	0	0	0	1	0	0	0	0
146	3/11/90	Boat	Lisa	0	1	1	5	1	2	6	0	0	5	4	1	1	4	2	5	4	0	0	2	3	12	6	0	0	2	7	0	0	13	0	0	0	2
147	3/11/90	Boat	Lisa	0	0	1	2	1	1	1	6	0	3	3	1	1	3	1	4	6	0	0	5	5	24	13	0	0	2	0	0	0	5	0	0	0	4
148	3/11/90	Boat	Lisa	0	0	1	3	1	2	1	6	3	2	1	1	2	3	1	4	1	0	0	5	3	28	18	5	0	5	0	0	0	4	0	0	0	2
149	3/11/90	Boat	Lisa	0	0	1	4	1	4	6	0	0	3	3	1	1	4	1	4	9	0	0	4	3	11	6	0	0	7	0	0	0	10	0	0	0	3
150	3/11/90	Boat	Lisa	0	0	1	2	4	0	5	6	0	3	3	1	1	4	1	4	6	0	0	5	3	29	26	22	5	6	2	0	0	6	0	0	0	2
151	3/11/90	Boat	Lisa	0	0	1	3	1	2	1	6	0	3	2	1	2	3	2	3	4	6	0	5	3	11	22	19	5	1	5	0	0	6	0	0	0	2
152	3/11/90	Boat	Lisa	0	0	1	3	1	1	6	0	0	2	2	1	1	4	2	4	3	4	8	5	3	3	19	0	0	1	5	0	0	7	6	5	0	2
153	3/11/90	Boat	Lisa	0	0	1	4	1	4	6	0	0	5	4	1	1	2	2	5	7	0	0	3	2	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
154	3/11/90	Boat	Lisa		)	1	4	1	1	1	6	0	3	2	1	2	4	3	4	4	6	0	5	2	11	22	19	4	1	7	0	0	7	0	0	0	2
155	3/11/90	Boat	Lisa	0	0	1	4	1	3	1	6	0	2	2	1	2	4	1	5	0	0	0	0	3	3	2	0	0	1	0	0	0	7	6	0	0	2
156	3/11/90	Boat	Lisa	0	0	1	4	1	4	6	7	0	3	3	1	1	3	1	5	0	0	0	0	3	7	14	11	20	7	3	0	0	13	5	0	0	0
157	3/11/90	Boat	Lisa	0	0	1	5	1	2	1	6	0	5	4	1	1	3	2	4	9	0	0	5	4	9	0	0	0	7	0	0	0	5	0	0	0	2
158	3/11/90	Boat	Lisa	0	0	1	2	1	1	1	6	0	2	2	1	2	4	2	4	8	0	0	1	2	11	3	15	0	7	1	5	0	8	0	0	0	1
159	3/11/90	Boat	Lisa	0	0	1	6	1	4	6	0	0	5	5	1	1	3	1	5	0	0	0	3	4	11	12	0	0	6	0	0	0	2	0	0	0	4
160	3/11/90	Boat	Lisa	0	0	1	5	1	2	1	6	0	5	4	5	4	4	1	4	9	0	0	1	1	34	36	0	0	13	0	0	0	5	0	0	0	2
161	3/11/90	Boat	Lisa	0	2	2	3	4	0	6	0	0	5	3	1	2	4	4	4	6	0	0	5	2	18	22	19	4	1	0	0	0	5	0	0	0	4

The Data Display

Number	Date	Location	Intrviewr	Enter/exit	Operator	Sex	Age	Owner	Yrs ownd	Activity			Size	Draw	Resident?	Mo/Yr	Ds/Mo	Familiar	Caught/ Outing	Why Caught			Release	Condition	Major Problems				Your Role?				Scenario Response				Ethics
162	3/11/90	Boat	Lise	0	0	1	2	1	3	6	0	0	3	3	1	1	3	1	5	8	0	0	5	4	6	0	0	0	3	0	0	0	5	0	0	0	2
163	3/11/90	Boat	Lise	0	0	2	4	1	2	1	3	6	4	3	3	2	4	2	3	1	2	6	2	5	18	22	0	0	7	0	0	0	2	0	0	0	4
164	3/11/90	Boat	Lise	0	0	1	1	1	2	1	3	6	3	2	1	1	3	1	4	6	0	0	5	2	32	0	0	0	1	0	0	0	7	2	0	0	2
165	3/14/90	10th	Lise	2	1	1	4	1	2	1	0	0	1	2	1	1	4	3	5	0	0	0	0	5	11	15	4	19	1	4	0	0	1	0	0	0	3
166	3/14/90	10th	Lise	1	1	1	2	3	0	1	6	0	3	2	1	1	4	3	4	1	2	7	6	3	11	12	31	0	1	5	11	0	2	10	0	0	4
167	3/14/90	10th	Lise	1	1	1	2	1	2	1	0	0	2	1	1	1	3	1	5	6	0	0	0	4	2	13	0	0	1	0	0	0	10	0	0	0	4
168	3/14/90	10th	Lise	2	1	1	6	1	3	1	6	0	2	2	1	1	6	1	4	9	0	0	6	4	12	13	1	38	1	7	0	0	5	0	0	0	4
169	3/14/90	10th	Lise	2	1	1	6	1	3	1	6	0	3	3	1	2	3	1	5	8	0	0	0	4	6	13	31	3	5	12	0	0	6	5	0	0	4
170	3/14/90	10th	Lise	1	2	1	3	1	1	1	6	0	2	2	1	0	0	4	0	0	0	0	0	5	16	11	8	0	18	7	0	0	2	0	0	0	4
171	3/14/90	10th	Lise	2	1	1	7	1	3	1	0	0	2	0	1	1	4	1	5	8	0	0	0	4	11	12	3	0	7	12	0	0	5	3	0	0	4
172	3/14/90	10th	Lise	1	1	1	5	1	3	6	0	0	2	3	1	3	3	1	5	0	0	0	0	4	12	4	0	0	18	1	0	0	8	0	0	0	3
173	3/14/90	10th	Lise	2	1	1	7	1	3	6	0	0	2	2	1	2	4	2	5	8	0	0	5	4	11	37	6	12	1	0	0	0	2	0	0	0	4
174	3/14/90	10th	Lise	2	1	1	3	1	1	1	3	6	2	2	2	4	3	3	4	4	0	0	1	5	11	12	6	4	5	1	7	0	6	0	0	0	3
175	3/14/90	10th	Lise	1	1	1	2	3	0	6	0	0	2	2	1	1	4	2	5	0	0	0	0	1	32	0	0	0	5	0	0	0	5	6	0	0	3
176	3/14/90	10th	Lise	1	2	1	6	1	4	1	0	0	3	2	2	3	4	3	5	0	0	0	0	4	36	11	29	4	11	5	0	0	2	0	0	0	2
177	3/14/90	10th	Lise	2	1	1	4	4	0	5	0	0	2	2	4	1	4	1	4	7	9	0	5	4	2	22	19	12	3	7	10	0	1	0	0	0	4
178	3/14/90	10th	Lise	1	1	1	6	1	2	1	0	0	2	2	2	4	2	3	5	4	0	0	5	4	29	37	0	0	1	0	0	0	8	0	0	0	0
179	3/14/90	10th	Lise	1	2	1	3	1	4	1	0	0	2	2	1	4	4	1	5	8	0	0	5	4	7	6	0	0	6	0	0	0	8	0	0	0	2
180	3/14/90	10th	Lise	0	0	1	3	1	4	1	5	0	2	2	1	1	3	1	5	8	0	0	0	4	31	12	29	5	2	3	0	0	10	0	0	0	2
181	3/14/90	10th	Lise	1	1	1	4	1	2	1	6	0	3	2	1	2	4	2	4	4	6	0	3	4	12	20	4	6	1	0	0	0	3	0	0	0	2
182	3/14/90	10th	Lise	1	1	1	7	1	2	6	0	0	2	2	1	4	4	2	5	8	9	0	5	4	13	0	0	0	11	0	0	0	2	3	0	0	4
183	3/14/90	10th	Lise	1	1	1	4	1	2	2	0	0	3	3	1	1	1	1	5	9	0	0	5	4	12	0	0	0	7	10	2	0	8	0	0	0	2
184	3/14/90	10th	Lise	1	1	1	3	1	2	1	6	0	2	2	1	1	4	2	4	6	0	0	5	3	18	19	0	0	1	0	0	0	2	0	0	0	2
185	3/4/90	No Coq	Carrie	2	1	1	3	1	1	1	6	0	2	2	1	1	4	3	4	7	0	0	5	3	6	19	0	0	7	0	0	0	4	10	0	0	4
186	3/4/90	No Coq	Carrie	2	1	1	3	1	1	1	6	0	1	3	1	1	4	3	3	3	0	0	5	3	3	31	19	0	7	0	0	0	10	0	0	0	4
187	3/4/90	No Coq	Carrie	1	1	1	3	1	2	1	0	0	1	1	1	1	4	4	4	3	4	0	5	3	11	12	4	0	7	8	0	0	5	2	0	0	2
188	3/4/90	No Coq	Carrie	1	2	1	3	1	1	1	0	0	2	0	5	1	4	4	5	0	0	0	5	5	31	0	0	0	2	12	0	0	10	0	0	0	2
189	3/4/90	No Coq	Carrie	1	1	1	5	3	0	6	0	0	2	2	1	4	4	2	2	7	0	0	5	2	35	0	0	0	7	0	0	0	1	0	0	0	4
190	3/4/90	No Coq	Carrie	2	1	1	8	1	3	1	0	0	2	3	1	3	4	2	5	3	0	0	6	4	11	12	37	29	16	0	0	0	0	0	0	0	4
191	3/4/90	No Coq	Carrie	2	1	1	2	1	2	1	0	0	1	1	2	4	2	3	5	5	0	0	5	4	29	0	0	0	4	0	0	0	8	0	0	0	3
192	3/4/90	No Coq	Carrie	2	2	1	4	1	2	6	0	0	2	0	1	2	4	4	5	8	0	0	3	3	11	12	4	20	2	0	0	0	5	0	0	0	3
193	3/4/90	No Coq	Carrie	1	1	1	8	1	2	1	0	0	2	2	1	2	3	1	5	3	0	0	5	4	31	11	13	12	15	0	0	0	3	0	0	0	2
194	3/4/90	No Coq	Carrie	2	3	2	5	1	2	1	0	0	4	2	1	1	2	1	5	5	0	0	8	4	7	4	16	0	18	0	0	0	5	0	0	0	3
195	3/4/90	No Coq	Carrie	2	2	1	0	1	1	1	0	0	2	2	1	1	0	3	3	8	0	0	1	5	35	9	0	0	7	0	0	0	4	13	0	0	4
196	3/4/90	No Coq	Carrie	2	2	1	8	1	4	1	0	0	1	1	4	3	3	4	5	5	0	0	0	2	18	27	0	0	7	0	0	0	13	0	0	0	4
197	3/4/90	No Coq	Carrie	0	3	2	0	1	2	6	0	0	2	0	1	1	3	2	3	4	0	0	5	2	32	0	0	0	6	10	0	0	10	0	0	0	3
198	3/4/90	No Coq	Carrie	1	2	2	5	1	2	6	0	0	2	0	3	4	0	4	5	8	7	0	2	2	38	0	0	0	7	0	0	0	5	0	0	0	4
199	3/4/90	No Coc	Carrie	2	1	1	4	1	2	1	6	0	2	1	1	1	4	1	4	7	0	0	6	4	11	1	0	0	10	0	0	0	10	0	0	0	4
200	3/4/90	No Coq	Carrie	1	2	2	3	1	1	1	0	0	2	1	1	1	4	1	5	4	8	0	5	4	29	22	4	6	13	0	0	0	5	6	12	0	2
201	3/4/90	No Coq	Carrie	1	1	1	3	1	2	1	6	0	3	0	1	1	2	1	5	9	0	0	2	2	35	0	0	0	10	0	0	0	5	0	0	0	3
202	3/4/90	No Coq	Carrie	1	2	2	2	1	0	6	0	0	2	0	1	1	2	2	5	3	0	0	5	2	32	0	0	0	9	0	0	0	2	0	0	0	2
203	3/4/90	No Coq	Carrie	2	1	1	5	1	3	1	0	0	2	2	2	4	3	3	5	6	0	0	5	2	1	6	36	0	7	0	0	0	6	0	0	0	4
204	3/6/90	No Coq	Carrie	2	1	1	0	1	3	1	0	0	2	1	1	1	2	1	5	5	6	7	3	3	11	13	0	0	1	7	0	0	10	0	0	0	3
205	3/6/90	No Coq	Carrie	2	1	1	6	1	4	1	0	0	1	1	2	4	3	2	5	5	0	0	6	2	20	19	0	0	7	0	0	0	5	2	0	0	4
206	3/6/90	No Coq	Carrie	2	2	1	6	1	4	1	0	0	2	1	3	1	3	4	5	8	0	0	3	2	1	2	13	0	7	0	0	0	5	3	0	0	2
207	3/6/90	No Coq	Carrie	1	1	1	2	1	0	1	0	0	0	0	1	1	4	1	5	0	0	0	3	3	3	37	29	0	7	5	0	0	1	0	0	0	2
208	3/6/90	No Coc	Carrie	2	1	1	6	1	2	1	0	0	2	1	2	4	3	1	5	5	0	0	4	2	29	0	0	0	15	0	0	0	8	0	0	0	3
209	3/6/90	No Coq	Carrie	2	1	1	5	1	2	1	0	0	2	1	2	3	1	4	5	8	0	0	3	5	32	0	0	0	6	0	0	0	13	12	0	0	2
210	3/6/90	No Coq	Carrie	2	1	1	5	1	3	6	0	0	2	0	1	1	3	1	5	0	0	0	0	2	38	0	0	0	7	0	0	0	12	0	0	0	2
211	3/6/90	No Coq	Carrie	1	1	1	6	1	4	1	0	0	1	1	2	4	2	1	4	6	0	0	6	4	3	38	5	0	1	4	0	0	5	0	0	0	3
212	3/6/90	No Coq	Carrie	2	1	1	7	1	4	1	0	0	2	3	2	4	3	2	4	3	0	0	3	4	29	0	0	0	7	0	0	0	12	0	0	0	3
213	3/6/90	No Coq	Carrie	2	1	1	5	1	2	6	0	0	2	3	2	4	2	3	4	9	0	0	1	4													
214	3/6/90	No Coq	Carrie	2	1	1	7	1	2	1	0	0	1	1	1	4	3	1	5	3	0	0	7	4	24	6	0	0	15	11	0	0	12	0	0	0	3
215	3/11/90	Boat	Carrie	0	0	1	5	1	2	6	0	0	2	3	1	2	4	1	4	6	0	0	4	3	12	20	21	0	12	2	0	0	5	0	0	0	4
216	3/11/90	Boat	Carrie	0	0	1	4	1	3	1	0	0	3	3	1	1	4	3	5	8	0	0	7	4	11	0	0	0	1	7	0	0	5	0	0	0	4
217	3/11/90	Boat	Carrie	0	0	1	4	1	2	6	0	0	5	4	5	4	4	3	5	0	0	0	0	5	3	31	0	0	7	0	0	0	8	0	0	0	0
218	3/11/90	Boat	Carrie	0	0	1	3	1	2	1	6	0	5	3	1	1	2	1	5	8	0	0	7	3	11	12	0	0	6	0	0	0	10	0	0	0	4
219	3/11/90	Boat	Carrie	0	0	1	6	1	1	6	0	0	5	4	2	4	1	4	5	6	0	0	0	5	11	0	0	0	1	0	0	0	8	0	0	0	4
220	3/11/90	Boat	Carrie	0	0	1	2	1	2	6	0	0	3	2	5	0	0	4	5	5	0	0	5	5	32	0	0	0	15	0	0	0	11	0	0	0	4
221	3/11/90	Boat	Carrie	0	0	1	3	1	3	1	0	0	3	2	1	1	4	1	5	0	0	0	0	4	22	20	5	0	12	16	0	0	10	0	0	0	3
222	3/11/90	Boat	Carrie	0	0	1	7	1	2	6	0	0	3	3	2	2	3	1	4	3	0	0	5	3	32	0	0	0	1	0	0	0	6	0	0	0	3
223	3/11/90	Boat	Carrie	0	0	2	4	1	2	1	6	0	3	2	1	1	3	1	5	8	0	0	7	3	11	4	0	0	7	0	0	0	5	0	0	0	4
224	3/11/90	Boat	Carrie	0	0	2	2	4	0	5	0	0	4	4	1	1	1	1	5	8	0	0	5	4	12	0	0	0	7	12	0	0	5	0	0	0	1
225	3/11/90	Boat	Carrie	0	0	1	5	1	3	6	0	0	4	3	1	1	4	1	5	8	0	0	5	4	7	6	0	0	1	7	0	0	3	9	0	0	2
226	3/11/90	Boat	Carrie	0	0	1	2	1	2	6	0	0	3	2	1	1	2	1	5	6	9	0	5	4	7	0	0	0	15	0	0	0	5	0	0	0	4
227	3/11/90	Boat	Carrie	0	0	1	4	1	3	6	0	0	3	3	1	3	4	1	5	8	0	0	5	4	12	6	0	0	1	3	0	0	10	0	0	0	1
228	3/11/90	Boat	Carrie	0	0	1	6	1	1	1	0	0	2	0	5	1	4	4	5	7	0	0	3	5	11	21	20	5	7	2	0	0	5	0	0	0	1
229	3/11/90	Boat	Carrie	0	0	1	6	1	2	1	0	0	2	2	5	3	3	2	5	8	5	0	7	3	7	6	0	0	7	18	0	0	5	0	0	0	4
230	3.11/90	Boat	Carrie	0	0	1	5	1	3	5	6	0	2	2	1	1	4	1	3	3	5	0	2	1	13	1	6	0	12	0	0	0	12	0	0	0	2
231	3/11/90	Boat	Carrie	0	1	2	2	1	2	6	0	0	2	2	1	1	3	1	5	8	0	0	5	3	20	7	12	6	4	0	0	0	5	0	0	0	4
232	3/11/90	Boat	Carrie	0	0	1	5	1	2	1	8	0	3	2	1	1	3	1	5	0	0	0	3	1	13	7	0	0	7	6	0	0	2	3	0	0	4
233	3/11/90	Boat	Carrie	0	0	1	2	1	3	6	0	0	2	0	2	0	0	3	5	7	0	0	5	3	2	4	0	0	1	13	0	0	5	1	0	0	4
234	3/11/90	Boat	Carrie	0	0	1	6	1	2	6	0	0	4	3	5	1	4	3	5	0	0	0	0	4	1	19	5	22	1	0	0	0	5	6	0	0	1
235	3/11/90	Boat	Carrie	0	0	1	4	1	2	1	0	0	2	2	1	1	3	1	5	8	0	0	5	4	12	6	0	0	15	0	0	0	10	0	0	0	4
236	3/11/90	Boat	Carrie	0	0	1	5	1	4	1	0	0	4	3	5	0	0	4	5	0	0	0	0	5	32	0	0	0	7	0	0	0	8	0	0	0	3
237	3/11/90	Boat	Carrie	2	1	1	3	3	4	1	0	0	1	1	1	1	1	1	4	5	9	0	5	3	29	4	0	0	7	0	0	0	5	0	0	0	1
238	3/11/90	Boat	Carrie	2	1	1	5	1	3	1	0	0	2	2	1	2	3	2	5	2	0	0	3	2	18	28	26	4	7	0	0	0	8	0	0	0	1
239	3/9/90	City	Deborah	2	2	2	5	1	3	1	6	0	2	0	2	3	2	1	5	9	0	0	7	1	12	19	0	0	7	12	0	0	12	0	0	0	4
240	3/9/90	City	Deborah	2	2	1	4	1	2	1	5	6	2	1	1	3	3	1	3	7	0	0	1	4	37	1	12	7	1	7	0	0	13	0	0	0	4
241	3/4/90	10th	Catherine	2	1	1	3	1	1	1	0	0	2	1	1	3	4	2	5	9	0	0	5	3	2	0	0	0	7	0	0	0	8	0	0	0	3

The Data Display

Number	Date	Location	Intrviewr	Enter/exit	Operator	Sex	Age	Owner	Yrs ownd	Activity			Size	Crew	Resident?	Mo/Yr	Da/Mo	Familiar	Caught/ Outing
242	3/4/90	No Coq	Brian	1	3	1	5	1	0	1	0	0	1	1	1	1	3	1	4
243	3/11/90	Boat	Lisa	0	1	1	4	1	2	1	6	0	3	1	1	1	4	1	4
244	3/11/90	Boat	Lisa	0	1	1	2	1	2	3	6	0	2	2	1	2	3	2	4
245																			
246																			

Number	Why Caught			Release	Condition	Major Problems				Your Role?				Scenario Response				Ethics
242	9	0	0	6	4	29	24	12	16	5	0	0	0	10	0	0	0	2
243	7	0	0	3	4	11	5	4	13	11	13	0	0	5	2	0	0	4
244	4	0	0	5	2	22	19	0	0	1	0	0	0	5	0	0	0	4
245																		
246																		

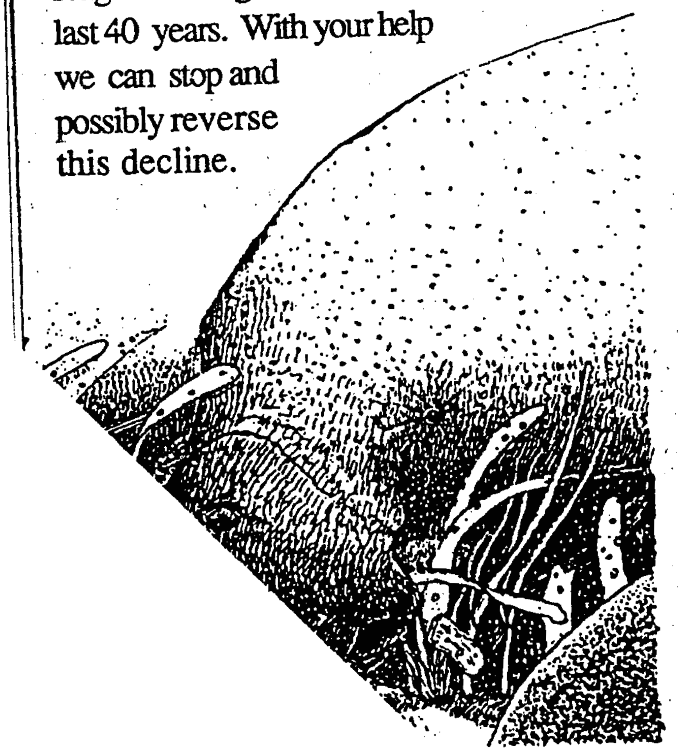
Appendix 2. Brochure

seagrasses

Luxuriant Bay Meadows

Rays of warm sunlight pierce clear subtropical waters. A lush carpet of dark green plants sways with the currents and tides. Young fish, shrimp, and crabs dart and scurry, searching out food and avoiding predators.

For centuries the grassflats of Sarasota Bay have supported a rich array of wildlife. And while most of the beds remain, they are suffering—about one quarter of our bays' seagrass acreage has vanished in the last 40 years. With your help we can stop and possibly reverse this decline.

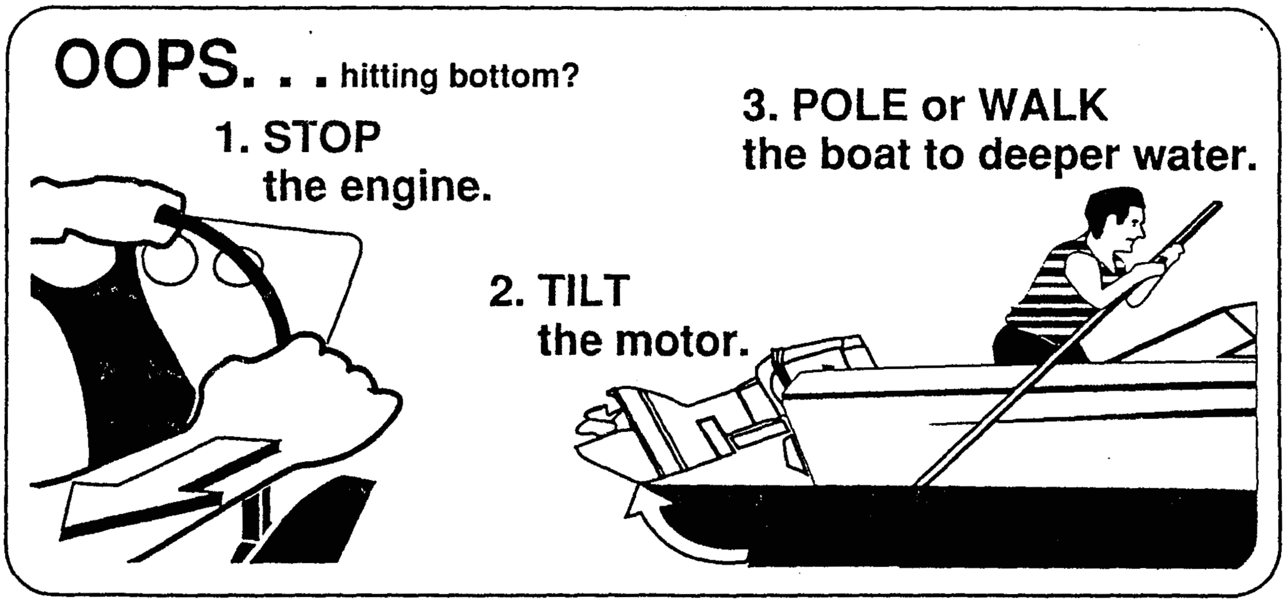


Appendix 3. Boat decal

PROTECT SEAGRASSES!!

Please keep this boat and its seagrass-slicing propeller away from grass beds.

- **Read the water** -- grass beds look like dark areas underwater.
- **Use navigation charts** -- seagrass is shown as light green or "Grs".
- **Stay in deep water** -- if near shallow water, drive cautiously and slowly.



Want more information about seagrasses? Send a SASE to : SEAGRASSES, Sarasota Bay Project, 1550 Ken Thompson Parkway., Sarasota, FL 34236

Appendix 4. Boater observation data sheets

Big Pass grass bed

SEAGRASS SIGNAGE BOATER OBSERVATION FIELD SHEET Observer________

Date________Time In______ Time Out ______ Wind Direction ________

Water Depth at beginning of observation session________Water Depth at end ________

BOAT

Size
large ave small

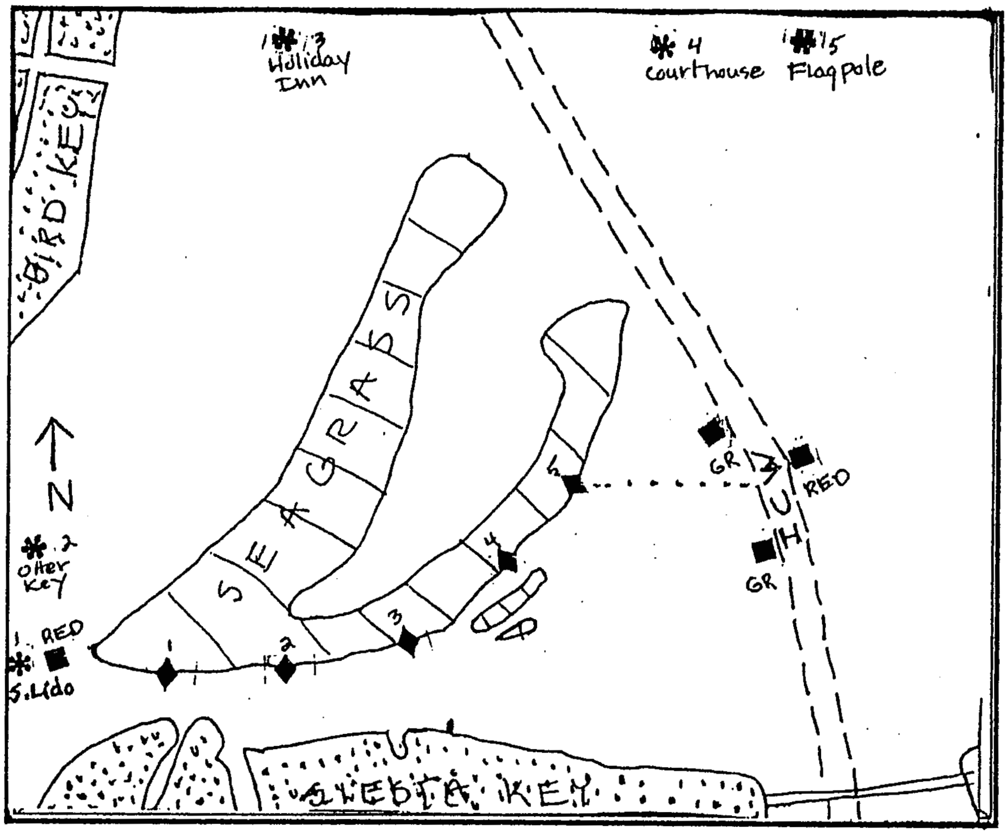
Motor
gas troll jetski off

Without Motor
sail paddle/row drift

BOATER

Total in Boat
1 2 3 4 >4

Unknown



MAP LEGEND

Speed
wake ________
fast slow

no wake ------

Direction
--> <--

* Sightlines

◆ Double Buoys

■ ICW markers

Using Fishing Gear
com non-com no

Skiing
yes

When Near Marker
stops slows down
same speed
change course
stays on course

BOAT ________ ENTERS GRASSBED
yes no maybe

Boat Anchors
anchors: in near

Motor
gas troll off

Boat Touches Grassbed
Stuck Mudtrail

Boater Exits
Motor on forward
reverse

Motor off pole
walking paddling

Prop up
down
unknown

City Island grass bed

SEAGRASS SIGNAGE BOATER OBSERVATION FIELD SHEET Observer________________

Date________ Time In________ Time Out________ Cloud Cover________ Wind Dir.________

Wind Speed________ Water Depth________

BOAT

Size
large ave small

Motor
gas troll jetski off

Without Motor
sail paddle/row drift

BOATER

Operator Age teen
young adult middle age
older

Operator Sex
male female

Total in Boat
1 2 3 4 >4

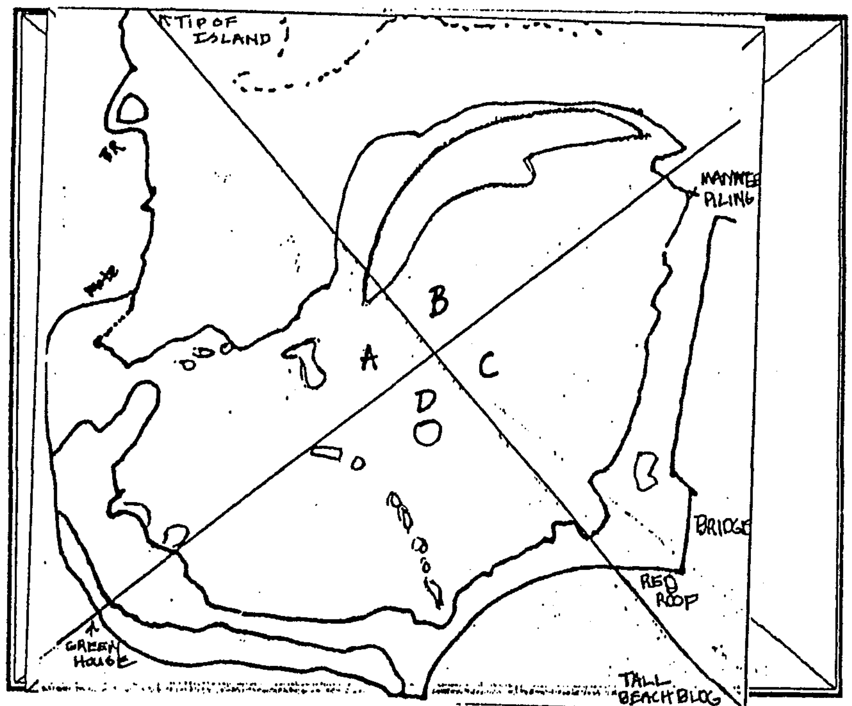
Alcohol
yes no n/a

MAP LEGEND

Speed
wake ________
fast slow

no wake ------

Direction
---> <---



ZONE A

Using Fishing Gear
com non-com no

Skiing
yes

When Near Marker:
stops slows down
same speed
change course
stays on course

Boat Enters Grassbed
yes no fast slow

Boat Anchors
anchors: in near

Motor
gas troll off

Boat Touches Grassbed
Stuck Mudtrailw/o stop

Boater Attitude
angry Ambiv
N/A amiable

Boater Exits
Motor on forward
reverse
Motor off pole
walking paddling
Prop up
down

ZONE B

Using Fishing Gear
com non-com no

Skiing
yes

When Near Marker:
stops slows down
same speed
change course
stays on course

Boat Enters Grassbed
yes no fast slow

Boat Anchors
anchors: in near

Motor
gas troll off

Boat Touches Grassbed
Stuck Mudtrailw/o stop

Boater Attitude
angry Ambiv
N/A Amiable

Boater Exits
Motor on forward
reverse
Motor off pole
walking paddling
Prop up
down

ZONE C

Using Fishing Gear
com non-com no

Skiing
yes

When Near Marker:
stops slows down
same speed
change course
stays on course

Boat Enters Grassbed
yes no fast slow

Boat Anchors
anchors: in near

Motor
gas troll off

Boat Touches Grassbed
Stuck Mudtrailw/o stop

Boater Attitude
angry Ambiv
N/A Amiable

Boater Exits
Motor on forward
reverse
Motor off pole
walking paddling
Prop up
down

ZONE D

Using Fishing Gear
com non-com no

Skiing
yes

When Near Marker:
stops slows down
same speed
change course
stays on course

Boat Enters Grassbed
yes no fast slow

Boat Anchors
anchors:in near

Motor
gas troll off

Boat Touches Grassbed
Stuck Mudtrailw/o stop

Boater Attitude
angry Ambiv
N/A amiable

Boater Exits
Motor on forward
reverse
Motor off pole
walking paddling
Prop up
down

Appendix 5. Groups to which seagrass slide show were presented

1. Sarasota Power Squadron	85 people
2. Sertoma Club	30 people
3. Sarasota Yacht Club	110 people
4. Mote Marine Volunteers	60 people
5. Bradenton Yacht Club	30 people
6. Anna Maria Power Squadron	50 people
7. Power Squadron Boating Class	60 people
8. Coast Guard Auxiliary (Flotilla 81)	60 people
9. Coast Guard Auxiliary (Flotilla 84)	30 people
TOTAL	515 people

Appendix 6. Marinas which received boat decals

C B's Bait and Tackle 1249 Stickney Point Rd. Sarasota, FL 34231	14 decals
Cannons Marina 6040 Gulf of Mexico Drive Longboat Key, FL 34228	25 decals
Club Nautico of Saraosta 5353 Tamiami Trail Sarasota, FL 34231	7 decals
Don and Mike's Boat and Ski Rental 520 Blackburn Point Road Osprey, FL 34229	9 decals
Five O'Clock Marine Services 500 Pine Avenue Anna Maria, FL 34216	5 decals
Island Boat Club P.O. 14070 Bradenton, FL 34280	12 decals
Osprey Marine Center P.O Box 577 Osprey, FL 34229	20 decals
Palma Sola Boat Rental 9915 Manatee Ave. West Bradenton, FL 34209	6 decals
Siesta Key Marina 1265 Old Stickney Point Rd. Sarasota, FL 34242	18 decals
TOTAL	**116 decals**

Appendix 7. The mapping process

For consistency, the following guidelines were used in mapping propeller cuts and determining acreage of each of the grass beds:

A. Propeller cut mapping

1. If a prop cut appeared as one linear or curvilinear cut with a break in it, it was counted as one prop cut.
2. Prop cuts which appeared to intersect were called two prop cuts.
3. Two cuts which were parallel, close together, and of the same length were counted as one cut, because most probably it was created by a boat with two side-by-side motors.
4. A cut was counted if some part of it was in a polygon (even if a majority of it was beyond the polygon boundaries).
5. If a cut crossed a polygon boundary into a different polygon, it was only counted once.
6. Turbidity streaks or wakes were not mapped unless there was evidence of a prop cut in that photograph or in a subsequent photograph.

B. Propeller cut length

1. Only length measurements of cuts wholly within the polygon or within two adjacent polygons were included.
2. If there was a break in the propeller cut (see A.1 above), the measurement included only those areas with visible cuts to the grass.
3. Only one of the two cuts were measured for propeller cuts from a boat with two motors (see A.3 above).

C. Acreage

1. The area was calculated using the continuous edge of the grass bed, regardless if the grass along the outer edge was sparse or dense.
2. Neither bare patches within the bed nor small grassy "islands" beyond the bed's edge were calculated.

D. Grazing cuts

1. This was the most subjective of all parameters measured.
2. Cuts which were roughly parallel (0^o to ~30^o) to the axis of the channel and were within a reasonable distance of the bed's edge were considered grazing cuts.
3. The shape of the bed and channel, water depth, and boating traffic patterns, were all considered in determining whether a cut was grazing or head-on.

E. Limitations to mapping propeller cuts from aerial photographs

1. Although photographers were instructed to shoot true verticals, when the water was clear, with the sun angle >20^o and <40^o to reduce sun glare, when wind was less than 10 mph, and to frame the photograph with the edge visible, minimizing open water and maximizing the area of the grass bed shot, ideal conditions were not evident in every photograph.

2. Polygons were the result of those areas where propeller cuts were visible in all three sets of photographs.

3. Cuts were sometimes obscured because of drift or rooted algae, long grass blades and epiphytic growth. Whenever possible each cut was compared to a photograph either preceding or subsequent to the one in question.

4. The second set of photographs, on November 21,1991, were the least revealing of known propeller cuts. Therefore, if skewed in one direction, the amount of pre-buoy cuts were under-reported and post-buoy cuts over-reported.

5. Mapping of all grass beds took place during a one week period by one mapper to aid in consistency in reading.

6. Ground truthing followed some but not all photography.

7. Some scars, appearing as "reverse" scars (i.e. dark lines in light patchy areas) were ground-truthed. Even though they may have been continuous linear to an obvious prop cut, some were found to be lines of rooted algae without any evidence of a change in water depth which would have indicated a prop cut. They were therefore not considered prop cuts.

Appendix 8. Results of boater observations studies

A. Big Pass grass bed

Data collected from the Big Pass boater observations compared the behavior of 296 boaters before buoys were installed to the behavior of 211 boats after the buoys were installed. Below are the general characteristics of the boaters and their boats observed in this area.

Table A-8.1. Characteristics of boaters and boats frequency results

Variable	Results
Boat size	large.........16.0%
	average 56.0%
	small.........27.0%
	unknown.....1.0%
Boat type	gas...........87.2%
	trolling.........0.2%
	jetski...........7.3%
	non-motor.....2.6%
	unknown......2.7%
Number of occupants in boat	1..............13.9%
	2..............30.6%
	3..............21.8%
	4 or more.....27.1%
	unknown.......6.6%
Boat speed	fast...........83.6%
	slow..........15.6%
	unknown. 1.8%

The results presented below are only from those tests that revealed meaningful information on boaters' reactions to the buoys. Some of the cross-tabulations were inconclusive due to a lack of data. Statistical tests for significance were impossible for these cross-tabulations, but the results will be presented for consideration. This does not mean the results are not meaningful, but simply could not be proven statistically significant. The results presented below will be prefaced by the question the data was collected to answer and by a hypothesis.

In the tables below, " before" refers to data collected before placement of the buoys. Likewise, "after" refers to the data collected after placement of the buoys.

QUESTION: Does the percentage of boaters entering the grass bed change after the placement of the buoys?

HYPOTHESIS: A smaller percentage of boaters will enter the grass bed after the buoys' installation.

RESULTS:

Table A-8.2. Boaters entering grass bed

	Boat enters grass bed	Boat does not enter grass bed	Boat maybe enters grass bed	Unknown
Before	0.7%	96.3%	3.1%	0.0%
After	9.0%	89.1%	1.4%	0.5%

Significance .0000

This test shows a significant increase in the percentage of boaters entering the grass bed after the buoys than before. The next test more closely examines the actions of the grass bed enterers.

QUESTION: Is there a change in the angle of entry and the location from which boaters are entering the grass bed before and after the buoy installation?

HYPOTHESIS: A smaller percentage of boaters will enter from the marked channel after the buoys are in place. The percentage of boats which enter at an angle roughly parallel to the channel axis will decrease.

RESULTS:

Table A-8.3. Location and angle of entry of boats entering grass bed

	From Siesta Key channel		From ICW		From Big Pass channel	
	Parallel	Head-on	Parallel	Head-on	Parallel	Head-on
Before	63.6%	18.2%	0.0%	0.0%	18.2%	0.0%
After	33.3%	14.2%	4.8%	19.0%	0.0%	28.6%

Significance .0482

There is a significant decrease in the percentage of boaters entering the channel from the Siesta Key channel, particularly among those who just graze the edge of the grass bed while travelling through the channel. Looking at the statistics of the other channels surrounding the grass bed, it appears as though the buoys are attracting boaters from the ICW.

QUESTION: Does the percentage of boats contacting the grass bed change after the buoys are installed?

HYPOTHESIS: Fewer boats entering the grass bed will contact the grass bed after the buoys are installed.

RESULTS:

Table A-8.4. Boats contacting grass bed after entry

	Boat contacts grass bed		Boat does not touch bed	Unknown
	Boat stuck	Boat leaves mudtrail		
Before	9.1%	0.0%	0.0%	90.9%
After	0.0%	31.8%	4.5%	63.6%

Significance: .0803

Comparing boaters entering the grass bed before and after the buoys were installed, there is an increase in the percentage of boaters who contact the grass bed. The test itself, however, is just marginally significant. The large increase in the percentage of boats leaving a mudtrail before and after buoys may be attributed to both the subjectivity of the observers and the distance of the observer from the boat. The high percentage of boats recorded as "unknown" are further evidence of this.

QUESTION: Do a greater percentage of commercial or recreational anglers fish in or near the grass after the buoys are in place than before?

HYPOTHESIS: A greater percentage of recreational fishermen will fish in or near the grass bed area after the buoys are in, than before.

RESULTS:

Table A-8.5. Anglers fishing in or near the grassbed before and after

	Commercial fishermen	Recreational fishermen	No fishing gear
Before	1.7%	1.0%	97.3%
After	0.5%	5.2%	94.3%

Significance: .0087

Among all boaters observed near the grass bed, there is a significant increase in recreational fisherman observed near the grass bed after the buoys, than before. There is a decrease in the percentage of observed commercial fisherman fishing in or near the grass bed.

The next test examines where the recreational fishermen are fishing after the buoys are in place.

QUESTION: Do a greater percentage of those who fish recreationally <u>enter</u> the grass bed before or after the buoy installation?

HYPOTHESIS: A smaller percentage of those who fish will <u>enter</u> the grass bed after buoy installation.

RESULTS:

Table A-8.6. Recreational fishermen entering the bed before and after buoy installation

	Enters grass bed	Does not enter	Maybe enters
Before	0.0%	66.7%	33.3%
After	81.8%	18.2%	0.0%

Significance: .0178

A much greater proportion of recreational fishermen fishing in or near the grass bed enter the grass bed after the buoys are installed, than before.

QUESTION: Do a greater percentage of boaters exit from the grass bed with their motors off when seagrass buoys are marking the bed than before buoys were installed?

HYPOTHESIS: The buoys increase awareness of the grass bed and boaters exit from the grass bed in the least damaging way--with motors off.

RESULTS:

Table A-8.7. Motor v. non-motor exiting the grass bed before and after grass bed markers

	Exit with motor on	Exit with motor off
Before	90.9%	9.1%
After	85.7%	14.3%

Significance 1.000

There is no significant change in the method of boats exiting the grass bed before and after the buoys are installed.

QUESTION: When seagrass buoys are marking the grass bed, is there a significant change in the position of the motorboat propeller when exiting from the grassbed than prior to buoy installation?

HYPOTHESIS: There is a greater percentage of boaters who exit with their propellers up after the buoys than before.

RESULTS:

Table A-8.8. Propeller position of boats exiting the grass bed before and after grass bed markers

	Propeller up	Propeller down	Unknown
Before	0.0%	50.0%	50.0%
After	15.8%	73.7%	10.5%

Significance: .2965

There is no significant change in the propeller status before and after the buoys are installed.

QUESTION: What percentage of boaters who changed their speed near the markers (implying knowledge of the grass bed) entered the grass bed and what percentage did not enter?

HYPOTHESIS: A greater percentage of boaters who changed their speed near the markers did not enter the grass bed.

RESULTS:

Table A-8.9. Boaters who changed speed near markers and entry

	Entered grass bed	Did not enter	Maybe entered grass bed
Stopped or slowed	26.1%	65.2%	8.7%
Didn't change speed	5.1%	94.2%	0.6%
Doesn't go near buoys	66.7%	33.3%	0.0%

Although there are no before and after comparisons to be made, it is interesting to note that 26.1% of those who presumably were aware of the grass bed (those who changed speed near markers), chose to enter the bed. Of the 16 boaters who entered the bed, six (37.5%) stopped or slowed down, presumably entering the bed intentionally. This strenghtens the evidence that buoys encourage people to enter the beds.

QUESTION: What percentage of boaters who changed their course near the markers (implying knowledge of the grass bed) entered the grass bed and what percentage did not enter compared to those who stayed on course?

HYPOTHESIS: A greater percentage of boaters who changed their course near the markers did not enter the grass bed.

RESULTS:

Table A-8.10. Boaters' course near markers correlated to bed entry

	Entered grass bed	Did not enter	Maybe entered grass bed
Changed course	19.6%	73.9%	6.5%
Stayed on course	2.3%	97.7%	0.0%
Not near marker	75.0%	25.0%	0.0%

Significance .0000

Of those boaters who changed course near the markers, 19.6% entered the bed and 73.9% did not enter the bed. Although the majority of those who did change their course did not enter the bed, almost one-fifth of those who presumably knew there was a grass bed, opted to enter it. Of the 15 who entered the bed, nine (60.0%) changed course, presumably entering the bed intentionally. This adds further evidence that the seagrass buoys are attracting boaters into beds.

In summary, a significantly greater percentage of boats entered the grass bed after the buoys than before. A smaller percentage of them entered from the channel marked with seagrass buoys and greater numbers entered from nearby channels with conventional markers. There is, if at all, a slight increase in the percentage of boats which touched the grass bed after the buoys than before. There is a significant increase in recreational fisherman fishing in or near the grass flats after the buoys were installed and a significant increase in recreational fishermen entering the grassbed after buoy installation. The presence of buoys had no significant observable effect concerning either motor usage or propeller position upon exiting the grass bed. Tests relating to speed and course changes near markers show evidence that buoys attract people to enter seagrass beds.

B. City Island grass bed

Data collected from the City Island boater observations compared the behavior of 202 boaters before buoys were installed to the behavior of 165 boaters after the buoys were installed. Below are the general characteristics of the boaters and their boats observed in this area.

Table A-8.11.Characteristics of boaters and boats frequency results

Variable	Results
Boat size	large..............8.4%
	average...........57.2%
	small.............24.3%
	n/a...............10.1%
Number of occupants	(1)...............20.4%
	(2)...............24.5%
	(3)...............23.2%
	(4).................6.0%
	(>4)...............0.8%
	unknown.........25.1%
Boat type	Motorboats
	gas...............72.5%
	trolling............0.5%
	jetski.............15.0%
	Non-motorboats
	sail.................3.3%
	paddle/row.........0.5%
	drifting........... 0.5%

The results presented below are only from those tests that revealed meaningful information on boaters' reactions to the buoys. Some of the cross-tabulations were inconclusive due to a lack of data. Statistical tests for significance were impossible for these cross-tabulations, but the results will be presented for consideration. This does not mean the results are not meaningful, but simply could not be proven statistically significant. The results presented below will be prefaced by the question the data was collected to answer and by a hypothesis.

In the tables below, " before" refers to data collected before placement of the buoys. Likewise, "after" refers to the data collected after placement of the buoys. See Appendix 4 for a map of the zone locations.

QUESTION: Does the number of boaters entering the grass bed change after the placement of
the buoys?

HYPOTHESIS: Fewer boaters will enter the grass bed on the marked edge.

RESULTS:

Table A-8.12. Percentages of boaters entering grass bed in each zone before and after placement of informational buoys

Zone A

	Boater does not enter	Boater enters fast	Boater enters slowly
Before	69.1%	27.3%	3.6%
After	62.0%	29.0%	9.0%

Significance: .1570

Zone B

	Boater does not enter	Boater enters fast	Boater enters slowly
Before	78.2%	18.4%	3.4%
After	70.8%	16.8%	12.4%

Significance: .0732

Zone C

	Boater does not enter	Boater enters fast	Boater enters slowly
Before	87.2%	11.7%	1.1%
After	68.7%	27.3%	4.0%

Significance: .0070

Zone D

	Boater does not enter	Boater enters fast	Boater enters slowly
Before	77.2%	19.5%	3.4%
After	55.7%	37.1%	7.1%

Significance: .0051

Table A-8.12 indicates an overall increase in the number of boaters entering the grass bed after the placement of the buoys. In zones C and D, a large increase in the percentage of boaters entering the grass bed fast was observed. Although the percentage of boaters entering slowly also increased in zones C and D, the difference was less dramatic.

In zone B on the other hand, the percentage of boaters entering fast changed very little after placement of the buoys, but a much larger increase in the percentage of boaters entering slowly was observed. It is also interesting to note that only 7.4% more boaters entered the grass bed in zone B. This was a much less significant increase than in zones C and D. The 7.1% increase observed in zone A was insignificant.

The information above both contradicts and supports the hypothesis that less boaters would enter the grass bed along the marked edge. Overall, more boaters entered after placement of the buoys. This suggests the buoys are actually *attracting* boaters to the grass bed. The increase was less, however, along the only completely marked edge.

In order to better understand the results of this test, we looked more closely at boater behavior around the buoys. Variables such as the boaters' angle of entry onto the grass bed, speed changes near the markers, and course changes near the markers were analyzed for any significant differences. We also found it necessary to determine if the type of craft (jetski, sailboat, inboard or outboard) or the type of boater (fishermen or recreational) changed significantly after placement of the buoys.The information will reveal more precisely how the buoys are affecting boater behavior.

The next test was designed to differentiate between boaters whose destination was the grass bed and those boaters who simply grazed the edge of the grass bed enroute to somewhere else. Boaters were separated into eight groups according to: their angle of entry (roughly perpendicular or parallel), the speed of their entry (either fast or slow) and the location of their entry (on a marked or unmarked edge). It was assumed that those boaters who entered on a perpendicular angle intended the grass bed as a destination, while those who entered on a path parallel to the adjacent channel did not. The results presented in Table A-8.13 are only for those boaters who entered the grass bed.

QUESTION: Do the boaters' speed and/or angle of entry into the grass bed change after the placement of the buoys?

HYPOTHESIS: Boaters will slow down near the markers, and the number of parallel or grazing entries will decrease after placement of the buoys.

RESULTS: The first set of results below analyzes the differences in the angle of boaters' entry into the grass bed. Percentages were obtained from the total number of boaters who entered the grass bed in each zone. Boaters who crossed the edge in C and traveled into B or D, for example, were not included in these calculations.

TABLE A-8.13. Angle of entry

Zone	BEFORE PLACEMENT unmarked area		AFTER PLACEMENT unmarked area		AFTER PLACEMENT marked area	
	perpendicular	parallel	perpendicular	parallel	perpendicular	parallel
A	67.6%	32.4%	61.9%	38.1%	93.8%	6.2%
B	100%	0.0%	n/a	n/a	72.3%	27.7%
C	14.3%	85.7%	50.0%	50.0%	90.0%	10.0%
D	64.0%	36.0%	42.8%	57.2%	n/a	n/a
column#	(1)	(2)	(3)	(4)	(5)	(6)

DISCUSSION: First, compare columns (1) and (5). Marked areas revealed higher percentages of perpendicular entries in zones A and C. This suggest the buoys are attracting boaters. In zone B, however, the percentage of perpendicular entries decreased from 100% to 72.3% after placement.

Parallel entries increased after placement on marked edges only in zone B. This could be due to the inadequacies of our sampling methods. Since the exact location of the grass bed edge before placement of the buoys was often unclear (especially during high tides), identifying parallel boater entry was sometimes difficult. After the placement of the buoys, the edge in zone B became much more defined and boater entry became much easier to identify. Hence, more parallel entries were reported after placement. Parallel entries in marked areas were low compared to unmarked areas in zones A and C (columns 2, 4 and 6).

The rise in the number of perpendicular entries along the marked edge demonstrates that buoys are an attractive force to boaters. On the other hand, the decrease in the number of parallel entries (with the exception of zone B) suggests the buoys act as a deterrent. In order to determine which is the case, it is necessary to examine boater behavior more carefully.

The next set of results analyzes any speed changes that occurred along with the changes in angle of entry. The figures in Table A-8.14 are percentages of only those boaters who entered on a perpendicular angle.

Table A-8.14. Speed of boats entering at a perpendicular angle

Zone	BEFORE PLACEMENT unmarked area		AFTER PLACEMENT unmarked area		AFTER PLACEMENT marked area	
	fast entry	slow entry	fast entry	slow entry	fast entry	slow entry
A	76.0%	24.0%	84.6%	15.4%	62.5%	37.5%
B	80.0%	20.0%	n/a	n/a	61.5%	38.5%
C	100.0%	0.0%	100.0%	0.0%	84.2%	15.8%
D	75.0%	25.0%	87.5%	12.5%	n/a	n/a
column#	(1)	(2)	(3)	(4)	(5)	(6)

DISCUSSION: Percentages of fast and slow perpendicular entries (columns 1 through 2) before placement are very similar for all zones with the exception of zone C. The percentages of fast entries along the marked areas (column 5) were less than in unmarked areas (columns 1 and 3).

Percentages of slow entries were higher after placement in zones A, B, and C (columns 4 and 6). Overall, there is a decrease in the percentage of boaters entering head on and fast, and a concomitant increase in the number of boater entering head-on and slowly.

Although this difference was insignificant, it is interesting to note that the percentage of boaters in zone B entering the grass bed *fast* on a perpendicular angle decreased from 80.0% to 61.5% after placement of the buoys. This was the largest decrease for any of the marked zones. On the other hand, the percentage of boaters entering the grass bed in zone B *slowly* on a perpendicular angle increased from 20.0% to 38.5% after placement. This was the largest increase observed for any of the marked zones.

The data supports the hypothesis that more boaters entering the grass bed head-on will slow down after placement of the buoys.

The figures in Table A-8.15 are percentages of only those boaters who entered on a nearly parallel angle.

Table A-8.15. Speed of parallel entry

	BEFORE PLACEMENT unmarked area		AFTER PLACEMENT unmarked area		AFTER PLACEMENT marked area	
Zone	fast entry	slow entry	fast entry	slow entry	fast entry	slow entry
A	100%	0.0%	87.5%	12.5%	100%	0.0%
B	0.0%	0.0%	n/a	n/a	40.0%	60.0%
C	100%	0.0%	100%	0.0%	100%	0.0%
D	100%	0.0%	83.3%	16.7%	n/a	n/a
column#	(1)	(2)	(3)	(4)	(5)	(6)

DISCUSSION: The data in Table A-8.15 indicate that the buoys had little or no effect on the speed of parallel entries in zones A and C. In zone B, no parallel entries were observed in the field before placement of the buoys, but a high percentage were observed after placement. This could be due again to the inadequacies of the sampling methods mentioned in the discussion for Table A-8.13. That is, parallel entries were much easier to identify after placement of the buoys. The fact that a high percentage of boaters entered the grass bed slowly in zone B suggests some effect on boater behavior that will benefit the grass bed.

It must be remembered that Tables A-8.14 and 15 analyze speed changes for only those boaters who entered the grass bed. But what about the boaters who did not enter the grass bed? Did the buoys affect their speed or course? The next set of tests attempt to answer these questions.

QUESTION: How many boaters change their course near the buoys? Are they then entering or turning away from the grass bed?

HYPOTHESIS: Boaters will change their course near the buoys to avoid the grass bed.

RESULTS:

Table A-8.16. Course changes near buoys for those boats entering the grass bed

	changed course	stayed on course
Zone A:	9.5%	90.5%
Zone B:	25.8%	74.2%
Zone C:	9.0%	91.0%
Zone D:	No buoys in this zone	

The percentage of boaters who changed their course to enter the grass bed was highest in zone B. These results suggests that the boaters were attracted by the buoys. The high percentage of boaters who stayed on course and entered the grass bed seems to indicate the buoys had little effect on the behavior of boaters who intended the grass bed as their destination.

The percentages presented in Table A-8.17 were obtained from only those boaters who did *not* enter the grass bed.

Table A-8.17. Course changes near buoys for those boats that did not enter the grass bed

	changed course	stayed on course
Zone A:	59.1%	40.9%
Zone B:	74.6%	25.4%
Zone C:	60.0%	40.0%
Zone D:	No buoys in this zone	

Table A-8.17 reveals that a high percentage of boaters changed their course near the buoys to avoid crossing the grass bed. The highest percentage occurred in zone B. Tables A-8.16 and 17 indicate a definite effect on boater behavior. More boaters are changing their course to enter in zone B, yet a higher percentage of boaters in all three marked zones changed their course to *avoid* the grass bed.

The next two tests attempt to determine any changes in boater speed near the buoys.

QUESTION: Do the buoys have any effect on boaters' speed ?

HYPOTHESIS: Boaters will slow down near the markers.

RESULTS: Percentages in Table A-8.18 were obtained from only those boaters who entered the grass bed.

Table A-8.18. Entering boaters' speed near buoys

	stopped	slowed down	continued at same speed
Zone A:	23.5%	0.0%	76.5%
Zone B:	10.0%	26.7%	63.3%
Zone C:	0.0%	11.1 %	88.9%
Zone D:	No buoys in this zone		

Statistical tests for significance were impossible. Note the highest percentage of boaters slowing down occurred in zone B. The data above support the hypothesis that boaters will slow down near the buoys before they enter the grass bed. The reason such a high percentage of boaters stopped in zone A is unclear, but the proximity of the Ski-a-rees (water skiing) boat dock and several public boat ramps could have been a factor.

Percentages in Table A-8.19 were obtained from only those boaters who did not enter the grass bed. Statistical tests for significance were impossible.

Table A-8.19 Boaters speed near buoys when the boat did not enter the grass bed

	stopped	slowed down	continued at same speed
Zone A:	4.8%	0.0%	95.2%
Zone B:	0.0%	12.7%	87.3%
Zone C:	0.0%	25.0 %	75.0%
Zone D:	No buoys in this zone		

Although they did not enter the grass bed, a high percentage of boaters changed their speed near the buoys. This suggests the buoys are acting as a deterrent.

The results above suggest the buoys act as deterrents, but many boaters nevertheless do enter the grass bed. In order to accurately assess the ability of the buoys to reduce damage, it is necessary to analyze any changes in the types of boats or boaters entering the grass bed. It is also necessary to examine any changes in boater behavior once they are on the grass bed.

The types of motors distinguished in the next two tests (either on or off) were: gas (both inboard and outboard), trolling motors, or jetski.

QUESTION: Do the buoys have any effect on the types of motors used to enter the grass bed?

HYPOTHESIS: Jetski use of the grass bed will increase after placement of the buoys

RESULTS:

Table A-8.20. Types of motorboat entering grass bed

	BEFORE			AFTER			
	gas	jet ski	off	gas	jet ski	off	significance
Zone A:	70.2%	27.7%	2.1%	72.2%	19.4%	8.3%	.3310
Zone B:	56.3%	37.5%	6.3%	64.9%	32.4%	2.7%	.7442
Zone C:	36.4%	63.6%	0.0%	46.7%	50.0%	3.3%	.6570
Zone D:	61.8%	35.3%	2.9%	57.1%	39.3%	3.6%	.9325

None of the results were significant. The results suggest the buoys have little effect on the type of motor used to enter the grass bed. The next test analyzes any effects the buoys had on the type of motor used to exit the grass bed.

QUESTION: Do the buoys have any affect on the type of motor used to exit the grass bed?

HYPOTHESIS: More boaters would exit with their motors off after placement of the buoys.

RESULTS:

Table A-8.21. Method of exiting from grass bed

	BEFORE				AFTER			
	gas(on)	trolling	off	no motor	gas(on)	trolling	off	no motor
Zone A:	91.3%	2.2%	4.3%	2.2%	86.5%	2.7%	8.1%	2.7%
Zone B:	93.7%	0.0%	6.3%	0.0%	80.0%	0.0%	15.0%	5.0%
Zone C:	100%	0.0%	0.0%	0.0%	86.2%	0.0%	6.9%	6.9%
Zone D:	96.9%	0.0%	0.0%	3.1%	96.7%	0.0%	3.3%	0.0%

No significant changes were encountered in zones A (.9005), B (.4135) C (.4637), or D (.5190). None of the results were significant. The results suggest the buoys have little effect on the type of motor used to exit the grass bed.

QUESTION: Does the number of skiers entering the grass bed change after placement of the buoys?

HYPOTHESIS: Fewer water skiers will enter the grass bed after placement of the buoys.

RESULTS: Percentages of all types of boats entering the bed were obtained from total boaters within each zone.

Table A-8.22. Percentage of entering boaters who are water skiers

	BEFORE		AFTER	
	skiing	not skiing	skiing	not skiing
Zone A:	15.7%	84.3%	23.7%	76.3%
Zone B:	0%	100%	2.5%	97.5%
Zone C:	16.7%	83.3%	16.1%	83.9%
Zone D:	26.5%	73.5%	16.1%	83.9%

Significance levels were: zone A, (.4985); zone B, (.4870), zone C, (.9685); zone D, (.4771.) None of the results were significant. The percentage of skiers that entered the grass bed after placement was lowest in zone B. This makes intuitive sense, because most skiers try to avoid shallow water and buoys.

QUESTION: Are the buoys attracting fishermen?

HYPOTHESIS: Buoys will attract more recreational fishermen.

RESULTS: Percentages were obtained from total boaters within each zone.

Table A-8.23. Percentage of entering boaters who are fishermen

	BEFORE		AFTER	
	commercial	non commercial	commercial	non commercial
Zone A:	3.9%	7.8%	10.5%	7.9%
Zone B:	10.5%	10.5%	5.0%	25.0%
Zone C:	0%	0%	9.7%	6.5%
Zone D:	2.9%	0%	6.5%	9.7%

Significance levels: A, (.3854); B, (.2495); C, (n/a); D, (.5000). No significant change in the number of fishermen entering the grass bed was encountered in any of the zones. Notice, however, the relatively high percentage of non-commercial fishermen entering the grass bed in zone B after placement of the buoys.

Discussion

The objective of this study has been to determine the ability of warning buoys to prevent boat propeller damage to seagrass beds. It is our hypothesis that the buoys will prevent damage by either reducing the number of boaters entering the grass bed and/or changing boater behavior while on the grass bed. The results obtained from this study both support and contradict our hypothesis.

Table A-8.12 indicates an overall increase in the number of boaters entering the grass bed after placement of the buoys. The increases observed along the marked edges in zones A and B, however, were considerably less than in zones C and D and were statistically insignificant. The reason for the overall increase is unclear, but could be seasonal. That is, the number of tourists on the bay may have increased during the time of study, and boaters less familiar with grass beds may be more likely to enter.

Boaters entering the grass bed slowly accounted for most of the increase observed in zones A and B. This fact supports our hypothesis that boaters will slow down near the buoys.

Statistical tests for significance were not performed on Tables A-8.13 through 19 due to a lack of pre-placement data. This made before and after comparisons impossible, but the percentages were presented for consideration. Interpreted correctly, these percentages should reveal how the buoys are effecting boater behavior.

Changes in the boaters' angle of entry onto the grass bed were presented in Table A-8.13. An increase in the percentage of perpendicular entries, along with a decrease in the number of parallel entries, was observed in zones A and C. Boaters in zone B responded to the buoys differently. In this zone, the percentage of perpendicular entries decreased, while parallel entries increased. As stated previously, we have assumed those boaters entering the grass bed on a perpendicular angle intend the grass bed as their destination.

The rise in the number of perpendicular entries along the marked edge suggests an attraction to boaters caused by the buoys. With the exception of zone B however, the decrease in the number of parallel entries suggests the buoys act as deterrents, especially for those boaters who do not wish to enter the grass bed. The increase in parallel entries observed in zone B might be explained by the inadequacies of our sampling methods described earlier.

Tables A-8.14 and 15 illustrate boaters' speeds with respect to their angle of entry. In Table A-8.14 the percentages of boaters entering the grass bed fast on a perpendicular angle were lower in the marked areas. Similarly, the percentages of slow perpendicular entries in the marked areas were higher than unmarked areas. These results support our hypothesis that boaters will slow down near the buoys.

The data in Table A-8.15 indicate that the buoys had little effect on the speed of parallel entries in zones A and C. The results for zone B are difficult to interpret because no parallel entries were reported before placement.

Tables A-8.16 and 17 illustrate course changes near the buoys. The highest percentage of boaters changing their course to enter the grass bed occurred in zone B, but the highest percentage of boaters who changed their course so as not to enter also occurred in zone B. The results from these two tests indicate the buoys are attracting some boaters, but are also deterring many others.

The data in Table A-8.18 again support our hypothesis that boaters will slow down before entering the grass bed near the buoys. It is interesting to note that many boaters slowed down near the markers, but chose not to enter (Table A-8.19). Once again this lends support to our hypothesis that the buoys will sometimes act as deterrents.

Significant changes in the type of motor used to enter or exit the grass bed (Tables A-8.20 and 21) were not found in any zone. Increases in the percentages of boaters exiting with their motors off after placement were found in every zone, with the sharpest increase occurring in zone B.

The results presented in Table A-8.23 did not reveal any significant changes in the percentage of recreational or commercial anglers entering the grass bed. The number of recreational fishermen entering the grass bed, however, did increase in every zone after placement. The largest increase was observed in zone B. It seems this increase in recreational fishermen could have accounted for the increases in perpendicular entries described earlier.

To summarize, the number of boaters entering the grass bed in unmarked zones increased after placement. A marginally significant increase (.07) of boaters entering the grass bed also occurred in zone B, the completely marked zone. The percentage of boaters entering the grass bed on a perpendicular angle increased in some areas, but decreased in the only completely marked zone. The number of boaters entering the bed at a nearly parallel angle, on the other hand, decreased in the unmarked zones, but increased in the marked zones. A higher percentage of boaters slowed down as they entered the grass bed on a marked edge than on an unmarked edge. A greater percentage of boaters changed their course to avoid the grass bed along the marked edge than along the unmarked edge. A greater percentage of boaters, however, also changed their course to enter the grass bed near the markers than near the unmarked edges.