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Recommendations for Hurricane Preparations and Responses for Boating Communities

and Industries CIRCULATING COPY



Maria L. Villanueva and Donald W. Pybas — editors

Florida Sea Grant College Program

TP-75



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Recommendations for Hurricane Preparations and Responses for Boating Communities and industries

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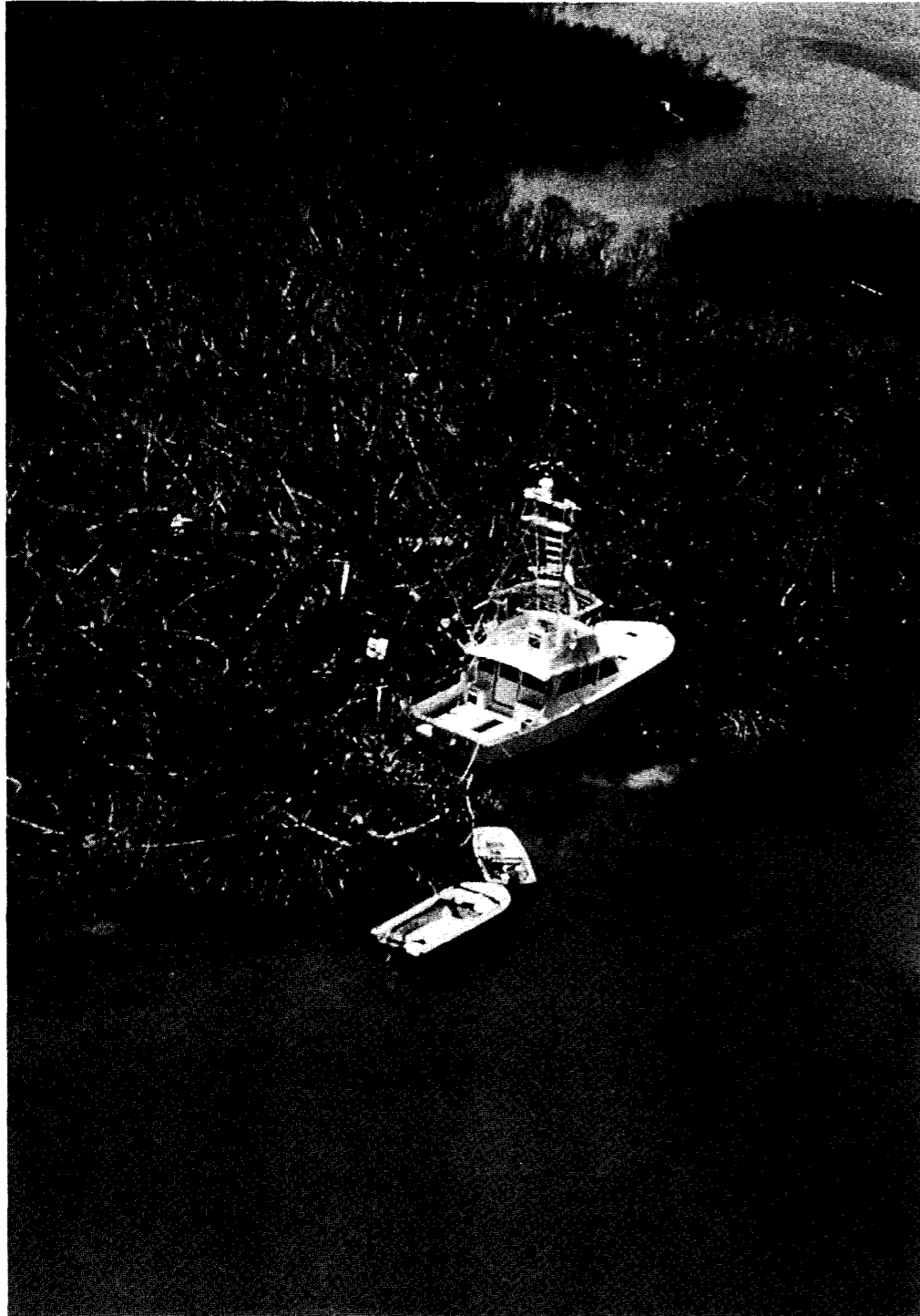
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1 .0 Introduction

Recent hurricane experiences revealed the lack of cooperative and coordinated efforts between the public and private sectors of marine interests. Many segments of both the private and public sectors do not have the necessary plans to efficiently prepare for, and respond and recover from, a catastrophic event. Hurricanes, such as Hurricane Andrew, which hit the greater Miami area (Dade County, Florida) in August 1992, can cause severe damage to wet berthed boats and destroy thousands of boats on trailers or dry storage. Additionally, boat storage facilities, boat repair facilities and other marine businesses can be damaged by a storm and deemed non-operational for a long period of time. These events can be especially difficult for local economies that depend on boating and boating related activities. It is apparent that coordinated plans for hurricane preparation, and response and recovery should be developed to address the needs of the boating sectors of coastal communities. On November 17-18, 1993, a workshop was convened at the University of Miami Rosenstiel School of Marine and Atmospheric Sciences to address the development of a framework for marine community hurricane planning.

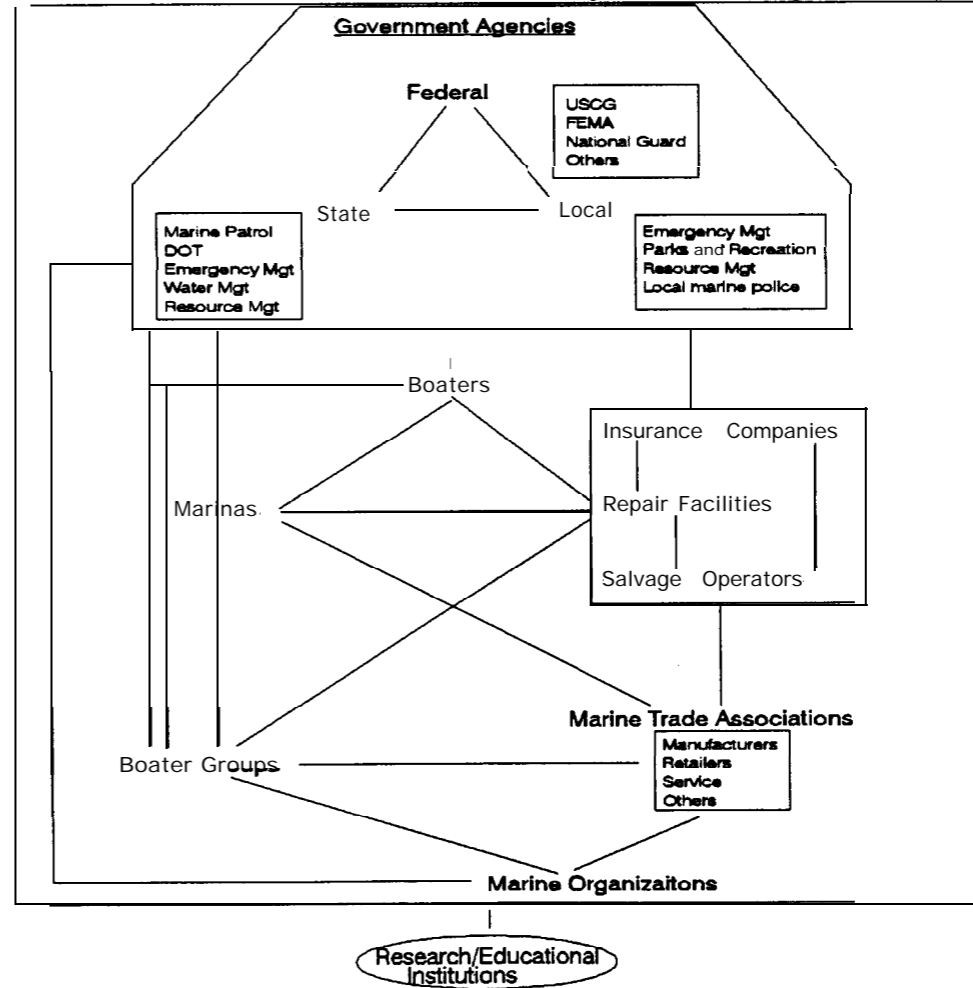
The workshop was sponsored by the Florida Sea Grant College Program and conducted by the University of Miami Boating Research Center and the Sea Grant Extension Program. The workshop addressed the need to re-evaluate marine hurricane policies and programs. Invited participants from various regulatory and enforcement agencies, municipal and county government, marine industry and the boating community were asked to explore and recommend alternative strategies and implementation of pre-hurricane preparation and post-hurricane response and recovery plans for boating communities. The recommendations of this workshop are listed in this report, along with invited presentations that set the stage for the workshop discussion groups. The need for developing a conceptual framework for organizing local marine community hurricane preparedness and response

and recovery plans was demonstrated in this workshop. Figure 1 illustrates the complexity of the undertaking as recommended by the following document.

Specifically, the objectives of the workshop were:

1. To facilitate exchange of hurricane experiences and information among different agencies and marine groups,
2. To review and reevaluate current policies and programs affecting hurricane preparation, response and recovery, the effectiveness of these programs, and policies with recent hurricane experiences,
3. To recommend pre- and post-hurricane strategies for the boating communities and recommend how these strategies can be implemented through development of a response and recovery framework, and
4. To increase institutional links and information sharing among agencies and marine organizations involved in pre- and post-hurricane operations (see Figure 1).

Figure 1
Institutional Links of Marine Community Hurricane Planning



2.0 Workshop Recommendations

A. Pre-Hurricane Planning and Preparation

Recommendation A1

Boat owners should have a Boater Hurricane Preparedness Plan. The plan should contain a concise review of materials, the steps to be taken to prepare the physical environment of the boat itself, and, if need be, a prearranged agreement with a storage facility or property owner that will allow storage of the boat during a hurricane.

A checklist of procedures for each step in a hurricane preparedness plan is a good reminder of important items that can reduce the amount of time trying to figure out what is left to do under a stressful situation.

Prior planning is the key to successful preparation. Experience has proven that boater hurricane preparedness education and preparation can reduce loss of property for both the boat owner and others. Knowing what preparations to make ahead of time, having appropriate supplies available, and knowing where to take a boat, if evacuation is necessary, can go a long way in survival with little or no damage. However, if one is unfortunate enough to be in the path of the worst sector of a severe hurricane, preparation can only go so far. This is when luck comes into play.

1a. Boaters should practice the routine of getting the boat ready and executing an evacuation under normal, relaxed circumstances. During an actual hurricane the time to accomplish preparations may be greater than normal due to boat traffic/bridge openings, lines at retail suppliers, and boatowners' preparations of their homes and/or businesses. Use a sunny weekend day to practice.

1b. The boat owner should take into consideration that a hurricane may strike during a time of absence and should plan accordingly. Prior arrangements should be made with someone who is familiar with the hurricane plan, the boat, and the evacuation site.

Wind borne debris poses as much of a threat to boats as does water borne flotsam and waves. Trailerable boats should be moved away from waterfront areas. One should take into consideration that storage on the leeward side of a building may reduce damage from debris. Tying down a boat near or under a tree is not a good idea.

1c. Larger vessels may be hauled out on low-boy transport trailers with prior arrangements or contracts with commercial haulers. The marina office should be aware of these arrangements and maintain appropriate records.

1d. Insurance companies should motivate boaters to be pro-active concerning hurricane preparedness by providing a discount for those who have a hurricane plan and make every attempt to execute it. These rates should be for the boat owner who actually writes a formal plan and files it with the insurance company. Financial incentive could be a useful tool.

Recommendation A2

Boat Storage Facilities should have a written Hurricane Plan. The plan should establish the sequence of events that are to go into effect on a set time frame.

2a. Operators of marinas and other boat storage facilities need to evaluate the docks and design criteria for load under storm conditions. Key factors that need to be exam-

ined for surviving a hurricane, especially if boats are stored in-water in the facility, are: docking boats in the slips for which they were designed; not overloading dock structures; proper maintenance of storage facilities including replacing deteriorated piles, docks and hardware on finger piers; properly retrofitted or designed and engineered docks; marina personnel should have assignments for securing the facility.

Many public marinas are administered by non-marine oriented agencies. These agencies may not understand that expedient removal of a damaged or sunken boat in a marina can reduce collateral damage to other boats, the marina's facilities, possibly minimize environmental damage from fuel spills, and prevent loose boats from impacting sensitive habitats.

Marina managers, especially in publicly run facilities, may not be able to allow access to boat owners, insurance representatives, marine salvor operators and other personnel for safety or security reasons due to loss of communications with superiors. If cooperative efforts are made to share information obtained on site, the result will be fewer requests for access to impacted areas.

Marina management should establish written policies and procedures for the following procedures: when and how the facility will be closed; what security measures will be put in place; what credentials will be required post-hurricane; what back-up modes of communication will be available; and who authorizes salvage and removal of vessels.

Personnel should be given certain tasks for which they will be responsible. All personnel should be familiar with the overall plan and assist with all aspects of the plan. The plan should include these checklists: (1) what equipment is to be shut off; (2) what materials need to be on hand prior to a hurricane; (3) materials needed after the storm to get the facility up and running as quickly as possible; (4) how to control access to the facility for safety and security reasons; (5) a list of tenants' contact phone numbers and status of their boat should be established; and (6) determine what records to remove from the marina when preparations are complete and personnel are evacuated from the site. These records may prove invaluable after the hurricane. Review

the Hurricane Plan with marina staff at least annually. Walk through procedures and check emergency equipment periodically.

2b. Marinas should require boat owners to have a written Hurricane Preparedness Plan and insurance prior to entering into a contract to store the boat in the marine facility. Some localities and/or states have laws prohibiting mandatory boat evacuation from marinas. If boats are to be left in a marine facility, the boat owner is still obligated to prepare for the hurricane so as to minimize damage to the boat, marina and other boats.

Marina and boat storage facilities should have adequately designed and installed docks and piles for increased survivability with boats in them. Alternative configuration or "tethering equipment" may be considered to secure boats in slips. If facilities will experience a storm surge, boats should be oriented "bow in" toward the oncoming water wherever possible. Larger boats should be moved to slips further from the marina entrance to lessen the potential for being torn loose and impacting smaller boats or docks "behind" them on adjacent docks.

2c. Each marina tenant should prepare a hurricane plan. The plan should be on file with the dockmaster. The plan should indicate who will be responsible for the boat in the event of a storm and what the actions of that person will be. Boating education and hurricane awareness campaigns should emphasize that the boat owner is responsible for his/her own boat and its preparation prior to a hurricane.

Hurricane planning is not just a piece of paper but, actually reaching an agreement with whomever a boat owner expects to work for him on his behalf, including a trailering company of large vessels, for moving boats of absentee owners or absentee captains, even pre-arranged agreements with a towing company.

Drystack stored boats may need to be removed by trailer as the structure may not be adequate to withstand hurricane force winds. Drystack facilities vary in quality of

design, construction, and maintenance. During hurricane preparation, the following questions should be addressed. (1) Is there a need to remove boats from the top level of racks? (2) Should lower tiered boats be tied down? (3) Is there a need to remove loose materials from exterior areas? Additionally, the battery switches on all boats should be set to the off position as damaged boats may leak fuel after a hurricane and pose a very dangerous situation, especially in enclosed facilities.

Many drystack customers do not purchase trailers when purchasing their boats. Therefore, alternate trailering services, rentals, etc., need to be explored. If a trailered removal by a contractor is arranged, then the marina facility should be notified.

2d. Private marine facilities should obtain adequate insurance coverage for property, liability, and especially, insurance to cover the period of time that the marina is unable to operate as it may be months before the business can open and generate income. By redesigning or retrofitting marina docks and facilities, insurance companies may be more inclined to underwrite these facilities. Hopefully a proactive loss prevention plan can assist marina facility owners in acquiring needed insurance.

Recommendation A3

Boater education programs that specifically deal with hurricane preparation and planning should be developed.

It is evident that even though boaters have hurricane plans, they are not necessarily followed. A major education program should be undertaken to encourage more people to formulate a plan and to execute measures for preparing their boats, whether they leave them in the marinas and "triple up" their lines versus actually moving their boats,

evacuating them to a safe haven or to a safer place. This would initiate some thought process as to whether they move their boats or prepare them on site.

3a. Boater education should be more relevant to the boater's geographic location and needs. Current boating education programs such as the Power Squadron and Coast Guard Auxiliary do not adequately address hurricane and heavy weather preparations in basic boating classes. These organizations also do not offer specialty classes on hurricane preparation, especially relating to ground tackle, selecting chafing gear, and harbors of refuge (hurricane havens) in coastal areas prone to hurricanes. However, these organizations are already highly motivated and in place and should have major involvement in hurricane preparedness education locally.

3b. Marina facilities should organize and conduct educational seminars and demonstrations at the marina for tenants and boat owners. These seminars and demonstrations could be sponsored by the marine industry associations and local government agencies. The seminars and demonstrations accomplish two things: 1) they provide goodwill and a sense of caring on the part of marina management toward their customers; and 2) they better prepare the boater and the marina facility for an increased chance of survival from a hurricane. Managers should provide for hands-on training using experienced boaters as volunteers, Coast Guard Auxiliary or Power Squadron personnel. Boaters should be encouraged to attend and participate. If necessary, incentives such as lunch or a raffle for free supplies may be used to attract boaters.

If the facility has a ship's store, provide "hurricane packages" of required items, especially plenty of lines or have a vendor set up a tent and sell supplies during the training. Many experienced boaters are willing to share their knowledge in the common interest of boating and seamanship to protect their boats. (On the other hand, many boaters seem to regard their insurance coverage as all that is needed and will not prepare for a hurricane).

Recommendation A4

Vessels need to be evacuated inland or moved out of slips to open areas in the marina basin at the earliest time possible, when it is still safe to move the boats. Most hurricane prone coastlines do not provide adequate protection for all types of boats.

Coastal marinas are not a viable sanctuary for a vessel of any type during a direct hurricane threat. Most wet slip marinas are not designed to accommodate vessels during storm surge and/or heavy winds. These elements tend to push and pound boats against pilings and/or lift pilings, docks and other vessels, etc. Slips are too narrow to allow for the violent motion of a vessel in a hurricane.

4a. Emergency Management offices should advise boaters to evacuate coastal marinas when it announces the Hurricane Watch. The concept of a "boater's warning" to coincide with the issuing of the National Weather Service Hurricane Watch should be developed. In other words, move the level of concern up one level instead of waiting for the Hurricane Warning. This would recommend that boaters act at the Watch. Experience with Hurricane Andrew in the Miami area, using the concept of a "boaters warning" time frame, would have required action on Thursday morning or approximately 72 hours prior to landfall. In the case of boaters surveyed after Hurricane Andrew, over 60 percent indicated that they moved their boat less than 24 hours prior to the storm (Baker and Villanueva, 1993).

Many questions face a boater who has decided to evacuate his boat prior to a storm. These include: (1) where do I go?; (2) Are there safe, sheltered waters for hurricane evacuation?; (3) How many boats can be accommodated in

these identified areas?; (4) Are there legal and physical restrictions in accessing these safe areas?; and (5) Are there draw or swing bridges along the path to a safe haven?

Improved technology has been developed for moorings through the use of helical screw anchors that provide improved holding ability over concrete or granite block mooring anchors. This technology also has a decreased potential for environmental impact during installation and during use by boats.

Consideration should be given to establishment of permanent mooring fields in areas where suitable. Evaluation of vulnerability of potential sites and the feasibility of public/private partnerships in developing and administering hurricane mooring fields on publicly owned submerged lands needs to be undertaken.

Doubling up of moorings in appropriate sites for regular day-to-day moorings and for hurricane moorings could be explored as a cost effective approach while providing an efficient use of wet stored boating facilities where large numbers of sailboats moor.

4b. Marine trade associations should inventory local and regional facilities that can store boats in the event of a hurricane. The inventory should include the names, addresses, and phone numbers of the storage facilities, the type of boats that could be stored, fees, facility rules, and the boat owners' responsibilities. This information should be provided to marina operators and to boat owners.

4c. Well known safe havens (especially those inland beyond draw bridges) need a well defined and organized emergency plan to permit access by boats in the event of a hurricane. Bridges have land evacuations routes using them. When will the bridges be closed and locked down? Who orders this? Does there need to be an organized flotilla plan to keep bridge openings to a minimum during hurricane preparations?

4d. An oversight advisory committee responsible to a local emergency management agency should be formed. Committee make-up should include representatives from the

Department of Transportation, Florida Marine Patrol, United States Coast Guard, Department of Environmental Protection, knowledgeable representatives of the boating community, and others. The committee should address these issues well ahead of hurricane season. A standing written policy should be established by the appropriate authorities and distributed to all parties, especially bridge tenders. Review of procedures should be conducted at least annually to insure all parties are aware of current policies.

B. Post-Hurricane Response and Recovery

Recommendation B1

Boat storage facilities should develop post-hurricane response plans which address timely communication with local agencies and timely facilities access.

Timely communication and facility access impact just about every member of the marine community; boat owners, marina operators, underwriters, marine salvors boat yards and others.

1a. Boat storage facilities should have a prearranged identification system for key employees at a marina. This would allow insurance adjustors, contracted marine salvors and other necessary personnel into a safe area declared so by the marina dockmaster or appropriate on-site party. Boat owners who want to stabilize or secure their vessels after the storm should be allowed into the facility if it is determined safe. Marina operators should establish limited access control by allowing only a few people in at a time for specific purposes.

Numerous outside agencies, especially disaster relief agencies, may request access to marine facilities shortly after a storm. The marina operator, who has employees or a cadre of trained and knowledgeable volunteers can expedite these activities by escorting people through the facility. Uncontrolled access to marinas should not be allowed due to dangerous conditions such as fuel spills and other hazards. Controlled access limits personal injury or possible loss of life and may limit or prevent property damage and/or looting.

1b. Marinas should consider doing their own hurricane documentation, for instance, videotapes of boats in the

facilities, before and after the storm. Detailed records and plans of the facility are very important in insurance settlements and disaster assistance programs. Boat storage facilities should keep their records and site plans where they can be evacuated from the site so they can be readily available for post-hurricane repairs.

1c. Communication with the boat owners and the marine community by marina management of both private and public marine facilities should be established as soon as possible. The economy of a given community may be largely dependent on marine business activities associated with boat storage facilities. If false expectations are established concerning repairs and reopening of damaged facilities, the boating community (of which most are taxpayers) will view the agency and/or the local government as not meeting their responsibilities. Ill will and legal action can be prevented by communicating an accurate assessment of the extent of damages, estimation of repair or replacement time of facilities, and possibly limited service at less severe damaged facilities for boats that need to be moved out of safe havens after the hurricane.

Recommendation B2

The Marine Industry Association should develop an inventory of local and regional boat repair facilities. This inventory should establish how many boats can be handled by any one repair facility at a time.

The association should also identify possible staging areas for damaged and salvaged boats until insurance adjustors and marine surveyors determine the extent of damage and disposition of the boat.

2a. The marine industry associations should set up a clearinghouse of all insurance companies and marine interests. They should have a listing and status of which boat yards are available, which are open, type of work that can be done in the facility, and which are merely storage yards.

2b. The marine trade associations should also explore establishing a communications "hot line" outside the impacted area. This hot line could be used to determine the extent of available repair facilities still in operation so that boats do not need to be removed from the area.

Recommendation B3

Insurance personnel should provide input from a marina facility to be shared in a clearinghouse operation set up outside the impacted area. This would provide all interests with information on the status and needs of each marina site.

3a. A clearing house concept could be developed by insurance companies with protocol response, catastrophe "cat" teams reporting back to a central site with shared information on the boats' general condition in given locations. This would assist underwriters, insurance adjustors, marine surveyors, and contracted marine salvors. Shared information through a clearing center would expedite finding insured boats when access to many areas will be restricted for days after a hurricane.

Insurance companies and pre-arranged salvor operators should be on file with the marina where an insured boat is a tenant. The boat owner should provide this information to the marina management with his dockage contract. Depending on the facility, procedures for access by contractors can be a problem. Pre-arranged access can reduce the

post-hurricane response time and thus the loss exposure to a boat.

3b. Industry standards should be established concerning salvor or towing services. Contracted services such as towing have been established through membership organizations such as Boat/US. Freelance salvor operators may be a potential problem as some boaters without insurance may hire them without a contract and get charged exorbitant amounts to raise a boat off the bottom. On the other hand, legitimate salvor operators may be denied access to a marina because they do not have a contract with an insurance company or the public agency that manages the facility.

Recommendation B4

Standardized scale, high quality, aerial photography should be provided for assessing marine facilities, boat related losses, and environmental damage caused by the hurricane.

4a. Complete overflight photography of the hurricane impacted area, especially the coastal nearshore and inshore areas, should be flown just prior to and immediately after a hurricane. A system through a state emergency management agency should be responsible for requesting this type of assistance from the Federal Emergency Management Administration (FEMA). FEMA in turn can access high technology photography from capable agencies or the military.

4b. Many local police or other agencies have the ability to take low level aerial photographs from the helicopters they use for flyovers to assess damage to impacted areas and for relief efforts soon after the storm. These photographs can be available within hours after the storm.

Recommendation B5

An efficient system of finding damaged or sunken vessels should be established. Insurance companies, marine patrol, surveillance satellites, Sea-Grant generated aerial photography, and an 800-number "boat lost and found" should be elements of this system.

5a. A clearinghouse for information on boats found as reported by the field officers of the Coast Guard and local agencies is necessary. In Florida, arrangements could be made with the Bureau of Vessel Registration with the Department of Environmental Protection to provide the information on owners of boats found. An entity which already has the information is the University of Miami Boating Research Center. The roles of an education/research center and vessel registration agencies as clearinghouses should be explored and defined for each state prone to hurricanes.

C. *Pre-hurricane and Post-hurricane Communication and Coordination*

Recommendation C1

The position of a Marine Coordinator in local, regional, and especially state Offices of Emergency Management, should be established. The coordinator would be responsible for working closely with marine industry and boating interests, public agencies responsible for boating and public safety, water management, drawbridge control, and boater education outreach program.

The local emergency management agencies have minimal staffs. They have tremendous responsibility to the community, as a whole, for many types of civil emergencies. These include nuclear accidents, major plane crashes, and severe storms. Coordinating storm preparations such as evacuation shelters, damage assessment, relief personnel and supplies, responding to outside relief agencies and the media is an overwhelming task.

The experiences with Hurricane Andrew have shown the devastation of the marine community with over 900 wet-stored boats sunk or damaged (Antonini, et al., 1993). In addition, hundreds of dry stored boats were destroyed, and several major marina complexes were severely damaged or destroyed. It was apparent that the marine community was left on its own for hurricane planning and preparation. With the exception of an educational publication developed and distributed to registered boat owners in Dade County, marine interests were essentially on their own to prepare for

a hurricane event.¹

1a. Each coastal county, as part of its emergency operations should have a Marine Coordinator whose sole interest is marine related. This person would function out of the emergency operation center and would coordinate any marine interests regarding hurricane preparations and response. The Marine Coordinator would be responsible for hurricane related boater education, identification and evaluation of local safe havens, and distribution of information on safe havens in each county. This position would be part of both the county and state hazard mitigation plan. The coordinator would be responsible to relay the plan, coordinate communications, and get feedback and make sure the plan is what the community wants and supports.

1b. The Marine Coordinator of the emergency management agency should be designated as the liaison between the local government agencies and the boating community/marine industry. With the marine coordinator, liaison with the U.S. Coast Guard and state marine police should be an on-going process for hurricane preparation and other marine disasters such as major petroleum spills. Coordinated educational programs should be established cooperatively with marine facilities and agencies for the boating community.

1c. Once a hurricane emergency has been declared, the Marine Coordinator would coordinate evacuation, establish communication, and be involved with recovery operations and respond to security problems and looting.

¹Note: It is recognized that human life and safety needs are paramount to other sectors of the community and that boating interests will take a lower priority during the immediate aftermath of a catastrophic hurricane event. Emergency relief resources will focus on human needs and transportation of supplies to areas impacted.

Recommendation C2

Create a Hurricane Response Committee made up of boaters, representatives from the marine industry, local and state regulatory and enforcement agencies, Department of Transportation, US Coast Guard, and the Marine Coordinator. Members of this committee will work together to ensure effective communication and coordination of pre-hurricane and post-hurricane efforts.

Pre-hurricane and post-hurricane plans and policies will be of no value during a hurricane if they are not communicated and coordinated properly. Past hurricane experiences have shown that a major problem encountered in pre-hurricane preparation and post-hurricane recovery and response was the breakdown or lack of communication among agencies and institutions involved.

2a. The Hurricane Committee should be responsible for communication and coordination of plans and policies of all agencies and institutions involved with hurricane planning and preparation. The plans and policies should be written down. If plans and policies conflict, the Hurricane Committee should take the initiative to resolve the conflict. Prior to a hurricane season, the Hurricane Committee should review all hurricane plans and policies. If there are new plans and policies, these should be properly communicated and coordinated prior to the hurricane season.

2b. The Hurricane Committee should compile a list of hurricane-related informational material including resources that can be tapped in the recovery phase. The latter should include sources of specialized equipment, material and supplies and offices that can offer city, county, state and federal assistance with specific information on what they have, how much they have, what they can do, and how they can be contacted.

Recommendation C3

Provide a separate communication center with a separate communication channel for marine interests within the Emergency Operations Center of the Office of Emergency Management. This center would provide the marine community and boating interests with their own information links. The Marine Coordinator would have the responsibility and the authority for the communication center.

The marine communication center would be the center of marine information network. It would provide the major information link among the state and local agencies, marine industry associations, marine businesses, boat storage facilities, and boaters in the event of a hurricane. The Marine Coordinator, through the marine communication center, would gather important information from various sectors of the marine community and relay this information to appropriate parties. Ideally, it should be able to answer questions and issues facing the marine community during a severe storm.

3a. The Marine Coordinator should coordinate with other groups and agencies which also provide communications services in the event of the hurricane. Foremost of these groups are the US Coast Guard, marine police, and marine trade associations. Communication activities of these groups should not conflict with one another but should complement one another.

3b. The communication system should be flexible and compatible with other communication systems for efficient operation. The use of VHF marine radios, cellular phones, 800 numbers, and amateur radio (HAM) portable transmitters should be explored and developed at the local, regional, and statewide levels. Communication equipment may be dam-

aged during a hurricane. Alternative or backup equipment needs to be planned for.

Recommendation C4

The marine communication center should develop and coordinate a strong communications link with the US Coast Guard and the marine police.

The US Coast Guard and the marine police are highly motivated groups which already have the resources for operational communications systems in place. These groups can provide timely on-site information about navigation, mariner's safety, and assessment of marine facilities. Any communication system is useless if you cannot get the information from the people on site. Information is needed from people who are at the site. Members of the US Coast Guard Auxiliary are trained mariners who have the resources to access on-site information that can be relayed to the marine communication network through their existing communication systems.

Recommendation C5

The marine industry associations should play a vital role in communications in response to a hurricane. The marine industry associations should explore the establishment of a hot line where members of the marine community can call before and after the hurricane for information.

5a. The marine industry hotline could be established through the use of an '800' number, VHF radio, or HAM radio network. The marine industry hot line should work hand in hand with the marine communication network through the Office of Emergency Management.

5b. Marine trade associations should work closely with the central Marine Coordinator to provide updated information of the status of marinas and boat repair yards.

Recommendation C6

Research and outreach programs for pre-hurricane preparation and post-hurricane response and recovery should be identified and developed.

6a. Research as to where potential safe havens (or historically believed safe havens) are needs to be conducted. For example, an evaluation of water depth, obstructions, bottom type, and location of shoreline landowners needs to be conducted by a non-biased entity such as a university research group or advisory organization.

6b. The mechanics of how to establish a mooring field, its administration and supervision, the permitting process, access to and procedure for evacuation to the mooring field when a storm threatens, needs to be explored. Is the concept to be a public facility, private, or cooperative effort? With most submerged lands in public ownership it would seem that the public sector would have a major role in any "hurricane mooring" plan. Identification of appropriate locations, bottom types, etc., needs to be conducted and an investigative evaluation of appropriate sites and design evaluation of proposed technology undertaken by an objective research entity.





Appendix A

Invited Presentations

NOTE: Sections in *Italic type* are questions or comments from workshop participants other than the speakers.

Appendix A. 1

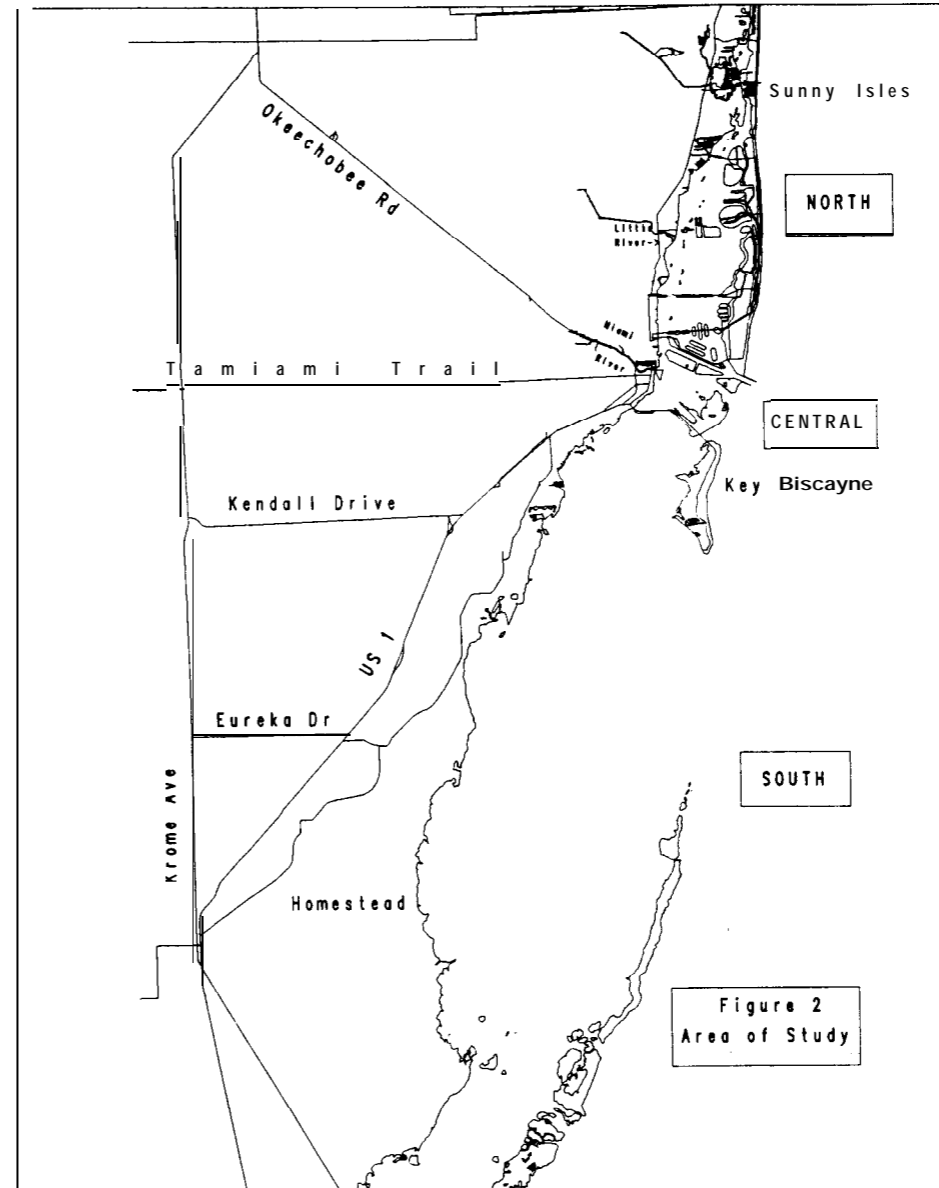
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Dr. Edward K. Baker
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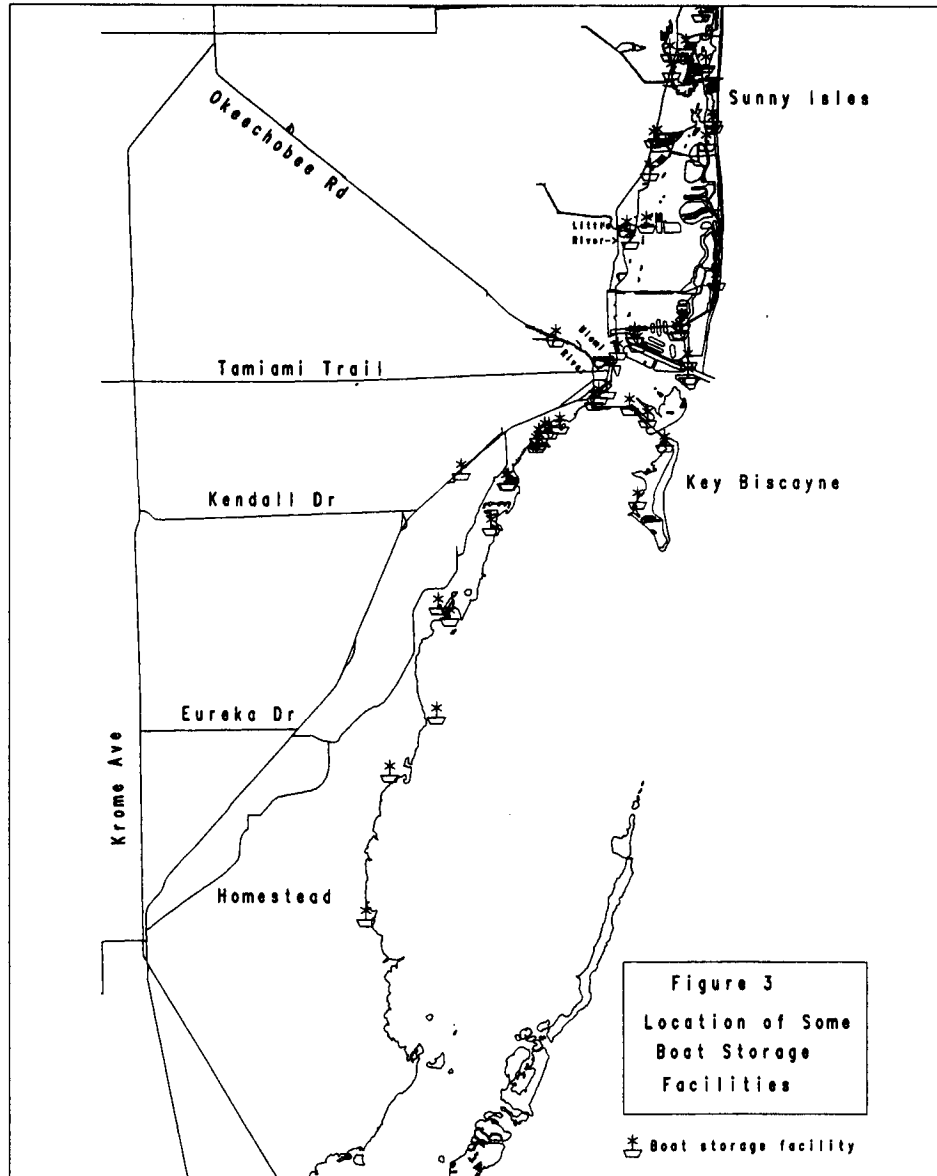
The first map (Figure 2) shows the geographic area for our study. This area is divided into three sections: 1) from Monroe County line to Kendall Drive (SW 88th St), 2) SW 88th Street to the mouth of Miami River, and 3) from the mouth of Miami River to the Broward County line. From previous studies, we have found that the types of boats and boating activities in these areas are different, hence better estimates of boating population are obtained through this stratification.

Figure 3 shows the marinas in Dade County. These are the ones with more than a hundred slips and Black Point is right here where a lot of damage was incurred (See Baker and Villanueva, 1993). Black Point was generally considered a safe haven prior to Hurricane Andrew. For those people who actually moved their boats, those who moved north did well, those who moved south didn't do so well. Sea Grant has graciously published our study and we have enough copies here for everyone to take a copy. It goes into a lot more detail about the particular actions of boaters prior to the storm.

What we found was that in the central region, including the Coconut Grove Sailing Club, where everyone was required to leave the marina, 100% of the people evacuated. The amount of damage incurred by those who moved to the north was very small. However, those in Black Point and Homestead who didn't move their boats incurred extensive damage. One might ask, "What recommendation can then be made about moving your boat when a hurricane is approaching?" To this question I would respond, "Move your boat out of path of the storm and do it early on."

In 1990, when we asked boaters in our survey at what point would they move their boats, we had over 50% who said they were going to move them more than 48 hours before the estimated landfall of the hurricane.





I remember the weekend before Hurricane Andrew very well. On Thursday, the news reports of Hurricane Andrew were buried on the back pages of the Miami Herald. Not big news. Friday, it was a little more serious. Saturday, it was front page news, headlines. We had very good weather that weekend. It was hot but good weather. However, forecasters also said that with the hurricane two days away, there is a 1200 mile margin of error in the prediction of estimated landfall. When a hurricane or a storm is 200 miles away with a 1200 mile error in prediction, there is not an awful lot you can do to prepare.

In any event, there was plenty of opportunity on that Saturday for boat owners to move their boats. But it turns out, less than 4% of boaters in general moved their boats more than 48 hours before the estimated landfall.

Forty percent of berthed boat owners did move their boats more than 48 hours before the storm. In general, less than 4% of all boat owners moved their boats. People just weren't that concerned. No one anticipated the strength of the storm. It is difficult to anticipate and forecast a storm.

In regards to preparation, we have a lot of people who basically said, "I will not move my boat. I have a safe place for it." In 1990, people thought the Miami River would be a safe place to put their boats. But there was a lot of publicity that went out about flood control. There was going to be a lot of water coming down to the Miami River.

There were signs in the 1990 study that a lot of people might not be prepared. In the 1990 study of berthed boat owners, less than 10% had contractual arrangements made. Only 50% of the people made plans where they had arranged a pick up. Only 50% did dry runs of their plans.

There are many things that boat owners have to think through to prepare their boats. Where are you going to move the boat? Who will be there to make sure that the boat is secure? Who will come around to pick up the captain? Certainly, making a dry run makes a lot of sense.

We were very fortunate. There are a few major marinas in the south: Black Point, Matheson Hammock, and Homestead. The number of marinas increases as you go north. If the hurricane had veered a little to the north,

you'd probably have seen a lot more problems.

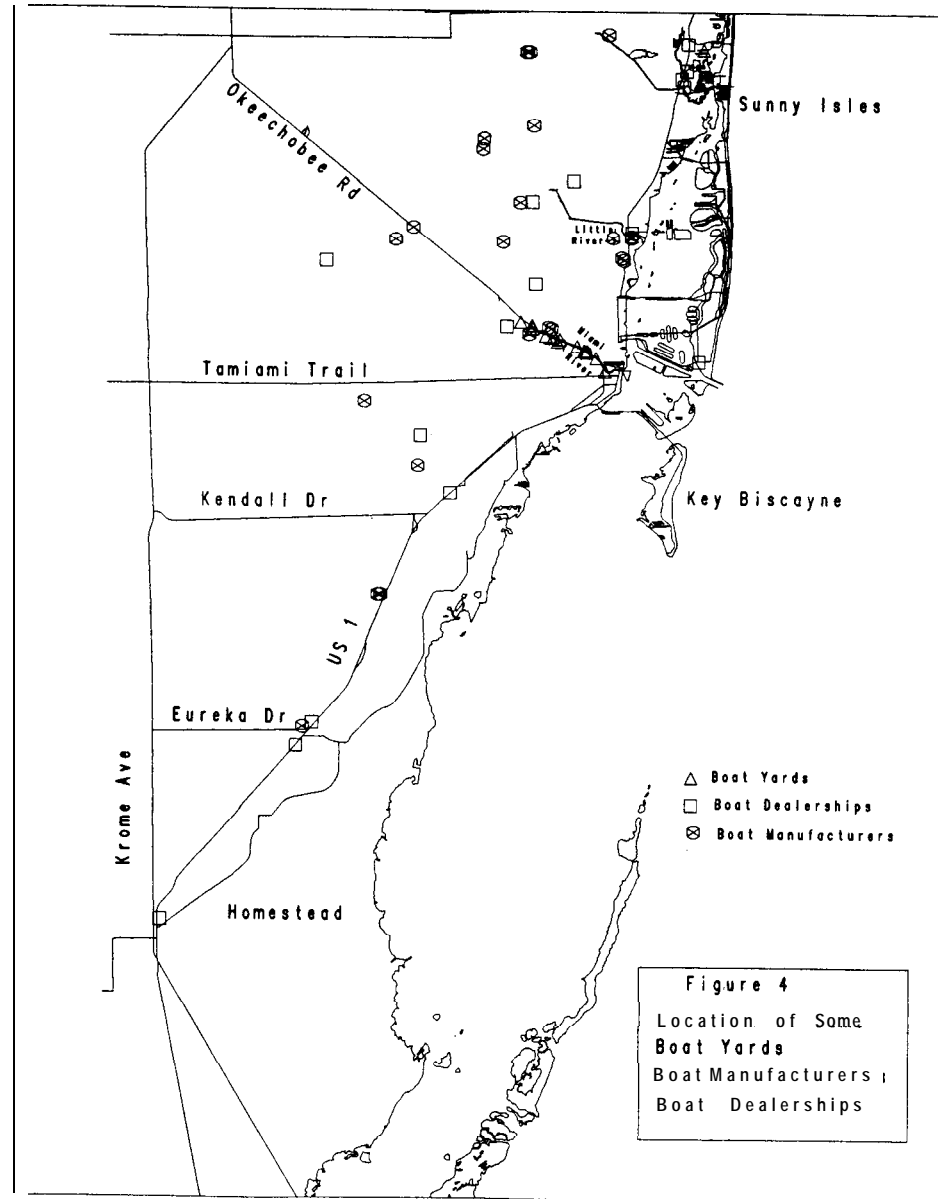
The boaters' response after the hurricane, was certainly optimistic. A lot of boaters are back in the water right after the hurricane. They are optimistic in using their boats and returning to the water at the same level of activity as before the hurricane.

If we look at the data, the boat owners anticipated level of activity after the hurricane is higher than before the hurricane. There is a statistical significant increase of the anticipated frequency of boat use from 'before' to 'after' the hurricane. This is an interesting phenomenon. This is similar to what happened to Coca Cola when they introduced the 'new' Coke. People began to pay more attention to the 'old' Coke. The phenomenon is the same with a boyfriend, girlfriend, husband or wife who are taken for granted. When someone else pays attention to them, then you again become more interested in them.

After the hurricane, boaters perhaps realized that boating is not something you take for granted. So you give it a little more of your attention and interest. And perhaps that is something that we have done with the event of Hurricane Andrew where we raised the level of awareness. I think people now are anxious in getting information about hurricane preparedness.

Figure 4 shows the locations in Dade County of the businesses that we included in our study (boat yards, boat dealers and boat manufacturers). The concentration is again in the northern region. These are the firms who responded to our survey and we have only a few observations. We have even fewer responses from the firms in the south region that incurred the most damage.

Generally, many marinas have a hurricane plan. The majority have hurricane preparedness plans. I am not sure what those plans are. I have not examined copies of the plans. If I've learned anything in the last year going to seminars like this, it is that Hurricane Andrew has taught



every marina to devise a hurricane plan and to think through what steps or preparation for the storm need to be taken. From our study, about 80% of all marinas require insurance of boats in their slips. That probably will go up to nearly 100%. But I think the level of awareness has increased after Hurricane Andrew and we are going to see a lot more marinas taking a more serious look at what their hurricane plan is, how they will disseminate this information to the boat owners in the marinas, and what steps need to be taken. I think in the future, we will see more cooperation between insurance companies and marinas to work together to evaluate effective hurricane evacuation plans for the marinas.

In our study, we did try to contact all boat manufacturers, boat dealers, and boat yards in the county. Our response rate from boaters was very good. For berthed boat owners, we had a 50% response. All large public marinas and 30% of other private marinas responded. There were about 80 marinas in Dade County. From boat yards, boat manufacturers, and boat dealers, we got a very poor response rate. This is an area where we, as a group, need to work on. I know it is inconvenient sometimes to answer surveys, but in all our correspondence and all our contacts we always offered a lot of help from our research assistants. Unless we have the information coming from the industry, it is very difficult to process and correlate and disseminate the information in a meaningful way.

What sort of scenario would you recommend now on how boaters and the local agencies can approach the hurricane in terms of preparation?

The recommendation of our study is primarily focused on additional training and additional information and workshops on seamanship. As far as I know the county is responding in that way. In fact this workshop, sponsored by Florida Sea Grant, is in response to that kind of recommendation.

The county came out with a booklet on hurricane preparation before Hurricane Andrew. They were supposed to have been mailed to all registered boaters in June 1992.

I think that is a very good point. I think in response to the 1990 study and also to other factors in Dade County, the county did respond by providing this Hurricane Manual for Marine Interests to all registered boat owners in the county. But keep in mind the level of awareness.

We all get bombarded with a lot of things in our mail day after day. You have to be aware of what the real concerns are. Hurricane Andrew has raised the level of awareness here, but we still have a lot of things to do. For example, I think in terms of seamanship training or seminars on how to tie your boats would be valuable.

My comment about the report, the county neglected to include a map where people will see where the hurricane holes are. I know they used to have this map. I think this is valuable to have this information and let people decide whether to use it or not.

I think in this storm, seamanship was not much of a factor. But still seamanship training and seminars would be a good way to go. I don't think the next hurricane would be as devastating as Andrew. There was not much you could do with that hurricane. It is hard to make any recommendation.

You must have read our report. That is what the conclusion section of our report said. It is very hard drawing conclusions from this work. But if you are unlucky and the storm happened to pass directly over your hurricane hole, you probably would not have been successful in riding out the storm. That is what our recommendations and conclusions would be.

I still believe that seamanship is very important. I heard a lot of people in my marina who said that their boats survived because they put two or three lines to tie their boats. When one line snapped during a hurricane, there is still another line securing the boat.

When you pass by some marinas, you will see boats with flimsy lines securing them. People spend thousands of dollars for their boats and trailers but do not spend enough for boat accessories to properly secure their boats. In any case, seamanship is still very much needed. Dade County produced a video for Cable Tap (public television) about tying your boat on a trailer inland or in the water.

Appendix A.2

Marine Industries Hurricane Preparation

Richard Bischoff²

Marine Council of Greater Miami

The Marine Council is an Organization including industry members, consumers, and boaters. It has been active for many years trying to be the voice of the boating community and put together a multitude of interests that exist. If you really think about it, the marine community is almost unlike any other segment of our society. It requires more interaction, I believe, between public and private interests than almost any other area. Running an airport requires a lot of public and private cooperation. The marine community requires even more than that. I think what will come out at the conclusion of this meeting is that we need more cooperation. We need more public-private cooperative efforts to solve the problems that we have and that is what we aim for.

I congratulate Sea Grant and the steps that they have done with legitimate statistics on what our problems were and how we might solve it. But very honestly, as part of the Marine Council, I am illegitimate, and I get to tell you what we learned, our conclusions, which are not necessarily scientific and which you might not agree with in this workshop. What I will do is to throw those up and see if you disagree with them or agree with them and take them a little further.

Let's paint the scene first, on Hurricane Andrew, then we'll go to the marine industry. Contrary to popular belief, that we didn't know what was coming until Sunday or Saturday, my understanding is that the National Weather Service, with every computer model they have said it was coming to Dade County. If that is true, and I now believe it is, why didn't we get warnings much earlier than we did? One of the conclusions we reached is that we need an

²A review copy of the transcript was sent to the speaker but no comments were received.

earlier warning system. Folks don't need to wait to know if the storm is to be a direct hit if it is a major hurricane. Boaters should be obligated to move their boats if that storm even has the substantial possibility of hitting this area. You may not know where to go, north or south; but one should know that you go inland.

There is no marina built in this county that I am aware of that will sustain a major hit such as Hurricane Andrew with boats in its slips. We don't build slips like that. We probably can't economically build a slip that will allow a boat to stay in it during a major storm. The slips don't have the width, the length, the height necessary. They don't have the strength. Let's not kid ourselves that staying in the marina is a wonderful thing to do. Moving inland is more wonderful and it's been proven in major hurricanes that I am aware of. Moving inland is better and the probability of survival for the vessel is better.

Marinas are going to require that boaters have a lot more insurance.

Another conclusion that we have reached is that the failure to rebuild the public marinas in Dade County has been a greater economic loss to this community than Hurricane Andrew. Most of the boats are insured but you cannot repurchase a wet slip for a stored vessel that is not trailerable and that has no parking space for it. That is a conclusion that we all talk about. Why is it that all private marinas are up and running? Why is it that most of the public marinas are not? And there are some exceptions to that which I apologize because I give credit to those marina managers who try to keep them up and running.

But frankly, most other marinas were insured. Those marinas which charged more per foot than any other marina in competition weren't insured and I ask the question why are public marinas not insured? Because they are self insured. They are self insured and they are not open. Not only not open, if they are like my marina at Bayside, they won't open for a long time. The economic scene. Again the charge for boat per foot is higher in public marinas. You always self insure when you have the capital to be able to bear the risk. If the city doesn't, and I don't think they do, they shouldn't be self insured, very frankly,

nor should the county. Why is it that Federal Emergency Management Agency is the only one that will rebuild docks in Dade County. That's the conclusion that we really ought to talk about.

The public enterprise sector, they cannot rebuild the industry because there is no place to put it. Look at the marine industry and realize the difficulties we have in its preparations and its result. I wrote a list of all the different parts of the marine industry and I tried to get some statistics and I just didn't fare well, very frankly. I think now we have better statistics than the ones that I was able to get. If you want a list that would take the full gamut of the marine industry, one would include passenger ship industry, commercial shipping industry, and one which is substantial in this area, the port facilities. Think about each one of these. Think about what you know about them after the hurricane. Some include the port facilities as part of recreation.

The commercial marine businesses runs the full gamut, from manufacturers to dealers; some are waterfront, some are not. The marinas themselves, the waterfront property owners, the boat owners, the boat manufacturers, the insurance agency, and so on. Each one of those will have their own story about the hurricane. But there are few marine communities with interests as diverse as this one. The Great Lakes have their own problems but you really feel that they don't have many diverse interests fighting each other or not cooperating with each other, as South Florida possibly does.

What's the scope of the marine industry? The statistics I obtained show that the recreational boating industry is a \$3.4 billion industry. They indicate there are 770,000 registered boats in Florida, but you then have to define if it includes documented vessels. I don't think it does. I think it is just for registrations.

There are three million boat operators in Florida; 40,000 employees in an industry, that is only for recreational boating according to 1987-1988 statistics and 6400 businesses in the marine industry. Again, it is much larger than that.

Dade County has 50,000 registered boats. Eighty-three percent of those registered boats are less than 26 feet in length.

Which marine industries were prepared when the hurricane arrived, and which ones are better prepared now? Those are the questions that we are supposed to address here. They make sense. What experiences have occurred? If you take each one of these industries, you probably have your own views of which one is best or better prepared. Which ones fared well? Passenger ships, commercial shipping, marine businesses, marinas, clubs, waterfront property owners, boat owners, boat manufacturers, insurance agencies, boat for hire (charter). Boat for hire fared very well as an industry. They required insurance, marine enforcement and education.

One thing to remember that even with the warning Saturday morning, which was more than 48 hours before Andrew's landfall, the conditions prior to Hurricane Andrew, in my opinion, were the best possible that one could ever see. We all had warning, knew it is coming, we had a weekend, and the wind was blowing all of two knots. All day Saturday and Sunday we could not have had better preparation conditions than we had and we will unlikely have that next time. Even with the kind of warning that we had, there were people moving around Friday afternoon and it is interesting to see those that were and those that were not. There were boats moving and everybody else in the world was in Home Depot or getting water. There was a lot of advance warning and the conditions were perfect.

I didn't bring the dirty pictures, the bows sticking up and the bows sticking down, and there were holes through those. I think most of you have seen those pictures. Estimated loss of 2,000 plus boats, 15,000 plus boats estimated damaged. Those that were inland fared very well. I believe in Coral Gables waterway, we had two boats go down, I own one of them. Only two down in Coral Gables waterway. Think about it. Many marinas were damaged and they were damaged seriously. They were damaged by flying debris. As far as I know, most of all the private facilities are open. However, with the public marinas: 44 slips in Pelican Harbor Marina; 198 in Crandon Marina, 2/3 full now; Dinner

Key Marina 582 wet slips with about 1/3 of Dinner Key open; Matheson Hammock Marina 252 slips, zero available; Black Point Marina 178 slips and 300 drystack racks, zero available.

They started construction of slips in Black Point Marina. Talking about racks in Black Point, how would you think about owning a boat in a rack in Dade County. It never occurred to me to leave a boat in a rack during the hurricane. What am I missing?

You are a seaman, that's what's the difference, right? I don't buy that. You know what it is about? Put a boat in a rack, inside a building, a nice facility. You know what, most of these people didn't buy trailers for their boats. That wasn't true ten years ago, in my experience. Most of the people have trailers sitting around in their backyards, or in facilities somewhere because that is an expensive commodity to buy and keep. I don't know what percentage. Facilities don't provide trailer parking. They just stack boats in the racks. But you can't move a boat in a rack. It needs a trailer. When you buy a boat, the dealer puts it in the water, then you store it in the rack. Then you don't need the trailer. I think we need to think about that. Maybe rack facilities need ground storage where boats from the top tier can be stored during a storm. But it never occurred to me to have a boat five tiers up in a storm. Think about that. It is strange to me that anyone would even consider a rack as a viable place for survival in a much less wind than a hurricane.

Closure of Miami River bridges. The conclusion here is that we need public and private cooperation. But for a year, we were told when the bridges would be closed at certain wind speeds. They lied. All of the sudden, during Hurricane Andrew, they closed it specifically when the wind was two knots. It prevented commercial ships from leaving which planned to leave. It prevented a lot of boat owners who planned on bringing their boats up the river and who had contracts and who had done their planning and done it right. How are we going to solve that problem? If there is a cooperative effort, then we will know when the bridges are going to be closed. My understanding is that the Department of Transportation is going to repeat this negligent act of Andrew and do it again. Contrary to Coast

Guard regulations, and contrary to the desires of those in the river and those who are going up the river. And that is what the community should try to figure out with some coordination.

Ft. Lauderdale has a flotilla plan to go up the New River. We here are not touched by a ten foot pole. Terrific. I don't know where the lawyers went. Quite a mistake, especially in the River where there are those who are interested parties that want to leave and those interested to get in. I think it is a terrible mistake to make, that we can't come up with some public and private curative effort to assist people to move vessels inland where they need to be.

The other thing that we concluded, not as scientists, is to stop worrying about where there are holes. Bad storms are here, tornadoes and hurricanes. I mean it's mother nature. The best example I know is my house in Stiltsville in Biscayne Bay south of Key Biscayne. It weighed 4600 pounds, was 26 feet long, equaling 150 pounds per foot, pilings 30 to 40 feet in depth and 90 feet of dock. Believe me, it's gone. Never found again. How do you move concrete pilings in the wind? I don't know. But the water helped push it somewhere.

But we shouldn't worry about it anymore. There were houses and there were facilities damaged way beyond the nucleus of that storm. That is why boaters need to move their boats inland where they reduce the chances of something like that happening.

Another conclusion. What are the experiences in the industry? You may know of the experiences with the other segments of the industry. But we know that coastal marinas are not adequate as hurricane refuges. This is important with the lease or evacuation issue. Because I have seen how county directors can say, "The best thing one can do is to stay in one's slip," which may be true for two hours before the full force wind. Don't risk lives. We helped the county do that and change some of those leases. But the state of Florida changed that. What they have done, in my view, is say that, anybody that requires removal from a marina prior to hurricane, that's unlawful." No lease can do that. Private property, a Private marina, why can't they do that, unless

they risk peoples lives. That is why we say that it is not in the best interest for boats to be left in the coastal marinas. They are not designed for it. We could create breakwaters to protect the coastal marinas and other properties. That is what the rest of the world does. Marinas in South America and in Europe have done that. Why haven't we talked about it?

Maybe we should establish hurricane moorings. It's been done around the world, especially in the Caribbean. The hurricane mooring systems, we have seen a lot of that. But the public facilities and government sectors say, "That is not our job." Private industry says, "How can we do that without your help?" There has to be a cooperative effort and I don't think it has been done.

Should we develop a flotilla plan, a sanctuary (hurricane haven) guide? This guide or manual we helped develop here one and a half years ago didn't tell people where to go. I have the feeling that the governmental entities, which is ironic, were more concerned with liability aspects. But why don't we do a service to the people in terms of where the sanctuaries might be. I do not have good answers for it. We do not coordinate at all the timing of evacuation and location of inland refuges. Ft. Lauderdale does. We should be able to figure it out. We close the Miami River as an evacuation center. I offered to go to Tallahassee to tell the Department of Transportation that Miami River is not a barrier island. We need some cooperative effort. The Coast Guard Flotilla Plan two years ago was at least a cooperative effort. There was an intent. Without an intent, it is a disaster.

Everyone knows we criticize. Where is the plan. The Coast Guard has a plan. Florida Marine Patrol has a plan. I am sure the Coral Gables marine patrol has a plan. Most have plans. But is it not in the best public interest to assist the people and let them access safe refuge.

It never crossed my mind to close Miami River on a Sunday morning at 10 o'clock with no adverse weather conditions, with no warnings or no publications thereafter. Seeing the boats come up and wondering if it will ram the bridge. It constitutes negligence.

Did you ever find out why they closed the bridges?

We heard the evacuation order from Office of Emergency Management and that evacuation order seemed to us to make sense to close the bridges to comply with the order.

Did you ask the Coast Guard about the closures?

The Coast Guard reminded them. We have yet to meet with them to coordinate this stuff. That is just one of the things in my messages of public and private cooperation. It needs to be done.

We need to build more boat ramps for removal capabilities. I believe if you go up Boca Raton in a quarter of a mile, you will find more ramps there than South Dade has in its entirety. Remember that a high percentage of boats in Dade are 26-feet and below. Many boats in Miami use ramps. They are trailered in the backyards. We bottleneck our ramps every weekend. Having ramps would be of a benefit in the event of the storm. Boats which are normally trailered could be removed from the water and other storage facilities.

There were a number of concerns that many of the resources were not made available for the preparation of the storm, during the storm, and after the storm. I guess the classic example is no sanctuary assistance, no guides, no hotlines, no help to boat owners. There seems to be no real help to the industry. There's the story of the vessel that ended up almost to Cutler Road; the vessel's owner had made arrangements with the Port of Miami to tie up there at the port as a sanctuary during the storm. When they went to do so, they were turned down. They were turned away in the face of the storm when there is a risk of life and property damage.

In the city of Coral Gables. Do people know what the status of the laws is, or does Coral Gables have a position on parking your boats in the waterways? Nobody knows what the situation is.

The public safety and assistance. Again, without the Flotilla Plan, without government assistance to the boating segment of our society, what is our situation with respect to public assistance to those who want to move their boats and have them operating after the fact? These people are caught in catch 22. That is a problem.

What will happen next time? I guess we won't have a major hit next time. I guess statistics say that. It could however be far worse if the hurricane was further to the north. The industry would have been impacted more. I guess more boats will be left in the marinas. I guess it is unfortunate because the laws do not provide for education but yet it is trying to protect lives.

The recovery experience hopefully will get out, be disseminated, publicized because of its value in reaching conclusions. I made suggestions that I hope we can talk about in the workshop. I hope we can have an earlier warning system. I hope we can have better service information. I hope we can have industry survival concerns. I hope we have more planning in the industry, and in the public and government entities.

There is more than merely economics involved notwithstanding the use of statistics. There is the quality of life issue that I find politicians here will listen to. There is an awful lot of people living in this area who are proud of this area because they feel that boating is a wonderful aspect of a fine quality of life. Twelve months in a year. I have kids who sail these waters 12 months a year. That is the quality of life people find in this area. Why is it that we have governments who are more concerned in getting money for racetracks to bring in tourists than improving and maintaining the quality of life among its residents? When the government, the industry and the public get together more on the same wavelength, we will all like that. That is my message to the marine community.

Appendix A.3

Post-hurricane **Salvage and Recovery**
Dr. Gustavo Antonini
Geography Department
University of Florida

My presentation is called Location Assessment of Hurricane Andrew Damaged Vessels in Biscayne Bay. Our original intent was to inventory and prioritize for removal of damaged vessels. However 2/3 of these vessels were removed within three months of the storm. Theoretically, the problem was removed. However, another question remained, namely what was the potential impact to the environment from damaged or sunken vessels. If damage to bay habitat occurred, where would we look? The vessels were already removed. Our study therefore was recast to answer these questions and to provide local and state authorities ex-facto analysis.

The primary purpose(s) of the study were to locate sunken vessels, characterize vessel condition, relate damage of sunken vessel to habitat area, identify potentially impacted areas and rate potential impact by vessel concentration.

Other objectives are to evaluate post-storm aerial photography to assess damage, to assess feasibility of the geographic information system (GIS) for post-storm analysis, and to recommend improvement in damage assessment.

The geographic area for the study is Biscayne Bay and its major tributaries. The area is bounded by 79th St. Causeway in the north and Card Sound in the south which is 90% in Dade and 10% in Monroe. The focus of the study is damaged/sunken vessels which are 100m from the shoreline upland and within the tidal and submerged habitat areas. The sources of the data are the aerial photos which were taken within a day or two to several months after the hurricane from private sources, and state and local agencies and NASA. Another source of data are reports from Florida Marine Patrol (FMP) and the Army Corps of Engineers.

How did we go about the study? First, sunken vessels were identified from aerial photos. Vessel conditions were characterized and locations were mapped. Second, ecologic units were synthesized and digitized from the maps. Third, vessel locations were; (1) overlain on ecologic units; (2) vessel concentrations were determined; (3) vessel concentrations were scaled; and (4) potential impactors were identified.

There were 918 vessels damaged and sunken in the study area. We mapped vessels by the following vessel conditions: fully submerged, partially submerged, floating, aground, or undetermined condition. Then we characterized the vessel by location and came up with the following: 1/3 were submerged, 1/3 were aground and 1/3 were floating and undetermined. Boats in the marinas were included.

A habitat map of Biscayne Bay by the Dade County Department Of Environmental Resource Management lumped habitats according to the following types: hard bottom, seagrasses, and bare bottom substrate. In addition, we have the mangroves and upland. So there are five habitat units covering this area. This ends the preparation of the source of materials.

Next we took these sources and combined source maps to identify the location of sunken vessels in habitat units. (Example, 59% of damaged vessels occurred in barren substrate.)

Then we determined vessels concentration per unit area. We scaled the information in the area. For example, 4 cells, which account for 389 vessels or about one-third of the damaged vessels, were located in about one-fourth km. Then we determined vessel damage epicenter and we plotted vessel location. We then showed the distribution of vessels damaged from this center. Finally, on a regional basis, we graphed vessel location in relation to hurricane eyewall at the time of landfall.

Next we looked at potential impacts. What we did is to put buffer zones around each vessel, using GIS, to estimate potential influence on habitat. We assumed that 100-meters would be a good potential impact on bay water habitat and 50-meters for tidal habitat. We then calculated the ratio of buffered areas to vessel count to get a relative aerial density to find its low, medium, high, and very high

potential impact on the environment. For example, 59.9% of low potential impact in barren substrate, while 36.9% of very high impact on seagrasses.

Next, we identified the geographic cells where these are situated and we mapped them. We identified nine locations and you are all familiar with them, the Miami River, Coral Gables Waterway, North Bay, Virginia Key, Kings Bay, Key Biscayne, Dinner Key, Coral Bay and Ocean Reef. We wanted to see how they measured up to each other in terms of potential impact relative to each other. Dinner Key is the highest in terms of potential impact relative to seagrasses, mangrove, upland, etc. We were getting a measure of relative impact on the environment.

Hurricane Andrew put Miami's moored recreation vessels on the storm track. Damaged vessels were in Dinner Key Marina area, Picnic Island, where 1/3 of sunken vessels in the area are located. Fifty percent of damaged vessels are within the area defined by Rickenbacker in the north and Kings Bay in the south. The vessels affected are in the marinas, anchorages, and recreational areas.

What are the lessons from Hurricane Andrew? First expect significant vessel damage for category 4 and 4+ storms. Open bay is high risk. A good example is Dinner Key Anchorage.

Second, hurricane holes which have soft or soft-medium bottom type offer poor holding conditions. A good example is No Name Harbor on Key Biscayne. Many of these harbors' type cannot hold the vessels.

Third, moored vessel vulnerability is affected by a number of factors. Site suitability, owner vigilance, owner experience, pre-storm preparation are all important. Which is more important and why? These are few questions that need to be addressed. Furthermore, why do you have more damage in some locations than in other locations? Why in some particular location some vessels fared well while some are totally or partially damaged? How can you rate potential damage to a hurricane site and vessel?

Fourth, storm damage assessment requires the timely access of large scale aerial photography and high resolution satellite imagery. The photography available was World War II vintage. At best, they were piecemeal and missions lagged

weeks after the storm. Most frustrating is the picture delivery which lagged weeks after the mission. When dealing with post-storm recovery, it is a particularly a vexing problem.

Fifth, the GIS technology makes feasible mapping and analyzing large geographic databases. There are problems though with the use of the GIS. It is not a turn-key operation. There are problems in acquiring files and you must rely on informal networks. Scales and various map resolutions require extensive editing.

Sixth, there is need to devise a method to determine the potential impact of sunken vessels in marine and shore habitat. A benefit of the work is it provides narrowing down the surge area to focus impact zone.

Our recommendations are to develop a vulnerability indexing system to rate the relative habitat potential of mooring sites to a range of storm events. This would permit potential ranking of boat facilities, public, private, marinas, residential docks and anchorages. This will provide boaters and marina industry guidelines for future storm events. Example, insurance premiums could be based on location of boats. The second recommendation is that boaters should be provided with information on bottom conditions for storm havens in the form of large scale maps. Third, we recommend government assistance in getting good aerial photos of hurricane impaired areas using, not the types of hand held cameras but of state of the art technology, and providing these pictures in a timely fashion to managers and other users.

About the environmental impact on the habitat, is that the impact of the removal or the damage caused by the sunken boats?

What I am talking about is that in a span of the day or less than a day, hours, you have a thousand boats that are sunk or damaged in some way. They were then removed. Is there any residual impact that occurred that we are not aware of, particularly to sensitive bay habitat area like seagrasses and mangroves that ought to be looked at? We

have no record of that because again, vessels were removed quickly.

How can we distinguish if the habitat was damaged by the sinking of the boat, or the removal or salvage of the boat, or if the damage was caused by the hurricane itself?

Like the mangroves. How can we distinguish between the two? All mangroves were flattened, how will you determine if that was caused by boat removal, the force of the hurricane, or by the sinking of the boat?

Now, we're looking at overlaying the location of the damaged vessel by aerial interpretation to the surrounding bay habitat or tidal habitat and we are saying that the vessel may, it's a conditional statement, may have an impact. If the state or local agencies are interested in determining whether or not there is an impact, where are they going to look? It is a big bay area. Where were the vessels. What kind of habitat was it?

But does it basically deal with how to identify areas to look for some damage?

Yes, but if it is a fine substrate, it is basically unimportant. But if they are seagrass or mangrove areas, then it is a prime concern.

I think you mentioned about the impact to habitat with the sunken vessel. But how can you compare a 32 ft sailboat damage to a boat that can cause how many thousand gallons of fuel to spill?

But how many of these type of vessels are there? These are relatively smaller vessels. About 99% are 50-feet and under, basically recreational vessels. The number of large commercial vessels was minimal. I do want to make a point on the matter of site suitability. For many years I did agricultural planning where site suitability is a standard operating procedure in farm planning. You find out what kind of soil is needed, etc. before making an investment on a particular crop. Similarly, if a facility is built in an urban

area it is important to find out what kind of services are there particularly from the standpoint of insurance. These kind of considerations are not put in the equation in determining how suitable a berth is for locating a vessel. We found for example, that many of these canals facing east-west had a much higher rate of incidence than north-south canals and so forth. Secondly, many of these canals were not designed for boat traffic. They were designed to scoop up buried material to build land. And some developers found it commanded a lot of money. So it was an afterthought to use the canals as access channels and tie-ups for boats. They were designed for storm water run off, etc. These kind of considerations has had an impact on the suitability or lack thereof of many of these residual canals serving as a tie up facility for boats. And it's going to matter. And I think that boaters need to be aware of the degree of risk based upon the suitability of where his boat is in addition to the way he prepared himself. Thank You.

Appendix A.4

Pre- and Post-Hurricane Information Dissemination and Information Sharing

Hernando Vergara³

Dade County Office of Emergency Management

I brought with me a manual entitled Hurricane Manual for Marine Interests. There are many things mentioned in the manual which are important. This manual will help me address the issue of public information sharing at the time of emergency. That's one factor why this booklet was put together. Some of you here were involved in the preparation of this booklet. During the preparation, we all argued about some major points in hurricane preparation but we were able to reach an agreement. It was not easy putting this booklet together because of the many factors that were considered. The main one is, what do you tell boaters at the time the hurricane approaches when the marinas tell them that they have to move their vessels out. Dade County does not have areas which it can recommend without getting involved in legal issues. In light of this, the best thing is for those vessels to remain in the marinas. Even some municipalities today do not agree with our office regarding this policy. But I think they are beginning to understand what we had intended in enforcing this policy. In the last year, the Florida legislature has supported us in this policy and will be changing the law whereby marinas will not force people out in time of the hurricane. I don't know exactly when that will take place but I think it will be next year.

I would like to start my presentation by showing a video tape that we use to inform boaters of hurricane preparation. The segment of the tape that I will show you is about 2 1/2 minutes. After we view this segment, I will get to some issues that we discussed before and then to questions and answers to address your concerns.

³A review copy of the transcript was sent to the speaker but no comments were received.

(The 2 1/2 minutes video shows how to prepare a boat for the hurricane. It shows the proper way of securing wet berthed boats in a marina and trailered boats at home.)

A question was asked before about how boats that were properly tied up compared with those that were not properly tied up and how much damage they incurred. An actual study was conducted and I have copy of the study in the office. If you are interested in the study, I can mail copies to you. Basically, boats that were properly tied up received less damage. This is one of the things that were discussed in the hurricane preparation booklet. Most recommendations we have in the booklet are still valid with the new lessons from Andrew. Another concern was raised about predicting the storm, and how difficult it is to determine where it will go. When Andrew became a threat to us, our office began taking actions on Friday. The storm struck on Monday morning. On Friday, we put out the first warning to boaters. It went out at 4PM to the news media. We relied on the news media to convey this information to everyone. Some local stations put it out. But I don't think a lot of stations did. At that time we urged boaters to begin to take action, to begin preparation in securing their vessels. They need to start right before the wind speeds start picking up because then it becomes increasingly dangerous to move vessels. Those boats that remained in the marinas obviously sustained more damage than those in areas that were more inland. The decision to stay or go if you had a boat tied up in the marina was based on individual contracts, in some cases. But most of the boatowners with boats in the marinas ignored the evacuation. I don't think it would have made one bit of difference if Black Point had evacuated. The damage to the marina would have been the same. The storm surge is inevitable and it creates a lot of problems to the marina, whether boats are there or not. It was suggested to have a breakwater at the marinas to prevent the rush of waters going in. But the storm surge may ride on top of that as well. Once the water is in, it is not effective. During the hurricane, a sunken boat, an artificial reef, was moved 1000 feet from its original location. It was in about 80 feet of water. It was not in even in the area where the eye of the storm was. The under current was so

strong that even an artificial reef was moved.

Some organizations represented here worked closely with us in preparing the hurricane manual. There were some concerns that were brought up as to which point the bridges to Miami River will be locked down. You have to remember that there comes a time when we have to weigh factors of what is more important, the boating population or the county residents? That's why we made the decisions that boaters should not bring their boats up the Miami River because it was used to discharge water from the Everglades and we need to have that access available. If there were too much water, we would be flooding the rest of the city and we couldn't allow that to happen. If we had all these boats blocking the path of the Miami River, we would have a lot of damage flowing to the sides.

One of the things you have to remember is that Hurricane Andrew was a dry storm and it moved very quickly. So it actually didn't dump as much water as we expected it would. So we were lucky in that sense.

But it's possible that with the higher tide the more water will flow underneath a boat?

But you have to remember that there will be other debris breaking up boats and causing them to sink. And these will in turn push the water to the side.

Excuse me for a moment. But I have a boat and my boat floats. When the tide comes up, my boat goes up and when the tide goes down, my boat goes down. When properly set up in the river, the river is the ideal and only place that the boat should be berthed because it is a hurricane hole. Cutting the area off to boaters is a disservice. Miami River is the perfect and ideal place for hurricane hole and the business about the boat breaking the bridge free is just ludicrous.

What about the business of one of these freighters in Miami getting free and blocking the waterway?

I think you should have boaters involved in the decision of how the river should be used.

These were arguments that we went through for years in trying to come up with this manual. Finally all these agencies agreed.

If you are talking about the Hurricane preparedness and the issue of the Miami River... The Dade County managers issue the order of evacuation. The Department of Transportation made the decision to lock down the bridges. And now he (Hernando) is justifying the decision.

The point that he is making I understand is that many years ago, the county used to have the flotilla plan, where they invited the boaters to bring their boats up the Miami River. People got used to that idea. And they really didn't look at the consequences that it might bring. The director of the Office of Emergency Management, looked this over. She then started negotiating with the South Florida Water Management District and other agencies. We started analyzing the impact if boats in the Miami River started breaking up and caused flooding in the city. The potential damage was far greater than when you have boats breaking up in the marinas.

Can we get you to invite the boating public because I sat in one of those meetings and the guys from South Florida Water Management District know zero about the boats or flooding. I don't have any idea where you are coming up with your answers. I don't like to pick on you because you are much younger than I am. And the flotilla didn't last that long, by the way. Just a few years. To some of us, that is just some small speck of history, but for you its probably some big piece of time.

It is a good point. We always think of our little boats going up the river. What we have to realize when we look at the salinity dams where all this water is flowing through, is that these areas are blocked by large freighters. These freighters are high up in the river and would block the flow of water which will then flood the city. My question is, if they don't allow our boats up the river, why do they permit the large freighters high up the river which will cause more damage due to blocking? Why don't you require all ships to

leave?

We issued the evacuation at 8AM Sunday morning.

There was no evacuation Sunday morning. There was nobody downtown to evacuate.

Well, there comes a time when you look at overall picture, we need to get people out and we need to have that road for evacuation.

But there was nobody there to evacuate.

We are going back five years here. The message I got from you and that the message coming from your office is first, that you are best off in leaving your boats in the coastal marinas. That is not correct. That is not the message that is supposed to come out from your office. The message that was supposed to come out from your office, and I thought it was doing so, is that don't go try to move your boat in the eye of the storm in risk of life. Everyone here agrees with that. The question is that of timing. But it is not best to leave your boat in the coastal marinas if you do it early.

When the wind reaches a certain speed or when an order of evacuation is issued, these people need to be out as well. We cannot have those bridges raised and impede traffic. When bridges go up, it can cause traffic jams. And we have the people coming from the Beach going in and out. People are going to the shelters. Everyone will be evacuating from the Beach and we open up shelters in specific areas. We are not going to tell them which one to go to. But we have to clear the roads for that.

What is evident and what will happen is that sooner or later Dade County is going to close down the bridge. If you can beat the bridge closing go for it. There are no penalties in these things. If you are up there, you're up there. By navigation, they can't stop you from going up the river.

I think it must be addressed that the river is a primary protection for boats in Dade County. The river must be used for protection of the boats. The rule should be fixed and whatever the rules are they should be stuck with. And they should be followed. And your office should be the lead agency. And you should coordinate the hurricane preparedness.

It was published here in the manual on page 15. It states the reason why we say not to take the boats in the river, with the Miami River Hurricane Planning criteria.

Do you know that the attendees at this workshop are almost all boaters and they all disagree with the last statement?

Well, I am surprised since we went through this before when we put this booklet together. But the thing to remember is that people should start taking their own responsibility for their own boats and Dade County wants to play that message strongly. It is your responsibility to find a spot for your boat when a hurricane threatens.

We found one but can't get to it.

In Ft. Lauderdale we have a very different scenario. The boating community is recognized as having a major impact. Sonny Irons was one of the people involved in the pre-hurricane evacuation. We have experimented with different scenarios and time periods. We now estimate that we have about 3 1/2 hours after the order is issued to evacuate our boats. That gives us 3 1/2 hours in our flotilla plan to bring the largest boats up, the ones that require bridge openings. It still allows for evacuation because we have a shared usage of the bridges and waterways. And that is what it should be. It is not locked up just for the boaters, nor down just for the cars. Police officials organized and orchestrated moving about the bridges. We estimate 3 1/2 hours now but it will probably be 5 1/2 hours. Because you must realize that when the storm happens in September or October, we really can't do anything in 3 1/2 hours. But when

you start in ground zero and say evacuate and all the bridges are shut down, you'll just strain the marine community without realizing it.

Why is it different in the Miami River versus the one in Ft. Lauderdale? In Ft. Lauderdale they have a large marine industry as well. Dade County position does not support that. Did the county get that position by logic or by dictate?

I've been involved in this from the beginning. It's all backwards. From the initial postulation of the 6 foot water wall coming out to the river. It's a stupid postulation and they don't mention it anymore. We have a presentation at your facility put on by the South Florida Water Management District. And that's real engineers there. And they told you what the relative importance of the Miami River basin is, and it is not that significant. I tried to push that the scenario with the large boat breaking free and improperly moored is no more danger to the land side than taking the bridge out and sinking. It is more dangerous. How about the cargo containers? The upper end of the river is lined with them. But they are not going to blow into the river. But blaming the boating community? I'm getting tired of the boating community taking the trash of everything. With all this science, nobody is taking steps in developing something. I am obviously not blaming your office because I've worked with your office. I've worked with Kate Hale, and I thought we have things working. We addressed the bridge closing. It was the people from the Department of Transportation which made an awful decision. They did not consult with the Coast Guard. These are the people who ordered the bridges closed. I don't know where you get this information about the Miami River and bridge closings. It sounds like very old information to me.

Again Dade County doesn't have a problem with those orders that are already in place. But again at the time we issued the evacuation, we could not afford to have all the traffic there. First of all we need the support of other agencies to have the coordination of opening the bridges because they have to get out of the way also. The US Coast Guard, when the winds are so high, will have to evacuate too. And the people are on their own. And we frankly

wanted to make a plea here and we do not want to make the wrong impression.

It was 12 hours in between when you actually closed the bridges and when it is actually required to close the bridges. At least 12 hours.

Well that is why we are again being honest with the boating community and we are giving them the facts. I know you guys are not happy . . .

We don't close bridges in St. Pete because we are in Miami Beach. Nobody would mind if somebody will make a judgement call to save lives. It is the idiocy of making judgement call to evacuate a barrier island such as Miami Beach that doesn't go across Brickell Avenue bridge. Believe me it doesn't. And this is for the Department of Transportation. Who do we need to talk to to shed some light on this situation? We really have regressed in the last 4 years. I am upset too. There has never been any comment from your office on the closing of the bridges prematurely until today. There has never been a justification by your office that Miami River is not a safe haven for boats. This is new and I am bothered with this. There should be some clarification about this soon.

Appendix A.5

Government, Industry, Academic and Boater Groups Coordination

Caroline Knight

Department of Community Affairs

Florida Coastal Management Program

I am from the Florida Coastal Management Program of the Department of Community Affairs in Tallahassee. Our office would like to work closely with you, the boating community. As you know, Secretary Shelly has been here working with the post hurricane recovery and this is the area that she perceives needs more work.

The Governor's Commission (Lewis Commission) prepared a post-hurricane Andrew report and there is a section on the evacuation problems of the marinas. I have only one copy. We will mail copies to you if you are interested in getting one. One of the recommendations of the Commission's report is that there be legislation on the hurricane preparation of the marina. It will be a part of Bill 911. This marina bill cannot really answer all the questions in hurricane preparation. We are now working with several groups in the boating community. Frank Herhold (Executive Director of the Marine Industry Association of South Florida) is reviewing it to see if there are some changes needed in the legislation. The Department of Insurance is required to file a report in response to this legislation. It is a one page report. They didn't have specific problems with it but as you can see they raised other questions. One of the questions is, is it the responsibility of the boat owners to find a hurricane haven for their boats? Another is to clarify the responsibilities of other agencies in the hurricane preparation, such as the event of a bridge lock down.

The Florida Coastal Management Program (FCMP) is housed under the office of the Secretary of Community Affairs. FCMP is a network of programs. The Florida Coastal Program is funded through NOAA and the Office of Coastal Resources Management. FCMP works closely with 11 state agencies. One of the most important things for the program is to get feedback from you. We operate through the

Interagency Management Committee (IMC) of Florida. IMC is chaired by Secretary Shelly. This body meets regularly and is attended by top administrators. They discuss issues relevant to coastal programs. They are the state regulation agencies and funding agencies. This body is there and they want to hear from you. As part of the outreach program, we have a Citizen Advisory Committee (CAC). The CAC has a boating subcommittee. Another subcommittee responsible for boating interests is the Boating Advisory Committee. That committee is run through the South Florida Waterway Management of the Florida Marine Patrol.

One of the major issues being worked on is marina siting. Where should marinas be located? What variables come into play in siting a marina. What agencies should be responsible in siting marinas? There are a number of questions involved. Again we are working with marine industry and marine community boating advisory committee and government agencies to look for recommendations. There are also mitigation and litigation concerns.

Hurricanes are a reality in Florida. The other reality is that hurricanes go on a cycle. It is estimated that we will have several hurricanes in Florida in the next 10 years. The population in Florida has greatly increased in the last decade and you can see the growth especially in coastal areas. We had a lot of migration with people not familiar with the area and who are not prepared for the hurricanes. With the interface between land and sea you will be faced with a number of legal issues. What you do on land is not necessarily what you do on the sea. We have almost 700,000 registered boats and a lot of those boatowners do not know what to do in hurricane.

Documented vessels in Florida are also required to register. Visitors, if they are here for more than 90 days are supposed to get Florida vessel registration. Non-motorized vessels are not required to be registered. There are more than a million vessels in Florida which means that there is one vessel for every 12 residents in Florida.

A hurricane is a natural occurrence in Florida. We have more and more vessels. Yet prior to Hurricane Andrew, the state, nor any of its agencies, was involved in any hurricane

plan, nor involved in any evacuation plan relative to the water. Right now it does not coordinate with the county or any local agency in any evacuation plan. But still they do not see any responsibility to this industry, which provides so much money to Tallahassee, to assist them in their time of most need.

You are right because I think I am the first person assigned to it. I also would like to comment that the marine field is not an exact science. I had to work with the various people here in this workshop whom I have asked to help me in getting information about marine interests. Marinas and the marine industry also have some responsibility. You must work together to get your message through.

One of the areas that the marine industry could be of great help to us is to provide us with marine related data. There is a scarcity of marine related data. But whatever data is available is most of the times unknown to us. But you folks have it on the top of your head.

Another issue I am working on is the non-point pollution source. The state wants to come up with a plan on non-point pollution sources. Marinas are part of that program. We would like to solicit your ideas and recommendations to help us come up with a plan.

One last message is that there is money for hazard mitigation. Think what is needed. We thought here about education programs, about informing boaters what to do and how to do it. The state has money for this type of program. So what you need to do is think what exactly is to be done. Will it be done by the government or non-profit entities? Also our Coastal Management Program is receiving application for grants and hazard mitigation is one of the things that we think will be addressed again.

Sea Grant will publish the history of hurricanes in Florida. Sea Grant also did some economic impact studies on recreational boating in the seventies.

If there is some form of legislation, it usually comes with some funding. And that funding, if channeled properly, should be utilized by the boating community. The boating

community would probably have some input. In Monroe County, we are trying to get some mitigation money from marinas to improve their risk during major storms or hurricanes. It would be advantageous to upgrade facilities and capabilities and find ways to alleviate the effects of wave actions. You folks are in the same position here. Dade County and every coast in the Eastern Seaboard would probably do the same. The hazard mitigation is through the Division of Emergency Management and the Office of the Secretary of Department of Community affairs.

There are a lot of people in South Florida because they probably want to locate here. They want to boat and enjoy the waters. There's a lot of people and they put pressure in the state which becomes unbalanced. People in Tallahassee would probably say "Well, we can eliminate growth by eliminating the reasons why people come to South Florida. Take away their marinas, make it a dangerous place to live. People can't recreate down here. They will go to Georgia and the state doesn't have to deal with the problems associated with boating.

I would like to make a point right now. I think if you need to take information back to Tallahassee, you need to tell them that they need to mandate, that we must have representation, especially representatives from the Offices of Emergency Management, Department of Transportation and the Florida Marine Patrol. I have had many meetings in the last 13 years with these agencies and always we did not have representation. They are the ones who should take leadership and lead these things from the state's standpoint. I don't know if we can make headway unless we have that type of representation.

Through the Division of Emergency Management, go to the secretary level and say, "Hey Mitigation plans are coming out and there is nothing that circulates in the public much less input review by the people who will be affected by it." We are on every list coming down from Tallahassee. We are not a secret down here. It is sometimes frustrating. As boaters, as a community, we need to get out together. There's a whole lot of things that we are left in the dark about. Take the subject of manatee plans that were proposed in Tallahassee without much notice and they've

only asked for the input when everything was already written in the plan. So we don't have our act together and we cannot address the situation. The hazard mitigation hasn't gone to any agencies here except one in Dade County. What concerns me is FEMA is mandating this mitigation plan and FEMA is not NOAA.

After seeing the hazard mitigation document report of Hurricane Andrew, the 1 1/2 pages of the marine related report and the recommendations that they put in there are ludicrous. They say that we should have all floating docks, all pilings should be 15 feet in the air and other things that don't necessarily fit. And this will count! They got this three weeks after the hurricane. They get a snapshot of what has a significant impact to us. People are fighting tooth and nails.

They are afraid of the surveys of what was damaged and what was missing. Dade County without FEMA is a disaster.

Appendix B

Pre-Hurricane Preparation and Post-Hurricane Response and Recovery Workshop

**University of Miami-RSMAS
November 17 - 18, 1993**

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