


1992

Rhode Island Marine Debris Pilot Project

Christina L. Beal
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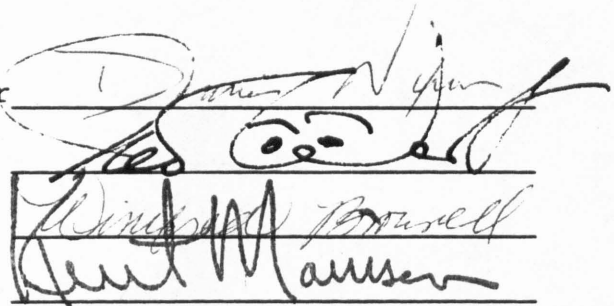
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MASTER OF ARTS THESIS
OF
CHRISTINA L. BEAL

APPROVED:

Thesis Committee

Major Professor



The image shows three handwritten signatures in black ink. The top signature is the most prominent and appears to be 'James N. [unclear]'. Below it are two other signatures, one of which is 'Wendell [unclear]' and the other is 'Kent [unclear]'. The signatures are written over horizontal lines.

DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND

1992

RHODE ISLAND MARINE DEBRIS

PILOT PROJECT

BY

CHRISTINA L. BEAL

A THESIS SUBMITTED IN PARTIAL FULLFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

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IN

MARINE AFFAIRS

UNIVERSITY OF RHODE ISLAND

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ABSTRACT

The Rhode Island Marine Debris Pilot Project was initiated in Newport, R.I. during the summer of 1991. The objective of the project was to decrease recreational boaters' contribution to marine debris. Two methods were used to achieve this goal. First, trash and recycling disposal facilities were increased around the harbor. Secondly, educational literature on the environmental consequences of marine debris, and the law that applies to overboard disposal, were distributed throughout the local marine community. The implementation of the pilot project led to a significant increase in the amount of debris brought ashore by boaters, and a decrease in the amount of floating debris in Newport Harbor.

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INTRODUCTION

Ever since humans first sailed the ocean we have deposited our unwanted waste into those seemingly infinite depths. Little of this garbage ever returned to society because its chemical composition allowed it to degrade in the marine environment.

Twentieth century technology has created materials which are durable and resistant to the weathering processes of the sea. Synthetic resins are now used in most areas of our daily lives.¹ These materials are prized for their strength and durability, the very same qualities which insure their persistence in the marine environment.²

Although changes have occurred in the type of materials used by humans, we have not changed our practice of disposing of that waste in the ocean. No longer do the oceans seem limitless in their ability to assimilate our debris. Plastics have made coastal nations recognize that the continued dumping of garbage into the ocean will eventually affect the quality of the marine environment.

This realization led to the development of an international treaty to end marine pollution from ships. The International Convention for the Prevention of Pollution from Ships³, commonly known as MARPOL, addresses five types of pollution from ships.

Annex V of the treaty deals with garbage generated by ships on the world oceans. This section of MARPOL entered into force in 1988 when the United States became a signatory to the convention.⁴ U.S. ratification of Annex V was prompted by the ever growing problem of debris on our coasts.

MARPOL Annex V is targeted at garbage generated by vessels; however, coastal debris in the U.S. comes from a variety of sources. U.S. beaches are assaulted with debris generated by land based sources such as; recreational beach users and sewage outfalls, and water borne sources such as; commercial and recreational vessels. The cumulative impact of this debris has awakened the American consciousness to the issue of marine litter.

Anyone who uses the shoreline or the waters of the U.S. is confronted with the effects of marine debris. The aesthetic qualities of recreational beaches are affected by debris washed ashore or left behind at these sites. Floating debris is known to have caused damage to vessels. Entangled marine wildlife washed onto the shoreline is also testimony to the widespread effects of human garbage in the ocean.

Debris is pervasive throughout the U.S. and its territories. All of the coastal states have initiated yearly beach cleanups in an effort to quantify the amount and type of debris which washes onto their shores.⁵

Rhode Island, although the smallest state, has 454 miles of coastline on which debris may accumulate. Most of this shoreline surrounds the state's most important natural resource, Narragansett Bay. Historically the Bay has been an important economic resource for Rhode Islanders. The Bay provides employment from fishing, boat building, and recreational activities. Debris in the waters and on the shore of Rhode Island threatens the economic stability that this resource provides.

Of the many user groups on the Bay, the recreational boating fleet is one of the largest in number, with 31,000 registered boats. It is assumed that this group must contribute to the problem of debris in Narragansett Bay.

Solutions to the problem of marine debris are needed. Education of the public has proven to be an effective method in the control of litter behavior⁶; however, education alone will not change litter behavior. In addition, facilities for garbage disposal need to be accessible and well marked for those using the shore and waters of Rhode Island.

A. HYPOTHESIS

It is hypothesized that recreational boaters will bring more trash ashore if convenient disposal sites for trash and recycling are readily available. It is also hypothesized that with education of the environmental

consequences of garbage disposal at sea, and the law applying to these actions, overboard disposal will decrease.

A minor hypothesis is that compliance with the regulatory requirements of the law will increase with education.

B. PILOT PROJECT

A pilot project was proposed to test these hypotheses. The objective of the project was to reduce the amount of garbage disposed of at sea and consequently to reduce the harmful effects of debris in the marine environment.

The pilot project was instituted in Newport Harbor during the summer of 1991. Newport was chosen as the test site due to the feasibility of implementing the project and the large number of boaters who would be reached by a project in the harbor. The pilot project attempts to solve the problem of marine debris, which is pervasive worldwide, within the confines of Newport Harbor.

The results of this project will be used to analyze the above hypotheses.

MARINE DEBRIS-CAUSE AND EFFECT

The term marine debris is used to describe man made items which are deposited into the ocean through accidental or intentional means.⁷ The term is most often used to refer to solids which float on or near the surface of the water, but also covers items which sink to the bottom. Marine debris is often the result of garbage dumped into the ocean by land based or water borne sources.

The type of debris found on coastal margins and nearshore waters depends upon the user groups in these waters. Nearshore waters often have the highest concentration of debris because eighty percent of marine activity occurs near the coast.⁸ In nearshore waters, which are commonly used by both recreational and commercial vessels, bags, cups, and disposable containers are common. Near industrial sites, where plastics are manufactured, small plastic pellets are particularly conspicuous.⁹ At sea, visible marine debris often emanates from ships and offshore platforms.¹⁰

A. SOURCES OF MARINE DEBRIS

Marine debris is generated by a wide variety of sources. The cumulative impact of debris from these sources is staggering. However, no one source can be blamed for the amount of debris found on the coast and in

the ocean today. Possible sources of debris in Rhode Island are listed below.

BEACH USERS

Food containers and packaging, which are lightweight and floatable, are left behind by recreational beach users.¹¹ Many of the beaches in Rhode Island are owned and managed by the State Department of Environmental Management (DEM). Due to a reduction in the state budget, the DEM instituted a "bag in-bag out" policy towards garbage on state lands during the summer of 1991.¹² As the public entered a state park a garbage bag was distributed to each group of visitors. The public was asked to deposit their garbage in the bag and take it home with them for proper disposal. Trash dumpsters and barrels were removed from the parks.

An often cited comment in opposition to this program indicated that litter left on the ground would be blown into the bay and exacerbate the problem of marine debris. The State government countered with the belief that the public would be more conscientious and thus leave less garbage behind. The state has proclaimed this program a success after the first season.¹³ This claim is supported by the Youth Corp beach cleanup crews which found less visible debris on state beaches over the summer of 1991. It is not known whether this is due to conscientious use of the parks by visitors, or whether litter was blown away thereby increasing the amount of wind borne litter deposited into the bay.

STREET LITTER

Street litter reaches the ocean via two paths. First, street debris, which is generally light weight, may be blown into the water by the wind. This debris is deposited in the surf zone, and stranded on the coast at low tide. The second path consists of sewer systems which carry litter from the streets into the ocean during heavy rains. In cities with antiquated sewer systems, where the sewage and storm runoff are combined, heavy rains strain the sewage plant's capacity forcing untreated sewage to be discharged directly into the ocean. This is generally the source of sanitary waste such as condoms, syringes, and tampon applicators.¹⁴

INDUSTRY

Small plastic pellets used in the manufacturing of plastic materials are found in abundance around industrialized areas. Scientific studies have shown that the highest concentration of these particles is in the southern waters of Rhode Island and Long Island Sound.¹⁵ The pellets, which are lightweight, are most likely lost during land or water shipments of raw materials or discharged through waste water systems into industrial outfalls.¹⁶

ANIMALS

Scavenging animals often frequent garbage bins as a source of food. Containers which have been left open or have no lid allow these animals access to the trash.

Litter is generated when bags are ripped open and their contents dispersed on the ground.¹⁷ Some of this debris may eventually find its way into the water.

VESSELS

Vessels have been blamed for the majority of the marine debris in the ocean. For years it has been the practice of all types of vessels to dispose of their wastes overboard. In the past most of these wastes have been biodegradable; this is no longer true. Plastics have become a staple on vessels in the galley, engine room and on deck. Therefore, they have become an increasing proportion of debris in the ocean.¹⁸

Vessels are believed to be the largest contributor to debris in the ocean. As a result vessels contribution to this problem has been studied and assessed by various organizations, and addressed by international and domestic legislation.

B. AMOUNT

VESSELS

The last major study on the amount of garbage generated by different types of vessels was conducted by the National Academy of Sciences (NAS) in 1975.¹⁹ Since that study there have been changes in both the size of crews on ships as well as the type of packaging used to store items. As a result much of the NAS data is outdated. In 1987 the Center for Marine Conservation

(CMC) attempted to update portions of the NAS data by inserting 1987 boat registration numbers in place of 1975 registration estimates.²⁰ Most recently, the Eastern Research Group completed a comprehensive analysis of vessel generated waste.²¹

Merchant Vessels

Merchant vessels carrying cargo were estimated by NAS to dump in excess of 560,000 metric tons of garbage into the ocean annually.²² Much of this material was in the form of dunnage or packaging such as strapping bands, plastic sheeting and wood pallets. Increased use of containerization as a method of shipment has reduced the amount of packaging material carried on board merchant vessels. This change is reflected in the Eastern Research Group estimation of 30,949 metric tons generated annually on merchant vessels.²³

Passenger Ships

Passenger ships or cruise ships which act as floating hotels generate a large amount of domestic waste. The Eastern Research Group has estimated that 258,074 metric tons are generated annually.²⁴

Fishing Vessels

There were 129,800 U.S. registered fishing vessels in operation in 1988.²⁵ The CMC estimated that 92,000 metric tons of galley wastes alone were generated on board U.S. fishing vessels in 1984. Portions of this debris are assumed to be deposited into the ocean.²⁶

Intentional or accidental loss of fishing gear such as nets, buoys and traps accounted for an estimated 100,000 tons of debris a year.²⁷ Much of this gear is made out of synthetic materials which do not degrade. Eastern Research Group has increased this estimate to 233,177 metric tons per year.²⁸

Recreational Vessels

There are an estimated 16 million recreational vessels in U.S. coastal waters, the majority of which are concentrated on the eastern seaboard.²⁹ Recreational boaters contribute to marine debris through galley, and recreational fishing wastes such as monofilament line. Citing NAS figures, the CMC estimates that .45 kg of garbage are generated per person per day. Thus recreational boaters generate 51,642 metric tons of garbage per year.³⁰ However, this estimate was dramatically increased by Eastern Research Group to 636,055 metric tons per year.³¹ The large increase in registered recreational boats is the cause of the increased waste estimates for this group. As with other marine based sources it is difficult to determine how much of this is disposed of at sea. We do know that an increasing percentage of the garbage disposed of at sea is plastic.³²

Government Vessels

Military vessels have historically been a large source of debris in the marine environment. For years the U.S. Navy disposed of their garbage at sea. The Navy estimated that they generate 3.05 pounds of garbage per person per day of which 7% is plastic.³³ Plastic waste disposal in the ocean by the U.S. Navy has been estimated at 4 tons per day.³⁴ The Navy is required to meet the provisions of MARPOL Annex V by 1992. They have made great strides in adding incinerators to their ships and informing their crews of the law.³⁵

Offshore Platforms

Offshore platforms contribute to marine debris through domestic, sewage and operational wastes. The NAS estimated their input to be 1.6 metric tons per year.³⁶ Eastern Research Group has estimated this source as producing 16,710 metric tons per year.³⁷ Specific items such as computer parts used for seismic data and drill pipe connectors can be traced back to this source.³⁸

Totals

The 1975 report by the NAS concluded that 636,000 metric tons of debris were being dumped into the oceans every year.³⁹ This is equivalent to 14 billion pounds in crew and cargo waste from all marine sources per year. Although the Eastern Research Group estimates that total waste generated by all of these sources is double the NAS

estimate or 1,239,322 metric tons per year, they estimate that only 565,791 metric tons are being dumped into the ocean each year. This estimate means that less waste was reaching the ocean from these sources than was thought before the implementation of Annex V. Eastern Research Group also indicates that this amount can be reduced to 337,306 metric tons if there is compliance with MARPOL provisions. (See Tables 1 and 2)

COASTAL ESTIMATES

The CMC has attempted to quantify the amount and type of debris that washes ashore on U.S. beaches each year.⁴⁰

Data cards have been distributed to beach cleanup volunteers each year for the past three years. The cards list eight categories of debris covering seventy two different items.⁴¹ Volunteers list each item of debris as it is picked up. These results are then entered into a national data base, which generates estimates of the amount and type of debris found on the coasts each year.⁴²

Indicator items are used to identify five sources of debris: galley wastes, fishing and boating gear, operational wastes, sewage wastes, and medical wastes. The CMC then calculates the contribution of each of these sources to the total amount of debris found on the coasts. Over the past three years the overall contribution of each of these indicator groups has been

TABLE 1

NATIONAL ACADEMY OF SCIENCES ESTIMATES OF MARINE LITTER

| Source | Amount | Percent |
|---------------------------------|--------------------|----------------|
| | (metric tons/year) | |
| <u>Regulated Sources</u> | | |
| Merchant Marine- crew wastes | 11,000 | 1.8% |
| Merchant Marine- cargo wastes | 560,000 | 89.5% |
| Passenger Vessels | 2,800 | 0.4% |
| Commercial Fishing- crew wastes | 34,000 | 5.4% |
| Recreational Boats | 10,300 | 1.6% |
| Military Vessels | 7,400 | 1.2% |
| Offshore Platforms | 400 | 0.1% |
| <u>Unregulated Sources</u> | | |
| Lost Fishing Gear | 100 | |
| Loss due to catastrophe | 10,000 | |
| TOTAL | 636,000 | |

*Source: National Academy of Sciences. Assessing Potential Ocean Pollutants. 1975: 422.

TABLE 2
 EASTERN RESEARCH GROUP'S ESTIMATES OF VESSEL GENERATED WASTE
 AND FINAL DISPOSITION, BEFORE AND AFTER ANNEX V IMPLEMENTATION
 (IN METRIC TONS)

| SOURCE | Total generated annually | PRE ANNEX V | | | POST ANNEX V | | |
|------------------------|--------------------------------|-----------------------|-----------------------|---------------------|-----------------------|-----------------------|---------------------|
| | | Off-loaded in port | Incinerated at sea | Dumped overboard | Off-loaded in port | Incinerated at sea | Dumped overboard |
| MERCHANT SHIPPING | 30,949 | 3,302 | 1,148 | 26,499 | 4,363 | 4,381 | 22,204 |
| COM. PASSENGER VESSELS | 258,074 | 232,121 | 638 | 25,315 | 255,830 | 1,117 | 1,128 |
| COMMERCIAL FISHING | 233,177 | 0 | 0 | 233,177 | 15,373 | 3,723 | 214,081 |
| RECREATIONAL BOATING | 636,055 | 424,036 | 0 | 212,018 | 594,740 | 0 | 41,315 |
| OFFSHORE OIL AND GAS | 16,710 | 10,733 | 0 | 5,977 | 5,945 | 0 | 0 |
| MISC. VESSEL CLASSES | 1,637 | 5 | 0 | 1,633 | 109 | 306 | 1,223 |
| U.S. NAVY | 57,596 | 0 | 0 | 57,596 | 3,859 | 0 | 53,737 |
| U.S. COAST GUARD | 4,317 | 1,452 | 0 | 2,864 | 1,054 | 0 | 3,262 |
| U.S. ARMY | 490 | 0 | 0 | 490 | 33 | 0 | 199 |
| NOAA | 317 | 7 | 88 | 222 | 11 | 148 | 158 |
| TOTAL | 1,239,322 | 671,656 | 1,874 | 565,791 | 881,319 | 9,674 | 337,306 |

*Source: Cantin, et al. "Quantitative Estimates of Garbage Generation and Disposal in the U.S. Maritime Sectors Before and After MARPOL Annex V." Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii.

reduced.⁴³ The most significant decrease has occurred in the amount of galley wastes found on the nation's beaches.

Each year the number of volunteers involved in beach cleanups has increased, allowing more miles of beach to be cleaned. In 1990 2,645,283 pounds of trash were collected by 108,749 volunteers along 3,720.5 miles of beach.⁴⁴ This results in approximately 711 pounds of garbage found per mile of beach.

Although these numbers are impressive the type of debris found on the coast is the most important aspect of the data. Sixty four percent of the coastal debris in 1990 was plastic.⁴⁵ Of the twelve most prevalent items found on the beach in 1990, eight were plastic. This composition has changed little over the past three years.

C. TYPES

Debris can be separated into two categories; degradable and non-degradable. Into the first category fall such items as food, paper, cardboard, and certain types of cans and bottles. Over time these items will break down or be used within the food chain. Degradation rates for these items will vary according to the chemical composition of the debris and physical action of the environment on the debris.⁴⁶ Food and paper are believed to degrade fairly quickly. Bottles and cans may last a year or more on the bottom of the ocean.⁴⁷

PLASTIC

Among the non-degradable items are plastics.

Plastics have many advantages over traditional materials which accounts for their increased use in recent years. They are easily modified, highly resistant to corrosion, light weight and shatter resistant.⁴⁸

Over the past twenty years plastics have entered most areas of our daily life. We have become a "single serving" society, where items are packaged for the individual. Plastic packaging now consists of one third of all plastic sales in the U.S. and accounts for most of the ten percent annual increase in plastics manufacturing.⁴⁹

Plastics arrive on the shoreline in many shapes and sizes. The most common item is cigarette filters. During the 1990 beach cleanup 531,828 cigarette butts were found making this is the most numerous item on U.S. beaches.⁵⁰ The common habit of throwing a cigarette overboard or into the street and hence into the sewer system has contributed to this problem. Cigarette filters are made of synthetic resins which are classified as plastic.⁵¹ Therefore disposal of cigarettes in the ocean is prohibited under Annex V. Other plastic materials ranking in the top twelve items collected include: plastic food bags and wrappers, plastic caps, lids, straws and eating utensils, foamed plastic cups and miscellaneous pieces of foamed and film plastic.⁵² (See Appendix A)

SOLUTIONS TO THE PROBLEM OF PLASTIC PERSISTENCERecycling

The most common solution to the problem of plastic proliferation is recycling. In general 7%, by weight, of the municipal solid waste stream is plastic material,⁵³ only 1% of which is recycled.⁵⁴ Milk jugs, water jugs and soda bottles, which are made of PET and HDEP type plastic, are most commonly recycled.⁵⁵ New technology is needed in order for recycling to become an economically competitive method of plastic reduction. The plastics industry is working on processes which will allow increased recycling of different types of plastic.⁵⁶ However, plastics recycling is not widespread and is still in the beginning stages across the nation.

Recycling is one method to reduce the amount of plastics in the environment. A second option is to produce degradable plastics. Plastic may be broken down into smaller particles, through biological or light induced processes which make the plastic less visible. Both of these degradation processes have proven to be slower in the marine environment than on land.⁵⁷

Photodegradation

Photodegradation works by incorporating a photosensitive link into the plastic polymer chain. As it is exposed to sunlight this link breaks down allowing the polymer to separate into smaller groups.⁵⁸

Unfortunately, the process of photodegradation is slowed in sea water by the cooler temperatures of the water.⁵⁹ Photodegradation is also inhibited when debris is trapped under eelgrass. This prohibits the exposure to light that is necessary for photodegradation to occur.

Biodegradation

Biodegradation works by incorporating a polymer, such as starch, into the chemical chain which will be broken down by micro organisms.⁶⁰ Bacteria, yeast and fungi attack the starch molecule and begin to grow on the surface of the plastic. This creates two changes; first the breakdown of the polymer, second a buoyancy change that allows the physical properties of the ocean to put more stress upon the material, breaking it down into smaller pieces.⁶¹

Although degradation of plastics breaks down the chemical structure it does not remove the plastic from the environment. Questions still remain as to the toxicity of these smaller pieces.⁶²

D. EFFECTS

The most obvious effect of marine debris is aesthetic. However, debris impacts both human and marine ecosystems in more important ways.

BEACH QUALITY

Degradation of beach quality due to marine debris has traditionally been considered solely an aesthetic

problem. As medical wastes, tampons, and dirty diapers accumulate on the beach, communities have realized that debris represents a sanitary and economic problem as well. Inevitably, tourist dollars, often an important part of the coastal communities economy, are lost as the public perceives a health risk at the beach.

VESSELS

Vessels of all sizes have incurred damage due to marine debris. The use of guards around saltwater intakes and chafing blades on propellers are examples of new technology developed to combat this problem. Plastic bags may be sucked into cooling systems causing engine overheating. Discarded nets and lines wrap around propeller shafts prohibiting control of vessel movement. Larger items such as lost containers and large logs may cause hull damage to a vessel.

WILDLIFE

The most serious result of marine debris is the effect that it has on marine wildlife. Entanglement and ingestion are the two methods by which marine life interacts with litter in the ocean.

Birds, mammals, turtles and fish have all been affected by debris. These animals are sometimes found with plastic bags, plastic pellets or pieces of fishing net in their stomachs.⁶³ Debris is easily and frequently mistaken for natural food. Turtles often mistake clear plastic bags for jellyfish, a food staple

for some species of turtles. To fish and birds, plastic pellets look like zooplankton. Once consumed these items are often indigestible. Accumulating in the stomach they give a false sense of satiety resulting in starvation and eventual death.⁶⁴ Ingestion of plastic is not easily recognized while an animal is alive and often can only be verified through autopsy. External entanglement, on the other hand, is more easily documented because it only requires visual sighting.

Many species of marine wildlife have been found entangled in nets, six-pack yokes or monofilament fishing line.⁶⁵ As an animal grows these items tighten around the body, eventually abrading the skin, causing infection. The weight of entangled netting often prevents an animal from swimming as fast as usual, thereby prohibiting it from catching its prey, or escaping predators. Monofilament fishing line entangled in a birds wing may catch in a tree leaving the animal to hang, unable to move. The methods by which entanglement affects an animal are dependent upon the type of debris.

Entanglement is thought to be the cause of an undetermined number of deaths.⁶⁶ Because many animals die before their entanglement can be documented specific numbers on how many animals die due to entanglement or ingestion of debris are not available.⁶⁷ Nonetheless, scientific research strongly indicates that marine debris has a substantial adverse impact on marine wildlife populations.⁶⁸

INCIDENTAL CATCH AND GHOST FISHING

Ghost fishing, the process whereby lost or discarded nets and traps continue to catch fish, has the potential to drastically affect fishery stocks.⁶⁹ Lost lobster pots, crab pots, and nets continue to catch animals. These items become traps, with ensnared or dead animals attracting others to feed upon the carnage. Those animals which are attracted often become ensnared themselves. This process may continue for years since pots and nets are often made of durable plastic. The ultimate result of ghost fishing is a decline in the number of animals that are available for humans to catch.

Incidental catch, when one species is caught in the hunt for another, may also reduce a species stock.⁷⁰ This process adversely impacts both bird and fish populations.

E. RHODE ISLAND

WILDLIFE

Narragansett Bay is an important habitat for many species of wildlife. These animals are threatened by the increase of debris in the state's water.

Seals are the only mammals that regularly occupy the waters of Narragansett Bay, migrating into the Bay during the winter months when their range extends from Cape Cod to Long Island.⁷¹ Seals, because of their inquisitive nature, have become notorious for entanglement in lost

nets and other types of plastic debris. Other mammals such as pilot whales and dolphins occasionally enter the lower reaches of the bay. However, their presence is thought to be purely incidental.⁷²

Turtles which regularly visit Narragansett Bay include the Loggerhead, Leatherback and Kemp's Ridley. These species inhabit the Bay in late summer.⁷³ Occasionally Green Turtles and Hawksbill turtles are also seen in bay waters. All, except the Leatherback, are bottom feeders which eat molluscs and crabs. Necroses of turtles washed onto Rhode Island beaches have not exhibited any evidence of death due to plastics.⁷⁴ Scientists believe that these bottom feeders consume so much that is indigestible, such as the shell of a crab, that any plastics they ingest are insignificant in their diet and therefore are passed through very easily.⁷⁵

The main source of food for the Leatherback is jellyfish. As mentioned above plastic bags are often mistaken for jellyfish. Therefore, Leatherbacks are the most vulnerable to plastic ingestion.⁷⁶ This problem has been well documented along the eastern seaboard.⁷⁷ Plastics in Narragansett Bay threaten the safety of these endangered turtles.

Sixty-two species of birds inhabit Narragansett Bay.⁷⁸ The majority of these are Gulls and Cormorants.⁷⁹ Many birds use Narragansett Bay as a feeding stop on their annual migrations north and south.

Birds are susceptible to entanglement in six-pack rings and monofilament line and the ingestion of small pieces of plastic. Entanglement of birds has been documented during the annual beach cleanups in Rhode Island.⁸⁰

Economically, shellfish and Flounder are the two most important species in the Bay.⁸¹ Two species of shellfish are commonly harvested from the bay, quahogs and lobster. The quahog industry is affected little by debris. However, lost or discarded lobster traps impact the fishery in two ways; directly by the loss of gear and indirectly through reduced fishery stocks.

Flounder was the most important fishery in the Bay.⁸² The winter flounder population has seen severe fluctuations over the years.⁸³ It is not known whether these fluctuations are due to over fishing or the result of natural decline. Lost and discarded nets will amplify any natural decline in fishery stock as the nets continue to capture fish.

AMOUNT AND TYPE

Plastic materials were noted in Narragansett Bay during the early 1970's. Candell (1973) indicated that most of the plastic found on the beach was associated with the consumption of food, probably in conjunction with recreational beach activities.⁸⁴ The author at that time called for more trash facilities near the shore to help alleviate this problem. It was estimated that 14.6 kg of plastic material per month passed down the bay via the East Passage in the summer.⁸⁵

The most recent estimates of debris in Rhode Island come from the annual beach cleanups conducted in 1988, 1989, and 1990. The composition of debris on R.I. shores has changed little over the past three years.⁸⁶ Each year plastics have composed approximately 60% of the debris found.⁸⁷ In both 1989 and 1990, seventeen thousand pounds of debris were cleaned from R.I. beaches.⁸⁸ The twelve most prevalent items found during these cleanup events were attributable to recreational activities on the bay and shoreline.⁸⁹ (See Appendix B)

A wide variety of debris enters the ocean every year. Sources range from recreational use of the shoreline to industrial cooling systems. The effects of debris are also far reaching, influencing the pleasure that we derive from a trip to the shore to the prices we pay for seafood. In 1987 these effects forced the government to take steps to stem the tide of debris in U.S. waters through legal means.

THE LAW**A. MARPOL ANNEX V**

The 1970's saw the implementation of much of our present environmental legislation. The issue of ocean pollution was addressed domestically by the Clean Water Act⁹⁰ and internationally by the Convention for the Prevention of Pollution by Ships (MARPOL).⁹¹ The International Maritime Organization, a body of the United Nations, opened MARPOL for signature in 1973. The treaty required 15 signatories with a combined gross tonnage of 50% of the world merchant fleet to enter into force.⁹² MARPOL was the first international initiative to seriously address the issue of pollution caused by ships.

Five types of pollution are addressed, each in a single Annex to the convention. Annexes I and II, deal with oil and hazardous material, and are mandatory upon ratification of the convention. Annexes III, IV and V cover packaged noxious substances, sewage, and garbage respectively, and are optional. Annex V, covers pollution by garbage disposal at sea, and received the required number of signatures, and necessary percentage of world ship tonnage, for international implementation with U.S. ratification in 1987.⁹³ Forty nations are now signatory to Annex V of the convention. (See Table 3)

TABLE 3

SIGNATORIES TO ANNEX V OF MARPOL

(AS OF JANUARY 30, 1990)

*source: Treaties in Force

| | |
|---------------------|--------------------------------|
| Algeria | Korea Rep |
| Antigua and Barbuda | Lebanon |
| Austria | Marshall Islands |
| Belgium | Netherlands |
| Columbia | Norway |
| Cote D'Ivoire | Oman |
| Cyprus | Panama |
| Columbia | Peru |
| Czechoslovakia | Poland |
| Denmark | Portugal |
| Egypt | St. Vincent and the Grenadines |
| Finland | Suriname |
| France | Sweden |
| Gabon | Tunisia |
| Germany | Tuvalu |
| Greece | USSR |
| Hungary | United Kingdom |
| Iceland | United States |
| Italy | Uruguay |
| Japan | Yugoslavia |

B. DEVELOPMENT OF DOMESTIC LEGISLATION

Marine pollution by garbage is a relatively new concern among the general public. Public attention was galvanized by two events. First, in the mid 1980's New York and New Jersey beaches became national news when they were found littered with medical debris that had been dumped into the ocean.⁹⁴ The public reacted to this sanitary threat by demanding solutions from their elected politicians. Secondly, in 1984 the "Coastweeks" beach cleanup program was initiated.⁹⁵ "Coastweeks" encourages public participation in beach cleanups which in turn creates public awareness of the marine debris problem.

Congressional attention to the issue of garbage disposal at sea began in 1986. Numerous bills were introduced which proposed methods to reduce plastic input into U.S. waters. On December 29, 1987 a compromise bill was approved and signed by the President. This bill was entitled the Marine Plastic Pollution Research and Control Act (MPPRCA). The MPPRCA entered into force one year later on December 31, 1988.⁹⁶ For detailed development of the law see Appendix C.

C. MARINE PLASTIC POLLUTION RESEARCH AND CONTROL ACT

The law prohibits the disposal of plastic by any U.S. flagged vessel in any water. This extends to foreign flagged vessels operating within 200 miles of the

U.S. coast regardless of whether or not they are a signatory to Annex V. The law also regulates the disposal of non-plastic items at certain distances from shore.⁹⁷

The MPPRCA represents a compromise on two issues. Initially H.R. 940 called for a plan to declare the Gulf of Mexico a special area.⁹⁸ Under MARPOL only victuals can be discharged in special areas, and then only beyond the territorial sea.⁹⁹ This plan was opposed by the Gulf shrimping industry. The shrimpers claimed that their boats were not equipped to hold all of their garbage for the full length of a trip. This provision would force them to shorten the length of a fishing trip, returning to shore with a less than full load. Concern over the effect of a special area designation on the U.S. shrimp industry led to exclusion of this provision in the MPPRCA.

Another area of conflict was whether the Navy would be required to comply with the provisions of Annex V. MARPOL does not require that government vessels comply with the conventions provisions.¹⁰⁰ The Navy is the largest contributor to marine debris in the U.S. It is estimated that Naval ships produce 3 pounds of garbage per person per day which is commonly thrown overboard.¹⁰¹ Congress determined that Naval vessels must comply with the MARPOL provisions within five years.¹⁰² The Navy has tackled this problem by

installing on board incinerators. Present compliance rates indicate completion by 1992.

The MPPRCA does not adhere strictly to the MARPOL Annex V protocol. The domestic legislation adds additional requirements. Specifically, vessels 26 feet and over must display an Annex V placard (see Appendix D), vessels 40 feet and over are required to have written waste management plans onboard and vessels 76 feet and over were required to have waste records stating where, when and what was disposed of at sea (this requirement was later changed).¹⁰³ Like Annex V the MPPRCA acknowledges special areas where all garbage disposal is prohibited. Under the MPPRCA, the EPA is required to study the problem of plastics in the marine environment. EPA is also charged with developing a management plan for the New York Bight Area.¹⁰⁴

D. REGULATIONS

The Coast Guard has been charged with developing regulations to implement the MPPRCA. Initial regulations were published in the Federal Register on April 28, 1989.¹⁰⁵ The stated objective of these regulations is to prevent the disposal of plastics and synthetic fishing nets in the marine environment. The regulations make it clear that the provisions apply to all vessels no matter what size. The Coast Guard has used a phase in method to allow vessels time to comply with the regulations.

There are six major provisions covered by the regulations. They are: definitions, enforcement, reception facilities, refuse record books, waste management plans and placards.

Two specific definitions are the most contentious and also the most important under the law. The term ship is defined as any ocean going vessel. Ocean going is further defined as any ship that sails the marine waters of the world.¹⁰⁶ This means that the Annex V provisions can apply to all vessels from a dinghy to a super tanker. The other term that provoked much attention is the definition of plastic.¹⁰⁷ Chitin which is a natural by-product of shell formation is considered a plastic when it has been harvested and adapted for use by man under the law.¹⁰⁸ Concern was raised that chitin in its natural form, e.g. the shell of a mollusk, would be included under this definition. The Coast Guard has modified this definition in order to make it clear that chitin is only considered a plastic when it has been modified and adapted for use by man.¹⁰⁹

Enforcement of the MPPRCA will range from on the spot inspection of vessels to captain-of-the port letters of warning or the imposition of civil penalties.¹¹⁰ Certificates of adequacy are issued when a port or marina has complied with Coast Guard regulations for adequate garbage reception facilities. Vessels may be denied entry to a port which does not comply with the MPPRCA

requirements for a certificate of adequacy.¹¹¹ "The Coast Guard enforcement strategy will be to cooperatively work with all members of the marine community in an equitable manner, but with the clear expectation that ports, terminals and shipping companies will take action now to achieve full compliance with Annex V."¹¹²

All ports, terminals and marinas are required to have adequate reception facilities for garbage. This means the port must be able to accept all of the garbage that a ship wishes to offload.¹¹³ Large amounts of spoiled goods and garbage from vessels not doing business with the terminal are the only exception to this rule. Reception facilities are to be "conveniently located so that mariners unfamiliar with the port or terminal can find it easily and so that its use will not be discouraged."¹¹⁴

These initial regulations were amended on May 2, 1990 to add requirements for waste management plans and placards. The additional regulations were to become effective July 26, 1990.

As mentioned above, placards will be required on all vessels over 26 feet.¹¹⁵ The number of placards required per vessel depends on the size of the vessel and will be considered sufficient when they are easily accessible for inspection by all crew and passengers.¹¹⁶ The placard is intended to serve as a constant reminder to crew and a source of information for passengers unaware of Annex V.

Placards may be designed as the vessel operator pleases but must contain the following information.¹¹⁷

1. The discharge of all materials in the navigable waters of the U.S. within three miles of land is prohibited.
2. The discharge of dunnage (lining and packaging materials that float) is prohibited within 25 miles of land.
3. The discharge of paper, rags, glass, crockery, metal and food if ground to one inch is permitted outside of three miles from land.
4. Unground garbage may be discharged beyond 12 miles from the nearest land.

Penalties for each violation of these rules may result in a civil penalty up to \$25,000, a fine of up to \$50,000, and imprisonment up to 5 years.

Waste management plans are required on all vessels 40 feet and over.¹¹⁸ The waste management plan was established to form a basis of training for all crew on a vessel. The format of a waste management plan has been left to the vessel. It could be as simple as "all garbage will be bagged and placed in a receptacle on shore." The plan shall designate who on board is in charge of carrying out the plan. All crew must be aware of the plan and its contents. These plans need only cover garbage that is generated on board, not garbage that has been contracted for transport as cargo, or trash that is caught in a fishing boat's nets. These increased requirements for larger boats are based upon the belief that these vessels have more people on board and therefore produce more garbage.

After looking at the rules and receiving comments the refuse record book requirements for vessels over 76 feet were set aside.¹¹⁹ It was determined that these requirements would be difficult to monitor and enforce. Record books would not encourage any more compliance than the placards and waste management plans already did, therefore they are not included in the final set of regulations.

On September 4, 1990 a final rule was published in the Federal Register. There were no changes from the previous amendments except for a clarification of the definition of plastics. On January 9, 1991 the Coast Guard published changes in the Annex V regulations.¹²⁰ These changes were the result of an amendment to MARPOL by the International Maritime Organization¹²¹ which designated the North Sea as a special area.

The January 1991 changes also eliminated the exemption for the loss of synthetic material incidental to the repair of fishing nets. The latter change was intended to further eliminate the amount of plastics deposited into the ocean. Initially under MARPOL lost fishing nets were not covered by the regulations if reasonable care had been taken to prevent their loss.¹²² This new rule reflects the growing international concern over the amount of fishing nets, especially driftnets, that are lost each year. The growing tendency among international organizations is to

increase the regulation of synthetic fishing gear, as is reflected in this new regulation.

E. THE COAST GUARD'S ROLE

The Coast Guard's responsibilities under Annex V are two fold. They must act as the primary enforcement agency, a role which they have traditionally held, and also as educator of the general public, a duty which is new to this service.¹²³ Throughout the development of Annex V it was generally agreed that enforcement alone would not generate compliance with the law. Education of the public is an integral part in the creation of a self-regulating environment, which is necessary to prevent garbage disposal at sea. The physical area which this law covers is simply too large for a single agency to patrol and any visual sightings of violations will occur purely by chance.

The Coast Guard will check for compliance upon routine boarding of a vessel. No extra boardings are planned to check specifically for compliance with MARPOL Annex V.¹²⁴ The boarding officer will look for a placard and waste management plan if applicable. They will also look for evidence of plastics stored on board the vessel. If a vessel has been at sea for a period of time, and there is reason to believe that plastics were used but no empty containers are found, then this may be used as evidence that plastics were dumped overboard.¹²⁵

Eyewitness statements may also be used to prosecute a vessel. A direct connection must be made between the debris and the accused vessel in order for prosecution to occur through an observer sighting.¹²⁶ This is an important and difficult point to prove. Most garbage is generic in nature and could have originated from any vessel. A case in point, is the report of a fishing vessel throwing garbage bags over the side. The Coast Guard retrieved the garbage and found inside a pizza box with the delivery slip containing the vessel's name still attached.¹²⁷ Without this piece of evidence the Coast Guard would not have been able to prosecute the vessel solely on the observer sighting.

The Coast Guard must also insure that ports have adequate facilities to accept garbage which is brought back to shore.¹²⁸ Under MARPOL all facilities that hold ten or more vessels must provide adequate facilities for garbage reception.¹²⁹ The Coast Guard has defined adequate as able to receive all of the waste that a vessel wishes to discharge.¹³⁰ Certificates of Adequacy are issued by the Coast Guard to insure a facility's compliance with this aspect of the law.

Education of the public is a necessary element in the implementation of MARPOL Annex V. Enforcement alone will not create an environment of compliance. The Coast Guard has been handed a difficult role, one which they are not used to performing- that of educator as well as enforcer of Annex V.

F. RHODE ISLAND LAW

Rhode Island has enacted state laws which prohibit the dumping of garbage on land and in the water. The Litter Control and Recycling Act¹³¹ declares as its purpose the control of litter and establishment of community recycling.¹³² Litter is defined as

"garbage, trash, waste, rubbish, ashes, cans, bottles, wire, paper, cartoons, boxes, automobile parts, furniture, glass, or anything else of an unsightly or unsanitary nature thrown, dropped, discarded, placed, or deposited by a person, on public property, on private property not owned by the person, or in or on waters of the state..."¹³³

Penalties are established for violations of the law, and enforcement is to be provided by state and local agencies.

Rhode Island has addressed the problem of litter through various pieces of legislation. Three methods of waste management are represented in State law. First, source reduction is achieved by requiring retail establishments which sell food to provide the option of paper or plastic bags to the consumer.¹³⁴ Secondly, degradability requirements are set for all beverage

connectors sold in the state.¹³⁵ Thirdly, the state will assist in waste mitigation through the placement of trash receptacles at various locations including marinas, boat launch ramps, public and private piers, beaches, and bathing areas.¹³⁶

The most ambitious solution to the problem of litter is the Rhode Island Recycling Act.¹³⁷ The Act initiated recycling in the state and set a recycling target of 15% of the total waste stream. It also requires that those substances that are not recyclable be bio or photodegradable.¹³⁸

Rhode Island's recycling law is one of the most ambitious in the nation, requiring mandatory recycling in all communities for household as well as commercial trash. Initial opposition to the act was voiced within the business community. Businesses argued that the decrease in trash hauling cost due to recycling would not be enough to reduce cost.¹³⁹

At present two thirds of Rhode Island communities are operating under the recycling law.¹⁴⁰ Recycling in other communities has been stalled due to a lack of space at the state landfill and recycling facility.

Rhode Island communities responded quickly to the call for recycling. The amount of cans, bottles and newspapers received at the state's landfill was so overwhelming that a special recycling center was opened to handle the recyclable materials.¹⁴¹

The state's recycling program, OSCAR (Ocean State Cleanup And Recycling), is supported through a tax placed upon the distributors of bottles and cans.¹⁴² A per container deposit was rejected in Rhode Island after an agreement was reached with the beverage industry for a tax upon all carbonated beverages sold. This tax is used to run the state recycling program.¹⁴³

Recycling has become a standard practice, in both business and at home, in Rhode Island. However, recycling facilities are lacking in public areas and along the shoreline. Compliance with Annex V regulations requires that trash facilities be available for vessels in a port. In Rhode Island, where recycling of waste has become standard practice, this means that recycling should be available for all who use the shoreline and water to recreate or work.

EDUCATION OF THE PUBLIC**A. BEACH CLEANUPS**

In 1984 Judie Neilson organized the first beach cleanup in Oregon, her native state. Two thousand one hundred volunteers participated, collecting over 26 tons of trash.¹⁴⁴ Since 1984 yearly beach cleanup programs have spread to all of the U.S. coastal states and territories as well as Mexico, Japan, and Canada.

Citizen participation is an integral part in the success of these cleanups. Volunteers donate three hours a year to collect, characterize and quantify the debris on the coast; in so doing the participants become intimately aware of the amount of debris in the ocean. Educational literature is distributed at the beach cleanup, informing the participants of the sources of debris they may encounter. The yearly beach cleanups are coordinated with "Coastweeks", a week of educational activities relating to the ocean.¹⁴⁵

Education of the public is a necessary element in reducing marine debris. Educational materials targeted at various user groups in the ocean have been developed by the Center for Marine Conservation (CMC), Sea Grant offices, State Governments, and the plastics industry. These materials are generally distributed free. A sampling of this literature is included in Appendix E.

B. PILOT PROJECTS

Demonstration projects have been used as an effective means of educating the boating public. The Newport, Oregon Marine Debris Project, sponsored by NOAA and NMFS, was the first to attempt community education through a pilot project.¹⁴⁶

The port of Newport is a small fishing and recreational boat harbor. The project sought to educate the local community on the effects of debris. The program also implemented shoreside collection facilities to encourage return of waste to shore.¹⁴⁷ The project demonstrated that with education and proper port planning the amount of garbage brought back ashore will be increased at little to no extra cost to the port.¹⁴⁸

The success of this project has spurred the development of similar projects across the nation. The west coast has been particularly active in initiating recycling and debris projects at the shore. California and Washington have both developed marine debris action plans.¹⁴⁹ On the east coast projects are ongoing in New Hampshire and New Jersey.¹⁵⁰ Each of these projects has assessed the needs of the user groups in their water, and have developed a plan to fulfill those needs.

All of these projects have been developed through a large private or public marina which dominates a harbor often controlling both slips and moorings. In the

Northeast, harbors were developed pier by pier with a single individual owning each pier. This has resulted in a highly privatized waterfront with little public access to harborside trash facilities. Mooring fields were generally developed later and are usually controlled by the local municipality.

This situation is representative of Newport, R.I. A large number of small private companies own much of the waterfront, while the city regulates the mooring field. The Marine Debris Project attempted to involve all of these entities in the reduction of marine debris, but emphasis was placed on the mooring holders to which the city was responsible for providing trash facilities.

C. RHODE ISLAND MARINE DEBRIS PILOT PROJECT

All of the factors discussed to this point led to the development of the Rhode Island Marine Debris Pilot Project.

Narragansett Bay is used by many different types of vessels; from recreational boats to fishing vessels and commercial ships. The Bay is also used by industrial and recreational activities. All of these uses contribute to debris in Narragansett Bay. As a result Rhode Island shores and waters have seen a proliferation in floating debris. Increased amounts of debris will lead to economic, environmental, and aesthetic losses within the State.

Methods to rid the Bay of debris are few. Neither bio or photodegradation of plastics are truly effective in the marine environment. Recycling is a method which has been effectively used on land but has not been transferred to shoreside recreational activities. State laws to alleviate the problem are in place but have never been enforced. With the passage of MARPOL Annex V, there is now a federal standard to which industry and states must comply. Suitable garbage facilities must be available for boaters at all sites that hold over 10 vessels. This includes municipalities which regulate moorings within a harbor.

The Coast Guard is responsible for the enforcement of the federal regulations. They have pursued the enforcement of placard requirements, but have not yet surveyed garbage facilities at marinas or municipalities which hold recreational vessels, to determine if they are adequate. The Coast Guard is also responsible for the education of boaters as to federal requirements. Educational activities for recreational boaters have been limited to the distribution of materials to government agencies and Coast Guard Auxiliary courses. Unfortunately, this method is not reaching the majority of boaters.

Pilot Projects have been shown to be an effective method of educating the boating public of the environmental consequences of garbage disposal at sea.

An inherent aspect of these projects is the increase of garbage facilities around a harbor so that disposal is easier for the boater. This can be achieved at little extra cost to a community when recycling is also initiated.

The Rhode Island Marine Debris Pilot Project grew out of a perceived need for methods to relieve the ever growing problem of debris on Rhode Island shores. Recreational boaters are the largest user group on the Bay and were not receiving information on the Annex V requirements or the environmental impact of garbage in the ocean. The following methodology was developed to alleviate this problem.

METHODOLOGY

Marine debris is an obvious problem on the shores of Rhode Island. One cannot walk along the coast without encountering some discarded evidence of human presence. Rhode Island Audubon and Department of Environmental Management (DEM) have been working together to develop a state wide plan to tackle marine debris. The first stage in this plan is the development of an educational curriculum for students in the 5th through 8th grades.¹⁵¹ The curriculum, presently under development, will be pilot tested in the Aquidneck Island schools in 1992.

The pilot project study area was selected in part because of the potential for future interaction with the Aquidneck Island School system, and in part because of the large concentration of boats in Newport Harbor. Another reason for selecting Newport as the test site concerned the need for disposal facilities in the harbor.

As of July 25, 1988 there were 2,277 slips and moorings in Newport Harbor.¹⁵² Within Rhode Island the number of slips and moorings total 15,785.¹⁵³ Newport's slip and mooring capacity represents 14.5% of the total. This is the largest recreational boat capacity of any harbor in Rhode Island.

The Newport boating community consists of a wide variety of vessels. Besides the recreational fleet,

Newport also serves a small but important fishing fleet. Three fish piers operate in the harbor. Newport is a popular destination for vessels from within and beyond the state, attracting a large charter fleet in the summer.

The pilot project focuses on three key areas: impact assessment, mitigation and education. Three methods were used to assess these areas. The first consisted of a survey at the beginning of the project, which was used to establish baseline information on waste habits among recreational boaters. This was followed by another survey distributed at the end of the project to determine the extent to which the attitudes and behavior had changed. The second method consisted of the establishment of disposal facilities within the harbor area. The third component consisted of educational material which was distributed throughout the boating community.

A. SURVEY

The survey was sent to 551 private mooring holders in Newport Harbor. (See Appendix F) The City of Newport mooring list was used to identify this group. The mooring holders were divided into four groups: resident private, non-resident private, resident commercial, and non-resident commercial. Only resident and non-resident private mooring holders were surveyed.

The initial survey was sent in the last week of June, 1991. The original start up date of June 1st was delayed because of concerns about the implementation of the project raised by the City of Newport. The month long delay may have reduced the behavior change resulting in smaller changes than otherwise would have taken place.

Survey response was used to determine the extent to which recreational boaters understand the laws and procedures controlling garbage disposal at sea. Surveys were also used to assess the need and best method of implementing new trash facilities.

Private mooring holders were surveyed for two reasons. First, they have little access to trash disposal facilities. Second, a pre and post survey could be completed anonymously, hopefully encouraging truthful answers. Survey anonymity was required by the University to insure that the survey could not later be used as legal evidence against the boater.

Transient boaters and vessels on commercial moorings were not surveyed because anonymity would not be possible if a pre and post survey were to be applied. Legally, boaters who use a marina should have trash facilities available to them and therefore are not representative of the community lacking these facilities.

The survey was distributed again to private mooring holders on September 15th. The purpose of repeating the survey was to determine if the educational activities

developed as part of the pilot project had any influence upon responses to survey questions.

Statistical analysis was used to analyze fifteen specific questions. These are summarized below.

1. To what extent is the sample representative of the boating population in Newport Harbor?
2. What is the average amount of trash generated per person per day onboard recreational vessels? Does the estimated amount differ between the first and second survey?
3. How many days per year does a boater use his vessel? This information will be used to arrive at a yearly estimate of garbage generated per boat.
4. To what extent do the vessels which are required to have an Annex V placard comply with the regulation, and are there changes in response between the first and second survey?
5. Do the vessels which are required to have a waste management plan comply with the regulation, and are there changes in response between the first and second survey?
6. Does the presence of an Annex V placard influence the type and amount of waste disposed of at sea?
7. To what extent are there differences between placard compliance and type of vessel?
8. Does overboard discharge vary with respect to type of vessel?
9. Does overboard disposal vary with the type of trash receptacle?
10. Does the receptacle type influence overboard disposal?
11. What percentage of the recreational fleet use their boat in Rhode Island waters?
12. What is the average cost of damage to a vessel caused by debris and how many vessels incur such damage?
13. An estimation of the proportion of the sample population willing to use recycling facilities if they were made available?

14. Boaters' perceptions on what is needed to encourage shoreside disposal?
15. How many boaters have seen educational material on marine debris and what form of education is the most effective?

B. DISPOSAL FACILITIES

During the summer of 1990, Newport had one public waste disposal site available to boaters. This facility was located at Ann St. Pier (Illustration 1), which is a City owned pier leased to a private operator during the summer. Fees were charged for dinghy dockage at the pier, with the income divided between the city and the operator. The fee at this site discourages use of this dock and the facilities were not well marked.

Until the summer of 1991, boaters in the Brenton Cove area of the harbor used the trash dumpsters provided by the State at Fort Adams. These facilities were removed in 1991 to comply with the new state policy of bag-in bag-out in all state parks. This left boaters in Brenton Cove with no trash facilities.

In an attempt to make trash disposal easier for the boater, three new sites, in addition to Ann St., were proposed. These sites were distributed around the harbor to facilitate accessibility for as many boaters as possible. Two new land sites, one at Stone Pier and one at Long Wharf, were developed with recycling available at all locations.



ILLUSTRATION 1
MAP OF NERT HARBOR

1, 2, and 3
Denote Mooring
Areas



3

LONG WHARF

2



Brenton Cove

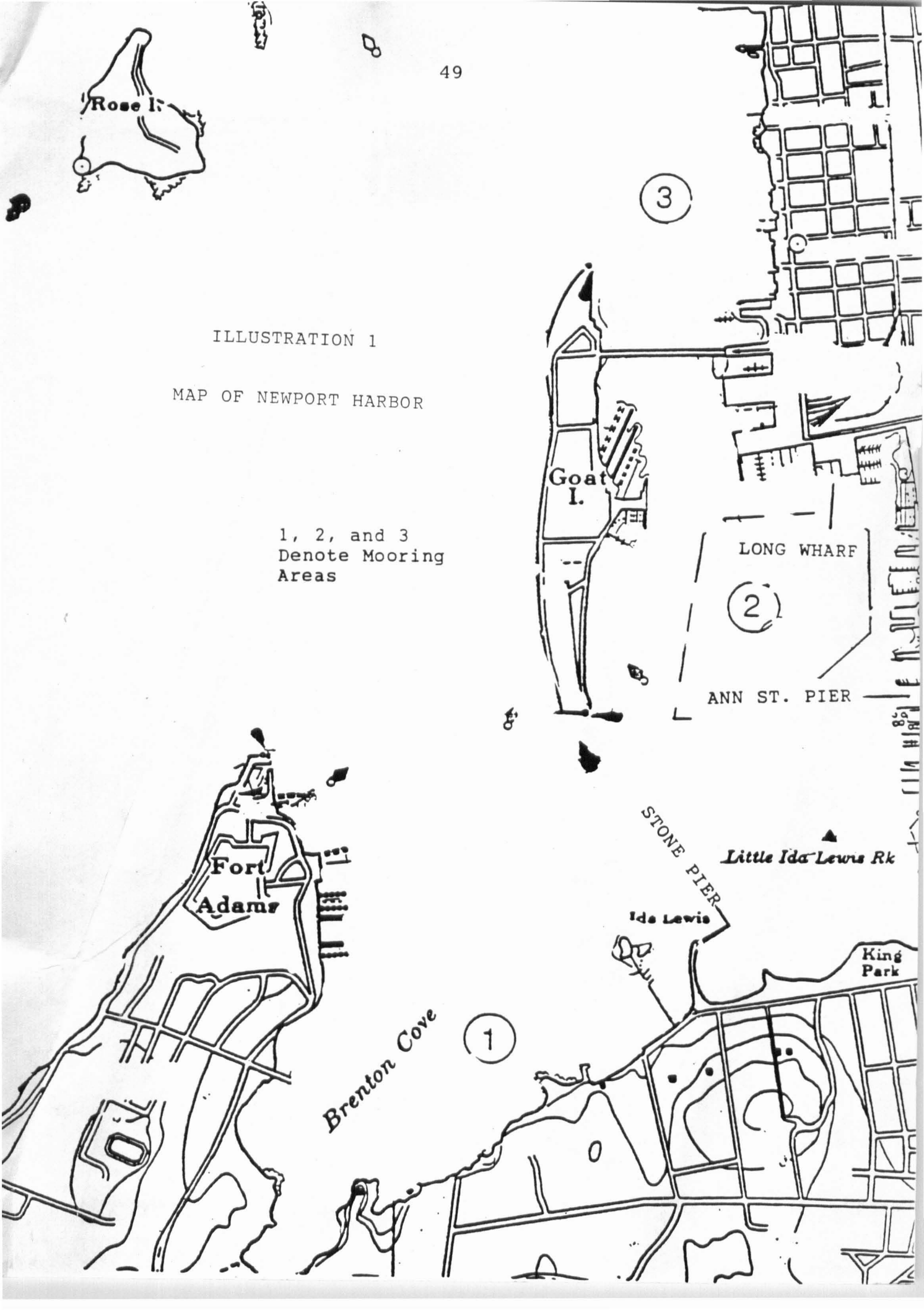




ILLUSTRATION 1

MAP OF NEWPORT HARBOR

1, 2, and 3
Denote Mooring
Areas



The proposed fourth site was a floating facility in Brenton Cove. Logistical problems prevented the development of this site and the idea was set aside for the initial season of the pilot project.

The final composition of disposal facilities was three land based sites. Each site consisted of a 4 yard dumpster, along with recycling facilities. The Ann St. and Long Wharf locations each had three recycling containers, two for mixed recyclables and one for newspaper. Mixed recyclables consist of milk and water jugs, soda bottles, aluminum soda cans, and tin and glass food containers. Stone Pier had a recycling box fabricated by Waste Management Inc. The box was a modified 4 yard dumpster with four recycling totes inside (Appendix G). Slots had been placed into the dumpster to insure easy disposal.

All of these sites were monitored twice a week to insure compliance with proper disposal practices. After initial contamination of the recycling bins at Ann St., signs were placed encouraging boaters to segregate their recyclables into the appropriate bins. The backs of the dumpsters which faced the harbor were clearly labeled "Harbor Area Trash" to help boaters locate the different sites. Signs were also posted stating what items were recyclable.

Data was gathered on the quantity of garbage and recycled material collected per week. The Harbormaster's office also kept a log on the type and amount of debris

which they removed from the harbor each week.

C. EDUCATION

The distribution of literature was the dominant method of education used by the project. A brochure entitled "Mariners Guide to Recycling in Newport" was written to inform boaters of what materials are recyclable in Newport, and where trash and recycling facilities were located. A brochure developed by several Rhode Island state agencies entitled "Some things Come Back to Haunt You" and a R.I. Sea Grant brochure, describing boaters' legal obligations were also used. Finally, posters developed by the R.I. Sea Grant and the CMC, depicting the effect of marine debris were also distributed.

The literature was distributed to the local marine stores, yacht clubs, and launch services listed in Table 4. This literature was restocked when necessary during the boating season.

SPECIAL EVENTS

The Marine Debris Project was also integrated with local sailing events. Brochures were distributed at "Sail Newport" to encourage boaters and sailing event visitors in Brenton Cove to use the City facilities. The Museum of Yachting participated in the program by encouraging participants to use recycling facilities during the Classic Yacht Regatta. The museum also included brochures in their mailings and distributed them

Table 4

LOCATION OF EDUCATIONAL LITERATURE DISTRIBUTION

Newport Yacht Club
Ann St. Pier
Old Port Launch Service
Custom's Department (Newport)
JT's Marine Store
Harbor Center Information
Armchair Sailor
Team One Marine Store
Museum of Yachting
Ida Lewis Yacht Club
New York Yacht Club
Sail Newport
Newport International Sailboat Show
Newport International Powerboat Show
Newport Harbormaster Department
Long Wharf Mooring Service
Newport Mooring Service

at the museum. Team One, a marine clothing and equipment store, included brochures in mailings to their local customers.

The Newport Yachting Center donated a booth for the project for both the Newport Sailboat and Powerboat shows. These two shows are the most important boat shows in the New England area, attracting visitors from throughout the region. Information on the Newport project and general information on marine debris were distributed free at the shows. Annex V placards and marine litter bumper stickers, were also distributed. The cost for these items was borne by Businesses Cleaning Newport.¹⁵⁴

Press releases were distributed during the summer months in order to inform and educate boaters of the program. A television release was broadcast on the local CBS affiliated news program "Six Live at Five" in conjunction with "Coastweeks" cleanup on September 21st.

Finally, the Harbormaster's office distributed information on the law and pilot project. The department was particularly active in cleaning floating debris from the harbor throughout the summer.

RESULTS

The following data was collected in Newport Harbor and may reflect the status of harbors with similar boating characteristics. Data was collected through three methods; survey, assessment of waste collection, and comparison of beach cleanup data.

A. SURVEY

The survey (Appendix F) asked sixteen questions, which were grouped into three categories; vessel information, refuse information, and planning information. Each question employed a simple fill in the blank or check off system of response. Questions were kept short to reduce the time required to complete the survey. Return postage was guaranteed to encourage a higher response rate. The survey was sent twice, once in late June and again in late September, to all private mooring holders in Newport. The June and September surveys were identical.

There was a potential for survey bias due to the self selection process of those surveyed who chose to respond and those who chose not to respond. Respondents may have been more environmentally conscious than those who did not respond. Non-respondents may be the largest contributors to debris in the Bay. Response rates and an analysis of whether respondents were representative of

the larger boating population in the harbor were used to test for any severe bias in the survey response.

Survey response rates varied from 45.7% for the June survey to 37.7% for the September survey. Since the survey was anonymous it is not known if the individuals who responded to the first survey also responded to the second, and whether all 37.7% who responded to the second survey also answered the first. As a result, a statistical test for two independent groups was the principal type of analysis.

Two statistical tests were employed. The Chi Square statistic was used to test for differences between the June and September responses. This test was also useful in interpreting the direction and magnitude of those responses which varied between the two surveys. The Student t test was used to test for differences in the means of sample and universal populations. This was useful in determining if the boating population which responded to the survey was representative of the total boating population surveyed. The SAS statistical program was used to compute the test results.¹⁵⁵

As enumerated in the Methodology section, fifteen questions were addressed. Each question is discussed below.

To what extent is the sample representative of the boating population in Newport Harbor?

Survey responses were categorized by type of vessel, sail or power, and size of vessel to test if they were representative of the total boating population in the harbor. This was done to both the June and September surveys. The size categories followed the regulatory requirements; under 26 feet not required to have a placard, 26-39 feet placard required, 40 feet and over placard and waste management plan required. Percentages were used in the analysis because of the different response rates to the two surveys.

For both surveys the response groups were representative in type and size of the boating population on private moorings in Newport Harbor. There were no statistically significant differences between the total boating population on private moorings in Newport Harbor and the June and September response group (Table 5).

What is the average amount of trash generated per person per day onboard a recreational vessel?

The last major study on the amount of trash generated by vessels was conducted by the National Academy of Sciences in 1975. Recently smaller projects have tried to analyze this question in individual harbors.¹⁵⁶

The Newport Marine Debris survey asked boaters to assess the quantity of trash generated, including bottles

TABLE 5

PERCENTAGE, BY TYPE AND SIZE, OF VESSELS ON PRIVATE
MOORINGS IN NEWPORT HARBOR (TOTAL, JUNE, SEPTEMBER)

| | <u>TYPE OF VESSEL</u> | | <u>SIZE OF VESSEL</u> | | |
|--|-----------------------|-------------|-----------------------|------------------|------------------|
| | <u>POWER</u> | <u>SAIL</u> | <u>0-25 FT.</u> | <u>26-39 FT.</u> | <u>40 FT. UP</u> |
| TOTAL | 22.32% | 77.67% | 39.20% | 51.36% | 20.62% |
| JUNE SURVEY RESPONSE | 20.2% | 79.8% | 30.45% | 57.6% | 11.93% |
| <u>N=</u> | 51 | 200 | 74 | 140 | 29 |
| <u>Student t Statistic</u> | (1.06) | (.02) | (-.24) | (.20) | (-.07) |
| SEPTEMBER SURVEY RESPONSE | 26% | 73% | 31.25% | 54.33% | 12% |
| <u>N=</u> | 54 | 152 | 65 | 113 | 25 |
| <u>Student t Statistic</u> | (.02) | (4.2) | (-.20) | (.09) | (-.07) |

and cans, per person per day onboard their vessel. Estimates were made by asking the respondents the amount of a trash bag filled per person per day. Answers were expressed as quarter full, half full, etc. A subsequent question asked what kind of trash bag was used.

In developing this question it was felt that boaters would be unable to quantify the amount of trash generated by weight or volume. Most people tend to measure quantity of trash in terms of the container in which it is stored. Assessing trash generated per person would be easier for the boater to determine by simply dividing a bag by the number of people on the boat. The number of gallons held by each type of bag was determined and an assessment of each individual's amount of trash generated based upon this information. The type of bag used was an integral part of this question. An answer of $\frac{1}{4}$ bag could have meant .75 gallons to 3 gallons. Without an answer to this section of the question the data was meaningless.

Estimated amounts ranged from .35 gallons per person to 13 gallons per person. The average amount of trash generated per person per day in the June survey was 1.6 gallons (Table 6). The average on the September survey was 1.33 gallons. The overall seasonal average totalled 1.41 gallons (1.22 lbs) of trash per person per day. This result falls within the range established by other surveys. The recently completed study on Nantucket estimated .74 lbs per day for four passengers and 1.48

lbs per day for 2 passengers per person per day.¹⁵⁷

However, this result is lower than the recent estimates conducted by the Eastern Research Group of 2.2 lbs per day.¹⁵⁸

How many days per year does a boater use their vessel?

The June results suggested an annual average use of 53 days. The September survey estimated an average use of 51 days per year.

This data is used to compute the average seasonal amount of trash generated per vessel. Knowing the supply of garbage it is then possible to estimate the capacity of garbage facilities necessary to handle the garbage created.

The June survey estimated that 1.6 gallons of trash was generated per person per day with an average of 3 people onboard (Table 6). Multiplying this by the amount of days the vessel is used yields an average seasonal trash generation rate.

The June survey estimated an average of 254.4 gallons of trash per vessel. The comparable September estimate totalled 198.9 gallons per boat.

Do you have an Annex V placard onboard?

One of the main objectives of the Newport Marine Debris Project was to inform boaters of MARPOL Annex V, the law relating to garbage disposal at sea. In so doing it was necessary to make boaters aware of their obligations under MARPOL Annex V. The main requirement

TABLE 6

MEAN OF VARIABLES (SIZE OF VESSEL, DAYS OF USE, HOURS OF USE, NUMBER OF CREW,
AMOUNT OF WASTE GENERATED) IN EACH SURVEY

| <u>JUNE SURVEY</u> | | | | | | |
|-------------------------|--|-----------------------|-----|-----|-------|--------------------|
| TOTAL OBSERVATIONS | VARIABLE | OBSERVATIONS/VARIABLE | MIN | MAX | MEAN | STANDARD DEVIATION |
| 252 | SIZE OF VESSEL | 243 | 13 | 70 | 29.69 | 8.17 |
| | DAYS OF USE/SEASON | 205 | 6 | 365 | 53.43 | 48.53 |
| | HOURS OF USE/TRIP | 205 | 1 | 504 | 31.53 | 63.26 |
| | NUMBER OF CREW | 208 | 1 | 12 | 3.33 | 1.40 |
| | AMOUNT OF WASTE/PERSON (in gallons/day) | 164 | .75 | 13 | 1.61 | 1.54 |
| <u>SEPTEMBER SURVEY</u> | | | | | | |
| TOTAL OBSERVATIONS | VARIABLE | OBSERVATIONS/VARIABLE | MIN | MAX | MEAN | STANDARD DEVIATION |
| 208 | SIZE OF VESSEL | 203 | 10 | 70 | 29.69 | 8.14 |
| | DAYS OF USE/SEASON | 169 | 8 | 365 | 51.24 | 46.44 |
| | HOURS OF USE/TRIP | 171 | 1 | 104 | 9.95 | 15.79 |
| | NUMBER OF CREW | 171 | 1 | 9 | 3.2 | 1.25 |
| | AMOUNT OF TRASH/PERSON (in gallons/day) | 172 | .35 | 13 | 1.33 | 1.29 |

for boaters is the placement of an Annex V placard on vessels 26 feet and over in length.

Although the Chi Square statistic used to analyze change in response between the first and second survey falls short of being statistically significant it does increase in the expected direction. That is, more boaters had the required Annex V placards onboard after the Marine Debris Project than did before the project (Table 7).

Among the boaters who were required to have a placard onboard, only 44% of the respondents in the first survey possessed one. The response rate increased to fifty five percent in the second survey; this is an increase of 11% over the June data.

Do you have a waste management plan onboard?

Written waste management plans are required on all vessels over 40 feet. A waste management plan may be as general as "all garbage will be taken ashore for disposal", or more specific such as "all paper products will be compacted, all cans and bottles will be separated for recycling etc."

Twenty percent of the boats surveyed were required to have a waste management plan. The majority of these boats did not comply with the regulation. Only 17% in the first survey and 16% in the second survey responded affirmatively to this question (Table 8). These changes are not statistically significant.

TABLE 7

PERCENTAGE OF VESSELS WITH A PLACARD
(BY VESSEL SIZE)

| VESSEL SIZE (IN FEET) | <u>JUNE SURVEY</u> | | <u>SEPT. SURVEY</u> | |
|--------------------------|--------------------|----------|---------------------|----------|
| | PLACARD INSTALLED | | PLACARD INSTALLED | |
| | YES | NO | YES | NO |
| 0-25 | 10 (12%) | 73 (88%) | 4 (6%) | 66 (94%) |
| 26 - 39 | 58 (41%) | 82 (59%) | 56 (50%) | 57 (50%) |
| 40 AND UP | 17 (59%) | 12 (41%) | 20 (80%) | 5 (20%) |
| 26 AND UP | 75 (44%) | 94 (56%) | 76 (55%) | 62 (45%) |

(CHI SQUARE STATISTIC
(X^2) = 1.68)

(CHI SQUARE STATISTIC
(X^2) = 2.84)

TABLE 8

PERCENTAGE OF VESSELS WITH WASTE MANAGEMENT PLANS
(BY VESSEL SIZE)

| VESSEL SIZE (IN FEET) | <u>JUNE SURVEY</u> | | <u>SEPT. SURVEY</u> | |
|--------------------------|-----------------------|-----------|-----------------------|-----------|
| | WASTE MANAGEMENT PLAN | | WASTE MANAGEMENT PLAN | |
| | YES | NO | YES | NO |
| 0-25 | 3 (4%) | 80 (96%) | 1 (1%) | 69 (99%) |
| 26 - 39 | 8 (6%) | 131 (94%) | 7 (6%) | 106 (94%) |
| 40 AND UP | 5 (17%) | 24 (83%) | 4 (16%) | 21 (84%) |

* DATA REFLECTS THE NUMBER OF SURVEY RESPONSES IN EACH CATEGORY

Does a placard influence overboard disposal?

A comparison was made between those who answered that nothing was acceptable for overboard disposal and those who listed one or more of the items on the survey as acceptable. It should be noted that the majority of boaters only considered food an acceptable item for overboard disposal (Table 9).

These data were analyzed from a variety of perspectives. Responses were analyzed by size group, pre survey only, post survey only, and pre versus post survey. The analysis suggests that no statistically significant differences exist between vessels which have an Annex V placard onboard and those which do not, with respect to overboard disposal.

Is one type of vessel, power or sail, more likely to discharge of garbage at sea?

This question arose because of the belief that power and sail boaters differ significantly in their behavior. Conversations with both groups indicated that sail boaters believe power boaters are to blame for most of the debris in the Bay. Similarly power boaters believe that since sail boaters are the majority in Newport Harbor they must be the greatest contributor to waste in the marine environment.

The data from the project does not indicate any statistically significant differences between the disposal practices of the two boating groups. None of

TABLE 9
 COMPARISON OF COMPLIANCE WITH MARPOL REQUIREMENTS BY BOAT OWNERS
 TO OVERBOARD DISPOSAL PRACTICES (BY VESSEL SIZE)

| <u>JUNE SURVEY</u> | | | | | | | | | |
|--|--------|----------|------------|----------|------------------|---------|----------|----------|--|
| BOAT LENGTH: LESS THAN 26 FEET | | | 26-39 FEET | | 40 FEET AND OVER | | TOTAL | | |
| PLACARD | YES | NO | YES | NO | YES | NO | YES | NO | |
| INSTALLED: | | | | | | | | | |
| ACCEPTABLE OVERBOARD | | | | | | | | | |
| WASTE | | | | | | | | | |
| FOOD WASTE | 4 (5%) | 45 (58%) | 27 (20%) | 42 (32%) | 9 (36%) | 6 (24%) | 40 (17%) | 93 (40%) | |
| CANS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| PAPER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| PLASTIC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| CIGARETTES | 1 (1%) | 1 (1%) | 0 | 2 (2%) | 0 | 0 | 1 (1%) | 3 (1%) | |
| NOTHING | 4 (5%) | 22 (28%) | 28 (21%) | 33 (25%) | 8 (32%) | 2 (8%) | 40 (17%) | 57 (24%) | |
| (CHI SQUARE STATISTIC (χ^2) = 3.48) | | | | | | | | | |

TABLE CONTINUED ON NEXT PAGE

TABLE 9 CONTINUED

SEPTEMBER SURVEY

| BOAT LENGTH: | LESS THAN 26 FEET | | 26-39 FEET | | 40 FEET AND OVER | | TOTAL | | |
|-----------------------------------|-----------------------|----------|------------|----------|------------------|---------|----------|----------|----|
| | PLACARD INSTALLED: | YES | NO | YES | NO | YES | NO | YES | NO |
| ACCEPTABLE OVERBOARD WASTE | | | | | | | | | |
| FOOD WASTE | 3 (4%) | 38 (56%) | 30 (27%) | 35 (32%) | 7 (29%) | 3 (13%) | 40 (20%) | 76 (37%) | |
| CANS | 0 | 3 (4%) | 1 (.1%) | 0 | 0 | 0 | 1 (.5%) | 3 (1%) | |
| PAPER | 0 | 0 | 0 | 0 | 0 | 1 (4%) | 0 | 1 (.5%) | |
| PLASTICS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| CIGARETTES | 2 (3%) | 2 (3%) | 2 (2%) | 2 (2%) | 0 | 2 (8%) | 6 (3%) | 4 (3%) | |
| NOTHING | 1 (2%) | 19 (28%) | 22 (20%) | 18 (16%) | 10 (42%) | 1 (4%) | 33 (16%) | 38 (19%) | |

(CHI SQUARE STATISTIC (X²) = 2.46)

* DATA REFLECTS THE NUMBER OF SURVEY RESPONSES IN EACH CATEGORY

** DUE TO SPARCITY CONSTRAINTS OF THE X² TEST THE DATA WAS COLLAPSED INTO TWO CATEGORIES
CATEGORIES ARE THE ANSWER NOTHING, ALL OTHER ANSWERS

the tests provided any significant differences between the two groups, including a separation by size of vessel (Table 10).

Is one type of vessel less likely to have a placard onboard?

The data were analyzed by comparing power vessels' response to the question of whether they possessed a placard in the June and September survey. No statistically significant differences were identified between the two surveys.

The same question was applied to sail boaters. This resulted in a statistically significant response for vessels over 26 feet (Table 11). Sail boaters account for the majority of the increase in vessels with placards onboard at the end of the pilot project.

Should the type of trash receptacle on a vessel be regulated?

Survey participants were asked what type of trash receptacle was used on their vessel. Questions had been raised in discussions of MARPOL Annex V regulations as to whether there should be a specified type of trash receptacle on different sized boats in order to encourage better trash disposal practices. This question is based upon the hypothesis that a boater's overboard disposal practice is influenced by the receptacle used to store waste. Further, it was hypothesized that vessels with no permanent receptacle would be more likely to throw their trash overboard.

TABLE 10
 TYPE OF VESSEL COMPARED WITH OVERBOARD DISPOSAL PRACTICES
 (BY VESSEL SIZE)

| <u>JUNE SURVEY</u> | | | | | | | | | |
|--|--------------------------|----------|--------------------|----------|-------------------------|----------|--------------|-----------|--|
| SIZE: | LESS THAN 26 FEET | | 26- 39 FEET | | 40 FEET AND OVER | | TOTAL | | |
| TYPE: | POWER | SAIL | POWER | SAIL | POWER | SAIL | POWER | SAIL | |
| ACCEPTABLE OVERBOARD | | | | | | | | | |
| WASTE | | | | | | | | | |
| FOOD WASTE | 13 (17%) | 36 (46%) | 8 (6%) | 61 (46%) | 4 (16%) | 11 (44%) | 25 (11%) | 108 (46%) | |
| CANS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| PAPER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| PLASTIC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GLASS | 2 (3%) | 0 | 0 | 0 | 0 | 0 | 2 (.8%) | 0 | |
| CIGARETTES | 1 (1%) | 0 | 0 | 2 (2%) | 0 | 0 | 1 (.4%) | 2 (.8%) | |
| NOTHING | 6 (8%) | 20 (26%) | 12 (9%) | 50 (38%) | 3 (12%) | 7 (28%) | 21 (8%) | 77 (33%) | |
| (CHI SQUARE STATISTIC (χ^2) = .004) | | | | | | | | | |

TABLE CONTINUED NEXT PAGE

TABLE 10 CONTINUED

SEPTEMBER SURVEY

| SIZE: TYPE: | LESS THAN 26 FEET | | 26-39 FEET | | 40 FEET AND OVER | | TOTAL | |
|-----------------------------|-------------------|----------|------------|----------|------------------|---------|----------|----------|
| | POWER | SAIL | POWER | SAIL | POWER | SAIL | POWER | SAIL |
| ACCEPTABLE OVERBOARD | | | | | | | | |
| WASTE | | | | | | | | |
| FOOD WASTE | 12 (19%) | 28 (42%) | 9 (8%) | 56 (51%) | 5 (21%) | 5 (21%) | 26 (12%) | 89 (44%) |
| CANS | 0 | 4 (7%) | 0 | 1 (1%) | 0 | 0 | 0 | 5 (2%) |
| PAPER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PLASTICS | 0 | 0 | 0 | 0 | 0 | 1 (4%) | 0 | 1 (.5%) |
| GLASS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CIGARETTES | 0 | 2 (3%) | 2 (2%) | 3 (3%) | 1 (4%) | 1 (4%) | 3 (2%) | 6 (3%) |
| NOTHING | 6 (9%) | 14 (21%) | 11 (10%) | 29 (26%) | 4 (17%) | 7 (29%) | 21 (11%) | 50 (25%) |

(CHI SQUARE STATISTIC (X^2) = 1.68)

* DATA REFLECTS THE NUMBER OF SURVEY RESPONSES IN EACH CATEGORY

** DUE TO SPARCITY CONSTRAINTS OF THE X^2 TEST DATA WAS COLLAPSED INTO TWO CATEGORIES FOR ANALYSIS, CATEGORIES ARE THE ANSWER NOTHING, ALL OTHER ANSWERS.

TABLE 11
COMPARISON OF COMPLIANCE WITH MARPOL REQUIREMENTS BY BOAT OWNERS
TO VESSEL TYPE (BY VESSEL SIZE)

| <u>JUNE SURVEY</u> | | | | | | | | | |
|--------------------|-------------------|----------|------------|----------|------------------|----------|----------|-----------|--|
| SIZE: | LESS THAN 26 FEET | | 26-39 FEET | | 40 FEET AND OVER | | TOTAL | | |
| PLACARD | YES | NO | YES | NO | YES | NO | YES | NO | |
| <u>INSTALLED:</u> | | | | | | | | | |
| <u>VESSEL TYPE</u> | | | | | | | | | |
| POWER | 4 (5%) | 18 (22%) | 1 (1%) | 12 (9%) | 6 (21%) | 2 (7%) | 11 (4%) | 32 (13%) | |
| SAIL | 6 (7%) | 54 (66%) | 57 (41%) | 70 (50%) | 11 (38%) | 10 (34%) | 66 (27%) | 134 (55%) | |

| <u>SEPTEMBER SURVEY</u> | | | | | | | | | |
|-------------------------|-------------------|----------|------------|----------|------------------|---------|----------|----------|--|
| SIZE: | LESS THAN 26 FEET | | 26-39 FEET | | 40 FEET AND OVER | | TOTAL | | |
| PLACARD | YES | NO | YES | NO | YES | NO | YES | NO | |
| <u>INSTALLED:</u> | | | | | | | | | |
| <u>VESSEL TYPE</u> | | | | | | | | | |
| POWER | 1 (1%) | 20 (29%) | 8 (7%) | 15 (13%) | 9 (36%) | 1 (4%) | 18 (9%) | 36 (17%) | |
| SAIL | 3 (4%) | 45 (65%) | 48 (43%) | 41 (37%) | 11 (44%) | 4 (16%) | 62 (30%) | 90 (44%) | |

(CHI SQUARE STATISTIC (X^2) FOR POWER VESSELS OVER 26 FEET = 0)
(CHI SQUARE STATISTIC (X^2) FOR SAIL VESSELS OVER 26 FEET = 4.6)

* DATA REFLECTS THE NUMBER OF SURVEY RESPONSES IN EACH CATEGORY

First, it was necessary to determine if there was any difference in type of trash receptacle based upon the size of the vessel. There was a statistically significant difference in the type of receptacle used by the three size categories in both the June and September survey (Table 12).

As expected, vessels under 26 feet were more likely to use a bag, bucket or some other form of receptacle. Vessels 26-39 feet were split on the use of a trash can or a bag only. It should be noted that if a respondent checked both trash can and bag in response to this question it was assumed that they were referring to a bag placed in a trash can. The majority of vessels over 40 feet used a trash can. Therefore, the data indicate that there is a difference in type of trash receptacle depending upon the size of the vessel.

In analyzing whether there was a difference based upon receptacle type in overboard disposal practice, the pre and post surveys were analyzed separately. No significant differences were found when comparing responses from the two surveys. This suggests that no relationship exists between the type of receptacle used and disposal practices upon a vessel.

Damage to vessels due to debris

Vessels are known to incur damage from debris, such as lines fouling a propeller or plastic bags sucked into an engine intake. An estimate of the frequency of this damage in Narragansett Bay was sought.

TABLE 12
 COMPARISON OF VESSEL SIZE WITH TYPE OF TRASH RECEPTACLE ON THE VESSEL (BY VESSEL SIZE)

| SIZE: | JUNE SURVEY | | |
|---------------------------|-------------------|------------|------------------|
| | LESS THAN 26 FEET | 26-39 FEET | 40 FEET AND OVER |
| TYPE OF RECEPTACLE | | | |
| TRASH CAN | 5 (7%) | 65 (46%) | 20 (69%) |
| BAG | 56 (77%) | 70 (50%) | 7 (24%) |
| BUCKET | 6 (8%) | 2 (1%) | 0 |
| COMPACTOR | 0 | 0 | 2 (7%) |
| NONE | 5 (7%) | 0 | 0 |
| OTHER | 1 (1%) | 3 (2%) | 0 |

(CHI SQUARE STATISTIC (χ^2) =51.25)

TABLE CONTINUED ON NEXT PAGE

TABLE 12 CONTINUED

SEPTEMBER SURVEY

| SIZE: | LESS THAN 26 FEET | 26-39 FEET | 40 FEET AND OVER |
|---------------------------|-------------------|------------|------------------|
| TYPE OF RECEPTACLE | | | |
| TRASH CAN | 3 (5%) | 53 (47%) | 18 (72%) |
| BAG | 49 (77%) | 53 (47%) | 6 (24%) |
| BUCKET | 10 (16%) | 5 (5%) | 0 |
| COMPACTOR | 0 | 0 | 1 (4%) |
| NONE | 1 (2%) | 0 | 0 |
| OTHER | 1 (1%) | 1 (1%) | 0 |

(CHI SQUARE STATISTIC (X^2) = 49.52)

* DATA REFLECTS THE NUMBER OF SURVEY RESPONSES IN EACH CATEGORY

** DUE TO THE SPARCITY CONSTRAINTS OF THE X^2 TEST THE DATA WAS COLLAPSED INTO THREE CATEGORIES, CATEGORIES ARE TRASH CAN, BAG, ALL OTHER RESPONSES

Twenty two percent of the June respondents had incurred damage from floating debris. Damage estimates ranged from \$0, merely requiring the obstruction be removed, to \$1,500. The mean of these estimates was \$122.72 for the June survey. Twenty one percent of the September respondents had incurred damage due to debris. Cost once again ranged from \$0 to \$2,000 with a mean of \$178.57 (Table 13).

The majority of respondents indicated that encounters with debris did not result in any monetary loss. Only 8.7% of the respondents to the first survey and 6.7% in the second survey, indicated that damage had resulted in monetary loss to the owner.

Would you recycle if facilities were available on shore?

Increasing attention has been paid to the problem of waste management in the U.S. In response, Rhode Island has instituted mandatory recycling in the home and business.¹⁵⁹

Recycling facilities at the shore are just beginning to be instituted around the nation. Boater response to these facilities has in general been very positive. In areas where recycling has already become a habit at home and work, boaters have been particularly receptive to transferring these practices to the shore.

This also appears to be the case in Newport. The majority of respondents, 89% in both surveys, indicated that they would recycle if this option was available to

TABLE 13

VESSEL DAMAGE ESTIMATES

| <u>JUNE SURVEY</u> | | <u>SEPTEMBER SURVEY</u> | |
|------------------------|--------------------|-------------------------|--------------------|
| <u>Cost of Damage*</u> | <u># Responses</u> | <u>Cost of damage</u> | <u># Responses</u> |
| \$0 | 33 | \$0 | 28 |
| \$50 | 4 | \$50 | 2 |
| \$100 | 2 | \$100 | 4 |
| \$150 | 2 | \$150 | 0 |
| \$200 | 7 | \$200 | 2 |
| \$250 | 0 | \$250 | 1 |
| \$300 | 2 | \$300 | 0 |
| \$350 | 1 | \$350 | 1 |
| \$500 | 1 | \$500 | 1 |
| \$700 | 1 | \$700 | 0 |
| \$1,000 | 1 | \$1,000 | 0 |
| \$1,500 | 1 | \$1,500 | 1 |
| \$2,000 | 0 | \$2,000 | 2 |
| MEAN COST | \$122.72 | MEAN COST | \$178.57 |

*Cost estimates reported by survey respondents

TABLE 14

PERCENTAGE OF SURVEY RESPONDENTS WILLING TO USE
RECYCLING FACILITIES AT THE SHORE IF THEY ARE AVAILABLE

| <u>JUNE SURVEY</u> | | <u>SEPTEMBER SURVEY</u> | |
|--------------------|-------------|-------------------------|-------------|
| No | 22 (10.6%) | No | 27 (11.1%) |
| Yes | 186 (89.4%) | Yes | 217 (88.9%) |

them (Table 14). Most of those who responded in the negative cited the problem of limited space on their vessel, with little room to store two bags of trash.

Many boaters used the recycling bins placed around Newport Harbor during the pilot project. However, visual checks of trash dumpsters revealed that more items could have been separated out of the waste stream and recycled.

Where do you sail your boat?

Boaters were asked to provide information on the areas in which they use their boat, and what percentage of their boating time was spent in each area. If Narragansett Bay was listed as the area where 75% or more of the sailing time was spent, then the vessel was considered to sail extensively on the Bay. On average 71% of the boaters, in Newport, use the Bay for the majority of their boating time.

What is the best method to encourage shoreside disposal?

Boaters were asked what they felt was the best way to encourage shoreside disposal of garbage. The majority, in both surveys, stated that dockside disposal facilities were the most important element in promoting the return of garbage to shore. Magazine or newspaper articles, posters, fines or penalties, and word of mouth, all received a similar percentage of responses. Brochures were ranked low on the list, with presentations ranked the lowest (Table 15). There were no statistically significant changes in response between the June and September surveys.

TABLE 15

PERCENTAGE OF SURVEY RESPONSES TO WHAT IS THE
BEST METHOD TO ENCOURAGE SHORE SIDE DISPOSAL OF TRASH

| METHODS | <u>JUNE SURVEY</u> | | <u>SEPTEMBER SURVEY</u> | |
|-------------------|--------------------|-------------|-------------------------|-------------|
| | <u>%</u> | <u>RANK</u> | <u>%</u> | <u>RANK</u> |
| DOCKSIDE DISPOSAL | 221 (38.6) | 1 | 175 (40.1) | 1 |
| BROCHURES | 45 (7.9) | 6 | 38 (8.7) | 6 |
| MAG/NEWS ART. | 65 (11.3) | 4 | 53 (12.1) | 3 |
| PRESENTATIONS | 17 (3.0) | 7 | 11 (2.5) | 7 |
| POSTERS | 74 (12.9) | 2 | 61 (14.0) | 2 |
| FINES/PENALTIES | 71 (12.4) | 3 | 50 (11.4) | 4 |
| WORD OF MOUTH | 64 (11.2) | 5 | 44 (10.1) | 5 |
| OTHER | 15 (2.6) | 8 | 05 (1.1) | 8 |

(CHI SQUARE STATISTIC (χ^2) = 4.02)

Have you seen any information on marine debris?

When asked whether they had seen any information on marine debris and what kind, the majority of respondents stated they had read a magazine or newspaper article. The newspaper category represented 25.58% of the responses in the June survey (Table 16). However, this percentage fell in the September survey to 23%. This reduction in response is in spite of press releases sent to local newspapers and regional boating magazines.

The most effective way to encourage recycling appears to be through the use of brochures. An increase, of more than 6%, in the number of people who had seen information on marine debris in this form was recorded between the two surveys. This is ironic since brochures were ranked low as an effective method of encouraging shoreside disposal.

Although the newspaper and magazine articles were ranked the highest in responses in both the pre and post survey, the percentage of individuals who had seen information in this form fell in the second survey. This occurred in all categories except advertisement, poster and brochure.

Although more boaters had seen information on marine debris after the pilot project, the change fell short of being statistically significant.

TABLE 16

EDUCATIONAL MATERIALS SEEN BY SURVEY RESPONDENTS

| | <u>JUNE SURVEY</u> | | | <u>SEPT. SURVEY</u> | | |
|------------------------------|--------------------|----------|-------------|---------------------|----------|-------------|
| | | <u>%</u> | <u>RANK</u> | | <u>%</u> | <u>RANK</u> |
| EDUCATIONAL MATERIALS | | | | | | |
| ADVERTISEMENT | 41 | (8.7) | 5 | 37 | (9.3) | 6 |
| MAG ARTICLE | 121 | (25.6) | 1 | 92 | (23.1) | 1 |
| BROCHURE | 23 | (4.9) | 9 | 45 | (11.3) | 2 |
| PRESENTATION | 15 | (3.2) | 12 | 10 | (2.5) | 11 |
| FRIEND | 46 | (9.7) | 4 | 38 | (9.5) | 5 |
| RADIO | 16 | (3.4) | 10 | 12 | (3.0) | 10 |
| T.V. | 56 | (11.8) | 2 | 42 | (10.5) | 3 |
| POSTER | 27 | (5.7) | 8 | 32 | (8.0) | 7 |
| BUMPER STICKER | 35 | (7.4) | 6 | 24 | (6.0) | 8 |
| OTHER | 16 | (3.4) | 11 | 07 | (1.8) | 12 |
| NO (as answer) | 49 | (10.4) | 3 | 39 | (9.8) | 4 |
| NO ANSWER GIVEN | 28 | (5.9) | 7 | 21 | (5.3) | 9 |

(CHI SQUARE STATISTIC (χ^2) = 17.36)

B. DISPOSAL SITESAMOUNT1990

Two 4 yard dumpsters were available for collection of boater trash in 1990. The Ann St. Pier dumpster was collected twice a week, and the Harbormaster dumpster was collected once a week.

The City was capable of collecting 12 cubic yards of trash a week in 1990. Assuming that the dumpsters were full upon pickup, over a three month period the City had the ability to collect 144 cubic yards (12.6 tons) of boater waste (Table 17). Reports from the boating public and Harbormaster indicate that the dumpsters were generally overflowing at pickup.

1991

During the Pilot Project trash and recycling receptacles were checked weekly before pick-up to assess the amount of trash collected. This allowed a computation of the amount of trash collected in 1991.

Much of the waste stream from a boat consists of beverage bottles and cans. These items are heavy and increase the weight of recyclable material. The boaters' waste stream is not as full of bottles and cans as the commercial waste stream, e.g. bars and restaurants, but has more of these items than the average household. Therefore, the boater recycling weight is an average of the commercial and residential recycling weight (Table 17).

In total 152 cubic yards of trash, and 38.1 cubic yards of recyclables were collected over the three months. The 190.1 cubic yards of trash and recycling collected are equivalent to 17.7 tons of trash (Table 17).

Recycling constituted 20% of the total by volume and 25% of the total by weight. Although this is more than the 13% of recyclables generally extracted from the Newport solid waste stream, it was obvious from visual observation of the bins that a larger percentage of recyclables could have been segregated by the boater.

The 1991 totals represent an increase of 5.1 tons, or 40% over the amount of trash collected in 1990.

COST

A major concern of the Newport City Manager was the cost of new facilities and an increased trash load. The project was successful in increasing the amount of trash brought ashore at little extra cost to the City. During the three months of the project the City of Newport paid \$1,528 for trash hauling and removal of boater trash. This is an increase of \$247 for the removal of 40% more trash than in 1990 (Table 18).

C. BEACH CLEANUP DATA

A comparison of the 1990 and 1991 Newport beach cleanup results was proposed for this thesis. Many factors contributed to the failure of this aspect of the project.

First Hurricane Bob deposited a significant amount of debris into the Bay which may not have been generated by boaters. Inland debris was picked up and deposited into the bay, and damaged boats contributed quantities of unusual debris. Most boaters do not throw the interior cushions of their boats overboard, but as a result of sinkings some of these items washed up on R.I. beaches. Large pilings were also found through out the bay as docks were lifted off by the tide, or the weight of a vessel caused it to break free. Many of these items found their way into Newport Harbor. For weeks after the hurricane, there were reports of large pieces of debris floating into the harbor.

Secondly, the Coordinator of the Newport Beach Cleanup, upon review of the harbor area, felt that the few participants in the cleanup would be more effective in concentrating their efforts on First Beach, located on the ocean side of Newport. The 1990 data were largely collected from around Newport Harbor. The Coordinator of the beach cleanup stated that the few volunteers who cleaned the harbor beaches commented on the lack of bottles and cans; estimating an 80% reduction of these items alone.

TABLE 17

AMOUNT OF TRASH COLLECTED

WEIGHT ESTIMATES(*)

| | |
|------------------------|-------------------------|
| RESIDENTIAL TRASH- | 175 pounds/cubic yard |
| RESIDENTIAL RECYCLING- | 145 pounds/cubic yard |
| COMMERCIAL RECYCLING- | 320 pounds/cubic yard |
| BOATER RECYCLING(**)- | 232.5 pounds/cubic yard |

1990

| <u>SITE</u> | <u>PICK UP</u> | <u>FACILITIES</u> |
|---------------|----------------|-------------------|
| Harbormaster- | 1xwk (4 | yard dumpster) |
| Ann St. Pier- | 2xwk (4 | yard dumpster) |

COLLECTION

12 cubic yards/wk times 3 months= 144 cubic yards
 144 cubic yards times 175 pds/cubic yard= 25200 pds.
 25200 pds divided by 2,000 pds/ton = **12.6 tons collected**

1991

| <u>SITE</u> | <u>PICK UP</u> | <u>FACILITIES</u> |
|---------------|----------------|--------------------------------------|
| Harbormaster- | 1xwk (4 | yard dumpster, 3 (95 gallon) toters) |
| Ann St. Pier- | 1xwk (4 | yard dumpster, 3 (95 gallon) toters) |
| Stone Pier- | 1xwk (4 | yard dumpster, 4 (95 gallon) toters) |

COLLECTION

TRASH- 152 cubic yards collected
 152 times 175 pds/cubic yard= 26600 pds
 26600 pds divided by 2,000 pds/ton= **13.3 tons trash**

RECYCLING- 81 toters collected
 81 times 95 gallons= 7695 gallons
 7695 gallons divide by 201.96 gallons/ cubic yard= 38.1
 cubic yards
 38.1 times 232.5 pds/cubic yard= 8858.25 pds
 8858.25 pds divided by 2,000 pds/ton= **4.4 tons recycled**
TOTAL- 17.7 tons collected

DIFFERENCE BETWEEN 1990 and 1991- 5.1 tons (40% increase)

RECYCLING- 25% of total by weight
 20% of total by volume

*Weights based upon tests conducted by Waste Management of Rhode Island Inc.

**Estimate (see text)

TABLE 18

COST OF COLLECTION

1990Dumpster Rental and Pickup

\$723 (1xwk Harbormaster, 2xwk Ann St.)

Disposal Cost

\$13.98 tip + \$24.91 haul = \$38.89/ ton

\$38.89 times 12.6 tons = \$490

Extra Pickups (3) = \$67.5

TOTAL = \$723 + \$490 + \$67.5 = \$1,280.51991TRASHDumpster Rental and Pickup

3 (4 yard) dumpsters

1xwk = \$180/ month

\$180 times 3 months = \$810

Disposal Cost

\$15.03 tip + \$26 haul = \$41.03

13.3 tons times \$41.03 = \$545.70

Extra pickups (3) = \$67.50

RECYCLEToter Rental and Pickup

Donated

Disposal Cost

\$0 tip + \$23.80 haul = \$23.8

4.4 tons times \$23.8 = \$104.72

TOTAL = \$810 + \$545.7 + \$104.72 + \$67.50 = \$1,527.92**COST DIFFERENCE = \$247.42**

ANALYSIS

The Rhode Island Marine Debris Pilot Project tests the hypothesis that education on the environmental consequences of garbage disposal at sea, as well as convenient shoreside garbage and recycling facilities, will influence recreational boaters to bring more trash ashore for disposal.

A pilot project was developed in Newport Harbor to test this hypothesis. The results of the project will be analyzed below.

A. PLACARDS

The June survey was used to determine recreational boaters knowledge on the issue of marine debris and served as the baseline data on which the Rhode Island Marine Debris Pilot Project was tested. Specific questions relating to recreational boaters' knowledge and compliance with the law were answered by the collected data. This information may be used in future planning situations.

Under Coast Guard regulations, placards are required on vessels 26 feet and over in length. The pilot project sought to inform boaters of this requirement through a variety of methods. Brochures were distributed throughout the marine community which enumerated the placard requirements. Press releases also conveyed the

message. Signs displayed at boat shows stated the need for a placard, and placards were distributed for free.

The effort to educate the boating public of the placard requirement was largely successful. Although the change in response between the surveys fell short of being statistically significant, it does increase in the expected direction. That is, more boaters had the required Annex V placards onboard after the Marine Debris Project than did before the project.

The Coast Guard instituted the placard requirements because they believed the placard would serve as a source of information to those visiting a vessel, and act as a constant reminder of the law to those using the vessel. The survey data indicates that boaters seem to have already formed their own opinions as to what is acceptable for overboard disposal and the presence of a placard does not influence that disposal practice. This does not mean that the placards are ineffective. This survey only asked boat owners of their disposal practice. The placard may be effective in influencing the decisions of those who do not own a boat or are not regularly on the water.

In order to achieve higher compliance with regulations it may be necessary to target educational material at one specific type of boater. Sail boaters account for the majority of the increase in vessels with placards at the end of the pilot project. The

educational element of the program was therefore most successful amongst the sailboat community. Distribution of educational material and press releases should have reached both boater types equally. The causes of this discrepancy can only be speculated upon.

The two local marine stores may have been more effective in reaching the sailing community. Power boaters may be less likely to buy or need items from these stores.

Information distributed at the Sailboat and Powerboat shows may also have contributed to this lopsided effect. The two shows were very different in terms of size and number of entrants. The powerboat show was much smaller, and had low gate entrance due to bad weather during the first three days of the show. Whether these factors affected power boaters exposure to educational information on marine debris or whether these boaters, even if exposed to the information, chose to ignore the information cannot be determined.

Education of boaters concerning the waste management plan requirements on vessels over 40 feet, was not successful. Compliance with this regulation was low amongst the boaters surveyed. The double requirements of a placard and a waste management plan for this vessel size could have an effect upon compliance. One commentator put it quite succinctly: "Waste Management Plan? Stupid! Insane!" Unfortunately these words seem to sum up boaters' feelings toward this requirement.

B. EDUCATION

Education of the public is considered a primary element in the eventual reduction of marine debris. The pilot project attempted to distribute information to the boating community by many different means; some of these efforts were more successful than others.

Posters and brochures were distributed to local yacht clubs. Marinas were not included in the distribution of information because of objections raised by the City of Newport. The City was concerned that if marina residents were informed of the City facilities, marina owners would encourage boaters to use the City disposal facilities instead of those provided by the marina. This would increase the City garbage load and reduce the marinas' costs.

Brochures were also distributed to the commercial launch and mooring services in the harbor. Old Port Marine, the largest commercial operator in the harbor, was asked to distribute brochures on their launches. Although the management of the company was amenable to this idea, it was impossible to force launch drivers to distribute the brochures. They were often placed under the steering console where they were not visible to the boater and eventually became waterlogged and useless. A solution to this problem would be to have a plastic holder on the launch in which brochures were placed, or to laminate a brochure for display on the launch.

The Harbormaster office used both verbal and written information to inform boaters of the project. The department passed on information upon request, but failed to integrate the information into a general message to boaters entering Newport. Time constraints proved to be the major deterrent to this type of information dispersal. Questions raised by boaters were answered as concisely and quickly as possible so that the Harbormaster could answer other calls and continue other duties.

A lecture series on marine debris was proposed for the pilot project. This series was to be presented to yacht clubs and other interested groups. The results of the first survey showed that a lecture series would be highly ineffectual. Presentations received the least response as an effective form of encouraging boaters to bring their trash ashore. Discussions with boaters revealed that the last thing a boater wanted to do in the summer was to hear a lecture about boating when they could actually be out boating. Therefore this idea was shelved for the summer, but could prove effective during the winter months.

Information on marine debris was integrated into a series of community events. The Museum of Yachting, which sponsors the Classic Yacht Regatta, included brochures on recycling in Newport with the race registration package. They also provided race

participants with recycling facilities throughout the race weekend. Sail Newport, the sponsor of many local racing events, was also provided with brochures to distribute to their members and participants in yachting events.

Local marine related businesses were asked to display brochures and posters on the issue of marine debris. This proved to be an effective place to distribute information because the majority of customers in these businesses are boaters. Brochures at many of these stores were restocked three or four times throughout the summer.

Press releases were made to local newspapers and regional boating journals. A basic press release is in Appendix H. Four articles on the program were published in local newspapers and regional boating magazines shown in Appendix I. The local press was very willing to publish articles on the project, and a regional boating newspaper followed the project closely throughout the summer.

According to the survey results not all of these efforts were equally effective. Brochures were rated low as a method of encouraging shoreside disposal in both surveys, yet more brochures were seen by boaters, changing from a ranking of 9th in the June survey to 2nd in the September survey. Magazine articles which are rated high as a means of information dispersal saw little change in educational response due to the project.

This confusing result could be due to the language used in the questions. One question asks what is the most effective method of encouraging shoreside disposal, while another asks what educational material the boater has seen. Respondents did not correlate education with shoreside disposal; therefore the difference in response to each question.

C. DISPOSAL SITES

Three sites were available for disposal of boater trash during the pilot project; Ann St., Stone Pier and Long Wharf. Each site consisted of a 4 yard dumpster and receptacles for recycling. Recycling at Ann St. and Long Wharf consisted of three recycling totes, at Stone Pier a special recycling box designed and fabricated by Waste Management Inc. of Rhode Island was available (Appendix G).

Trash and recycling containers were emptied once a week. This insured that dumpsters and recycling bins were as full as possible when picked up. Dumpsters were monitored to make sure that they were not overflowing, and special pickups arranged when this occurred.

Waste Management Inc. of Rhode Island is the city contracted trash hauler, and as such was responsible for the removal of both trash and recycling materials. An initial pickup schedule, for both trash and recycling, was set for Saturday morning. Saturday was chosen so

that trash receptacles would be empty at the beginning of the weekend. Many boaters come to Newport for the weekend or use their boats exclusively on weekends. Therefore this is when the majority of trash is generated and disposed of.

Unfortunately this schedule never took hold. City trash is traditionally picked up on Monday morning. The Saturday pickup resulted in two separate loads of municipal trash. This trash is collected and hauled at a lower rate than commercial waste; therefore it was necessary to have all City waste placed in the same load. Pickup was erratic during the first three weeks. This problem was resolved when pick-up was changed to Monday.

The three trash sites were monitored before each pickup to assess the amount of trash collected. In general the trash dumpsters were always full upon pickup. The recycling facilities varied per pickup, although during the month of August they were consistently full.

The 1991 totals represent an increase of 5.1 tons, or 40% more trash collected than in 1990. This is a significant increase in the amount of trash brought ashore by boaters. While many factors could have influenced boaters trash disposal habits, none are as significant as the pilot project.

COST

A major concern of the Newport City Manager was the cost of new facilities and an increased trash load. The City of Newport pays a tip fee per ton of trash to the state landfill authority. The landfill has placed a cap on the amount of trash which the City may haul to the landfill each year. If this cap is exceeded the City must pay a higher tip fee per ton. The City of Newport was concerned that the collection of more trash from boaters would result in their exceeding this cap. Negotiations with the City were conducted to alleviate concerns over this issue.

A key element in the reduction of this concern was the donation of recycling totes and pickup for the project by Waste Management Inc. of R.I. Without the support of this group the City would never have agreed to the increased cost of the Marine Debris Project.

The extra 5.1 tons was almost equalled in weight by the amount of recyclables separated from the waste stream thereby reducing the hauling cost. This is important evidence in the argument for recycling in all Rhode Island waterfront communities. Recycling is an effective method of increasing the amount of waste brought ashore with little additional cost to a municipality. If boaters know that they would find trash and recycling facilities in every harbor in Rhode Island, the amount of boater waste brought ashore could be significantly increased.

DISPOSAL SITE PROBLEMS AND SUCCESSES

The success of each site depended largely on its location (Illustration 1 shows the site locations). The Long Wharf site located near the Harbormaster office was mainly used by the Harbormaster department. Recyclables and trash picked out of the harbor were separated and placed in their respective cans. The dumpster at this site was heavily used but the recycling bins located around the corner from the dumpster were not. Boaters who were going to recycle generally used the Newport Yacht Club facilities.

A problem with this site is that there are no public dinghy docks in the area. If the City proceeds with plans to develop Long Wharf as a municipal marina, disposal facilities in this area will be very important. However, if the site continues to hold small fishing boats then there is no need for recycling at Long Wharf.

The Ann St. Pier site was plagued with problems. This area receives heavy tourist traffic because it is one of the only piers where the public can gain visual access to the harbor. The recycling totes at this location were often used as garbage cans, leading to contamination of the recycled material by ice cream and beverage containers. There was also a tendency for boaters to be lazy and place their trash in a tote instead of in a garbage dumpster.

Ann St. Pier was the only site which required extra

dumpster and recycling pickups. Since this was the most familiar disposal site to visitors in the harbor extra dumpster pickups were required during holiday or special event weekends. Extra recycling pickup was required once due to a problem with local businesses using the site. One of the City's concerns at the beginning of the project was an ongoing problem with local businesses using the Ann St. Pier dumpster to dispose of their trash. The City did not want to make a habit of collecting commercial trash at this location. All businesses in the Ann St. area were asked to cooperate with the project and be responsible for the disposal of their own trash. It was explained that continued contamination of the City dumpsters by commercial trash would lead to the removal of these facilities and therefore the elimination of the Marine Debris Project. As most of these businesses are located on the waterfront and realize the benefits of a cleaner harbor, they pledged to cooperate. Unfortunately, one restaurant did not convey this message to their busboys, who were consistently throwing liquor bottles in the Ann St. bins, filling them in one night. Once the problem was explained to the manager of the restaurant the practice ceased.

The problems at Ann St. are reflective of the heavy use this site receives. Ann St. is the only dinghy dock near the downtown Newport shopping area; therefore it is

an important site for visitors in Newport Harbor. Visitors are less likely to be aware of the proper method of trash disposal in Newport, leading to a lower compliance rate at these facilities.

Stone Pier was the most successful of all of the sites. This site is located at Kings Park where there is a free dinghy dock. This was a convenient site for transients and live aboards as the anchorage is just to the north. This was also the closest area for those mooring their boat in Brenton Cove. The special recycling box used at this site was a success. The color of the box, which was painted white, helped avoid confusion with the garbage dumpster. Whole bags of recyclables would not fit down the slot so that contamination could not occur in this manner. Comments were received, such as: "I have never seen Kings Park looking cleaner" and "I travel all the way across the harbor to use these facilities because they are cleaner, and you have to be an idiot to not figure out where to put something." The boaters who used the launch ramp at Stone Pier were also aware of the dumpster and recycling box, which led to more trash separated on the water.

D. HARBOR DEBRIS

Throughout the summer the amount and type of debris was dependent upon the events occurring in the harbor. During the Jazz festival there was a plethora of balloon

pieces from water balloon fights. Condoms and Tampon applicators were found throughout the summer but were most prevalent after heavy rains. Six pack rings, pieces of plastic, and plastic bottles used as lobster buoys were the most common items found. Styrofoam coffee cups and plastic fishing gloves were common around the three fishing piers. Bait barrels were found floating in the harbor throughout the summer. The debris in Newport Harbor came from a variety of sources with no one source appearing to be predominant.

Daily observation of debris noted a reduction in floating bottles and cans throughout the summer. In the beginning of the summer approximately 20 bottles a day would be collected in the harbor. By the end of the summer the quantity had been reduced to 4 or 5 a week. Plastic pieces remained a problem throughout the summer. Plastic debris would float with the wind and current, into and out of the harbor each day. If this debris was not picked out of the water, or stranded on the beach, the process would continue ad infinitum.

When a North West wind blew, debris flowed into Newport from the upper reaches of the Bay. The prevailing breeze during the summer months is from the South West. This pushed debris in the harbor into the North Eastern corner, where the Harbormaster office is located.

Much of the debris scooped out of the water during the summer was caught in the floating eelgrass which is constantly uprooted from the shallow areas of the harbor by the wind and tide. Plastics would float amongst or just below a layer of eelgrass. Every day the Harbormaster Department scooped buckets of eelgrass and plastics from around the Harbormaster docks.

Quantifying this debris would have been impossible, taking hours of painstaking work. Instead, eelgrass and debris were both collected and placed into a dumpster. Approximately one large garbage can of eelgrass and debris was filled per day. The majority of debris collected in this manner were plastic.

Hurricane Bob also influenced the amount of debris seen in Newport Harbor. Debris on the shoreline, which was not generally immersed by the tide, was lifted off by the storm surge and proceeded to float in and out on the tide. Large debris slicks were also observed in the East Passage of the Bay. Much of this debris was material which had accumulated on the shore but had never been immersed; in effect we were seeing years of accumulated beach debris washed into the Bay during the hurricane.

CONCLUSIONS

Sailors' unwanted wastes have traditionally been discarded at sea. Although twentieth century technology has created materials which are durable and resistant to weathering processes, this practice has not changed. The result has been an increase in the amount of plastic debris washed ashore each year.

It is difficult to walk the beach in Rhode Island without encountering some discarded evidence of human presence. Rhode Island shores are subject to debris from a variety of sources; from land based recreational activities and sewage outfalls, to commercial fishing and recreational boating. The enclosed nature of Narragansett Bay confines this debris to Rhode Island shores.

Of the many user groups on the Bay, the recreational boating fleet is one of the largest in number. It was assumed that this group must contribute in part to the problem of marine debris in the Bay.

It was hypothesized that recreational boaters would bring more trash ashore if convenient disposal sites for trash and recycling were made available to the boater. It was also hypothesized that if boaters were educated of the environmental consequences of garbage disposal at sea and the law applying to these actions, overboard disposal would decrease. A minor hypothesis tested whether

compliance by the boating public with the regulatory requirements of the law would increase with education.

A pilot project was developed in Newport Harbor to test these hypotheses. The objective of the project was to reduce the amount of garbage disposed of at sea and consequently, reduce the harmful effects of debris in the marine environment. This objective was met by the Marine Debris Project.

There was a significant increase in the amount of trash brought ashore by recreational boaters during the pilot project. Harbor trash collection rates increased 40% over the boating season prior to the project. A correlated reduction in floatable debris, specifically bottles and cans, was also observed although not statistically tested and verified.

This reduction can be attributed to the institution of shoreside recycling facilities. These facilities were heavily used by Newport boaters, collecting 4.4 tons of recyclables, during the pilot project. Collected recyclables were almost equal, in weight, to the extra amount of trash collected during the pilot project. The lower cost of recycling disposal allowed this extra trash to be collected at little extra cost to the City.

Distribution of educational literature, on the topic of marine debris, to recreational boaters was also successful. Educational activities resulted in an increased compliance rate with regulatory requirements,

and an increased knowledge of the detrimental effects of marine debris in the environment. The results of the Marine Debris Pilot Project support the belief that education is an integral aspect in the change of behavior on environmental issues.

The results of the pilot project accept the research hypothesis. The combination of an increased number of disposal facilities in Newport Harbor with convenient recycling available at each site, and the institution of an educational campaign targeting recreational boaters did result in a reduction in marine debris and an increase in trash brought ashore.

The methods employed by the Rhode Island Marine Debris Pilot Project are not difficult to implement, and are not costly to a municipality. The benefits to the environment and the local economy from reduction in marine debris are numerous; endangered marine animal populations are not further depleted, fisheries stocks are no longer lost from possible commercial harvest, and tourism dollars are increased due to a cleaner, healthier environment.

A. RECOMMENDATIONS

The Rhode Island Marine Debris Pilot Project was successful in meeting the first year goals. Further improvements are necessary to build upon this success. The following recommendations will help the project achieve a new set of goals.

Specific recommendations for Newport Harbor include the development of the proposed floating site in Brenton Cove. This area of the harbor is still lacking trash disposal facilities for the recreational boater. Another recommended change is that a recycling box be placed at Ann St. Pier. This would alleviate the problem of contamination of recycling facilities at this site.

Visual observation of harbor dumpsters revealed that a higher percentage of the waste stream could be recycled. Recyclable materials placed in a dumpster were believed to be the result of visitors who were unaware of the shoreside recycling facilities.

Onshore trash and recycling facilities must be made available statewide if true compliance is to occur. If boaters know that they will find these facilities in every Rhode Island harbor, compliance rates will increase. Recycling at the shore needs to be as easy and convenient as recycling in the home.

The findings of the pilot project indicate that recreational boaters do not throw their trash overboard in the quantity expected. Respondents to the survey rarely listed any item other than food as acceptable for overboard disposal. Observed behavior of boaters throughout the summer rarely showed overboard disposal practices. Most of the floating objects found in the harbor were not directly attributable to the recreational boating community. Much of the debris could have come from land based sources, such as recreational beach

users.

The Marine Debris Project should be expanded to other user groups on Narragansett Bay. Commercial and recreational fishermen, recreational beach users, and sewage outfalls, all contribute to the problem of debris in Rhode Island waters.

Reduction of marine debris in Rhode Island will only occur if all communities and user groups on the Bay are dedicated to solving the problem.

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APPENDIX A

COMPOSITION OF NATIONAL DEBRIS

| <u>YEAR</u> | <u>Number of volunteers</u> | <u>Miles cleaned</u> | <u>Pounds of debris</u> | <u>Composition percentage</u> |
|-------------|---------------------------------|--------------------------|-----------------------------|--|
| <u>1988</u> | 47,531 | 3,517.85 | 1,953,800 | plastic 61.94% metal 11.36% paper 11.77% glass 9.54% wood 2.34% rubber 1.77% cloth 1.25% |
| <u>1989</u> | 65,636 | 2,946 | 1,722,833 | plastic 62.68% metal 10.65% paper 9.85% glass 11.12% wood 2.41% rubber 1.99% cloth 1.25% |
| <u>1990</u> | 108,749 | 3,720.5 | 2,645,283 | plastic 63.98% metal 10.23% paper 9.95% glass 10.08% wood 2.58% rubber 2.04% cloth 1.15% |

*Source: Center for Marine Conservation. Cleaning America's Beaches: 1988 National Beach Cleanup Results, Cleaning North America's Beaches: 1989 Beach Cleanup Results, Cleaning North America's Beaches: 1990 Beach Cleanup Results.

NATIONAL DIRTY DOZEN

1988

1. plastic pieces
2. foamed plastic pieces
3. plastic eating utensils
4. metal beverage cans
5. foamed plastic cups
6. glass beverage bottles
7. plastic caps and lids
8. paper pieces
9. plastic trash bags
10. misc. plastic bags
11. glass pieces
12. plastic soda bottles

1989

1. plastic pieces
2. foamed plastic pieces
3. plastic eating utensils
4. glass pieces
5. cigarette filters
6. plastic caps and lids
7. paper pieces
8. glass beverage bottles
9. metal beverage cans
10. foamed plastic cups
11. misc. plastic bags
12. plastic trash bags

1990

1. cigarette filters
2. plastic pieces
3. foamed plastic pieces
4. paper pieces
5. glass pieces
6. plastic food bags and wrappers
7. glass beverage bottles
8. metal beverage cans
9. plastic caps and lids
10. plastic straws
11. foamed plastic cups
12. plastic eating utensils

*Source: Center for Marine Conservation. Cleaning North America's Beaches: 1988 Beach Cleanup Results, Cleaning North America's Beaches: 1989 Beach Cleanup Results, Cleaning North America's Beaches: 1990 Beach Cleanup Results.

APPENDIX B

COMPOSITION OF RHODE ISLAND DEBRIS

| <u>YEAR</u> | <u>Number of Volunteers</u> | <u>Miles Cleaned</u> | <u>Pounds of debris</u> | <u>Composition percentage</u> |
|-------------|---------------------------------|--------------------------|-----------------------------|--|
| <u>1988</u> | 500 | 100 | 15,000 | plastic 60.6% metal 13.2% paper 13.3% glass 7.0% wood 1.3% rubber 3.3% cloth 1.3% |
| <u>1989</u> | 1,000 | 45 | 17,000 | plastic 60.2% metal 11.4% paper 11.1% glass 11.7% wood 2.2% rubber 2.0% cloth 1.4% |
| <u>1990</u> | 1,000 | 42 | 17,000 | plastic 61.5% metal 10.6% paper 11.2% glass 9.9% wood 3.1% rubber 2.4% cloth 1.3% |

*Source: Center for Marine Conservation. Cleaning North America's Beaches: 1988 Beach Cleanup Results, Cleaning North America's Beaches: 1989 Beach Cleanup Results, Cleaning North America's Beaches: 1990 Beach Cleanup Results.

RHODE ISLAND DIRTY DOZEN

| <u>1988</u> | <u>1989</u> | <u>1990</u> |
|------------------------------|--------------------------|-----------------------------|
| 1. plastic eating utensils | plastic pieces | cigarette filters |
| 2. misc. plastic bags | plastic eating utensils | plastic pieces |
| 3. metal beverage cans | glass pieces | metal beverage cans |
| 4. plastic pieces | glass beverage bottles | glass beverage bottles |
| 5. paper pieces | metal beverage cans | paper pieces |
| 6. foamed plastic cups | plastic caps, lids | plastic food bags, wrappers |
| 7. small foamed pieces | paper pieces | foamed pieces |
| 8. plastic trash bags | misc. plastic bags | foamed plastic cups |
| 9. metal bottle caps | small foamed pieces | plastic caps, lids |
| 10. plastic beverage bottles | foamed plastic cups | plastic straws |
| 11. plastic eating utensils | plastic trash bags | glass pieces |
| 12. glass beverage bottles | plastic beverage bottles | plastic eating utensils |

*Source: Center for Marine Conservation: Cleaning North America's Beaches: 1988 Beach Cleanup Results, Cleaning North America's Beaches: 1989 Beach Cleanup Results, Cleaning North America's Beaches: 1990 Beach Cleanup Results.

APPENDIX C

DEVELOPMENT OF DOMESTIC LEGISLATION

Senator John Chafee (RI) introduced the first domestic legislation to address the debris problem. The bill, entitled the Plastic Waste Reduction Act of 1986,¹ called for the Environmental Protection Agency (EPA) to look at the affect of plastic on the terrestrial and marine environments. EPA was also asked to assess possible solutions to the problem of plastic persistence in the environment. The bill contained initial legislation requiring six pack holders in all states be made of degradable plastic.

Subsequent bills were introduced in both the House and Senate. Senator Ted Stevens (AK) introduced the Driftnet Impact Monitoring, Assessment, and Control Act of 1986.² This bill established a bounty system for lost or discarded nets and required a study to determine the feasibility of marking or identifying nets by boat. It also proposed that portions of nets be degradable so that they would eventually disintegrate if lost.

This was followed by a bill introduced by representative William Hughes (NJ) entitled the Plastic Waste Study Act of 1986. This bill charged the EPA and NOAA with conducting a study on the affects of marine debris and offering possible solutions.³

In 1987 the White House sent Annex V of MARPOL to the Senate for advice and consent to ratify. As a result

eight more bills were introduced. Senator Lautenberg (NJ) introduced the Plastic Pollution Control Act of 1987.⁴ This proposal specifically called for the implementation of Annex V in the U.S., a study of the ways to reduce plastic pollution in the marine environment, and required a public education outreach program. Two other introduced bills were reiterations of the Driftnet bill of 1986. Senator Chafee also reintroduced his 1986 bill.

Of the three other bills introduced in 1987 Representative Studts' (MA) Plastic Pollution Research and Control Act (H.R. 940) went the furthest.⁵ This bill called for enabling legislation to implement Annex V domestically. It also required the development of a plan to deal with shoreside reception of garbage. Studies on the feasibility of implementing driftnet marking or degradability requirements were also called for.

On April 2, 1987, thirty U.S. Senators wrote to President Ronald Reagan asking for his support in developing a committee to address the problem of plastic debris in the ocean.⁶ As a result, the President asked NOAA to chair an interagency task force to coordinate federal measures and set policy in this area. After reviewing the House and Senate bills the administration introduced its own bill on the debris problem. At the same time the foreign relations committee recommended that the senate ratify MARPOL Annex V. The U.S.

ratification would provide the required shipping tonnage for Annex V to enter into force internationally.

On October 14, 1987 Senator Lautenberg (NJ) made an impassioned appeal urging his colleagues to approve H.R. 940.

Recreational and Sport Fishing vehicles junk more than 100,000 pounds of plastic bottles, bags, and other garbage into U.S. coastal waters each year. What laws do we have to respond? The answer is today we have none. The Refuse Act of 1899, the Clean Water Act, and the Ocean Dumping Act aren't enforced or designed to tackle the problem here at home or internationally. What we need is Annex V and strong domestic legislation to put it into effect. Annex V would help stop plastic disposal from ships. And it would regulate garbage disposal. It provides the foundation for stopping plastic pollution in U.S. waters and international waters as well.⁷

The Senate heeded his advice and the resulting legislation was soon before the President.

On December 29, 1987 a compromise bill incorporating the Studts bill, H.R. 940, was approved and signed by the President. This bill was entitled the Marine Plastic Pollution Research and Control Act. The Act entered into force one year later.

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APPENDIX D

APPENDIX E

See Pouch on Back Cover for Literature

APPENDIX F

Rhode Island Planning Survey

This survey is part of a grant to gather refuse information for future planning purposes in R.I. waters. Please answer candidly, this information will be anonymous. Surveys have been sent to all private mooring holders in Newport Harbor. Please have the person who uses the mooring most frequently fill out the questionnaire. By returning this survey it indicates your consent to have this data used as grouped data.

The survey will take five minutes to complete.

VESSEL INFORMATION

| <u>TYPE</u> | <u>AREA</u> | <u>STATE</u> |
|-------------------------|---------------------------------|----------------------|
| Commercial Power_____ | Where do you operate your boat? | of registration or |
| Recreational Power_____ | (please indicate the approx. % | documentation?_____ |
| Commercial Sail_____ | of time in each area) | |
| Recreational Sail_____ | Narragansett Bay_____ | |
| Other(specify)_____ | Long Island Sound_____ | <u>SIZE</u> |
| | New England_____ | Length Over All_____ |
| | Offshore_____ | |

USE

How many days/year do you use your vessel? _____
 Length of average trip? _____
 Average # of people on board? _____

REFUSE INFORMATION

| <u>RECEPTACLE TYPE</u> | <u>AMOUNT</u> | <u>DISPOSAL</u> |
|------------------------|---|---------------------------|
| on board your vessel? | of refuse per person per day? | Where do you dispose of |
| Trash can_____ | (Please include beverage | your refuse? |
| Bag_____ | containers) | On board incinerator_____ |
| Bucket_____ | 1/4 bag_____ | On shore dumpster_____ |
| Compactor_____ | 1/2 bag_____ | At home_____ |
| None_____ | 3/4 bag_____ | At sea_____ |
| Other(specify)_____ | 1 bag_____ | Other(specify)_____ |
| | Please indicate what type of bag | |
| | you use (plastic grocery, paper grocery | |
| | small plastic, etc.)_____ | |

OVERBOARD DISPOSAL

What do you feel is acceptable?
 Food waste (apple cores, leftovers, scraps)_____ Cans_____ Paper_____
 Plastics_____ Glass_____ Cigarette butts_____ Other (specify)_____

PLANNING INFORMATION

| <u>VISUAL</u> | <u>DAMAGE</u> | <u>RECYCLING FACILITIES</u> |
|----------------------------|--------------------------------------|-----------------------------|
| Do you see debris when | to your vessel due to debris | If available at the shore |
| on the water (e.g. | (e.g. plastic bags in salt | would you use them? |
| plastic bags, nets or | water intake, lines or nets | Yes_____ No_____ |
| line, cans, plastic | wrapped around the propeller)? | |
| bottles)? Yes_____ No_____ | No_____ Yes_____ Cost of repair_____ | |

ANNEX V

Placard on board?
 Yes_____ No_____

SHORESIDE FACILITIES

What is the best way to encourage their use?
 Dockside Disposal Facilities_____ Brochures_____
 Magazine/Newspaper Articles_____ Presentations_____
 Posters_____ Fines/Penalties_____ Word of Mouth_____
 Other(specify)_____

WASTE MANAGEMENT PLAN

Do you have a written
 plan? Yes_____ No_____

OVER PLEASE

EDUCATION

Have you seen any information on marine debris?

Advertisement_____ Magazine Article_____ Brochure_____ Presentation_____

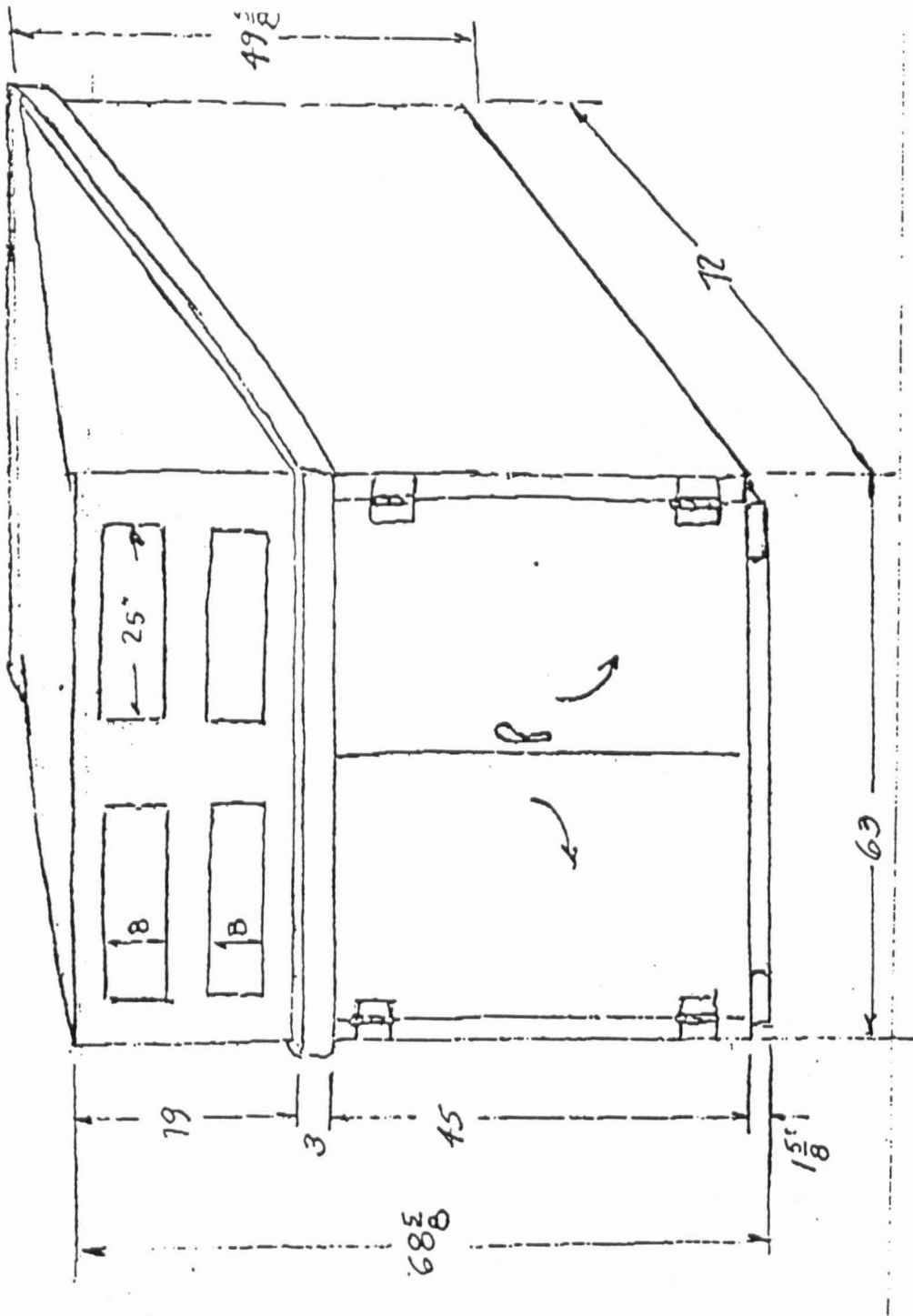
Talked with a friend_____ Radio Program_____ T.V. Program_____ Poster_____

Bumper Stickers_____ Other(specify)_____

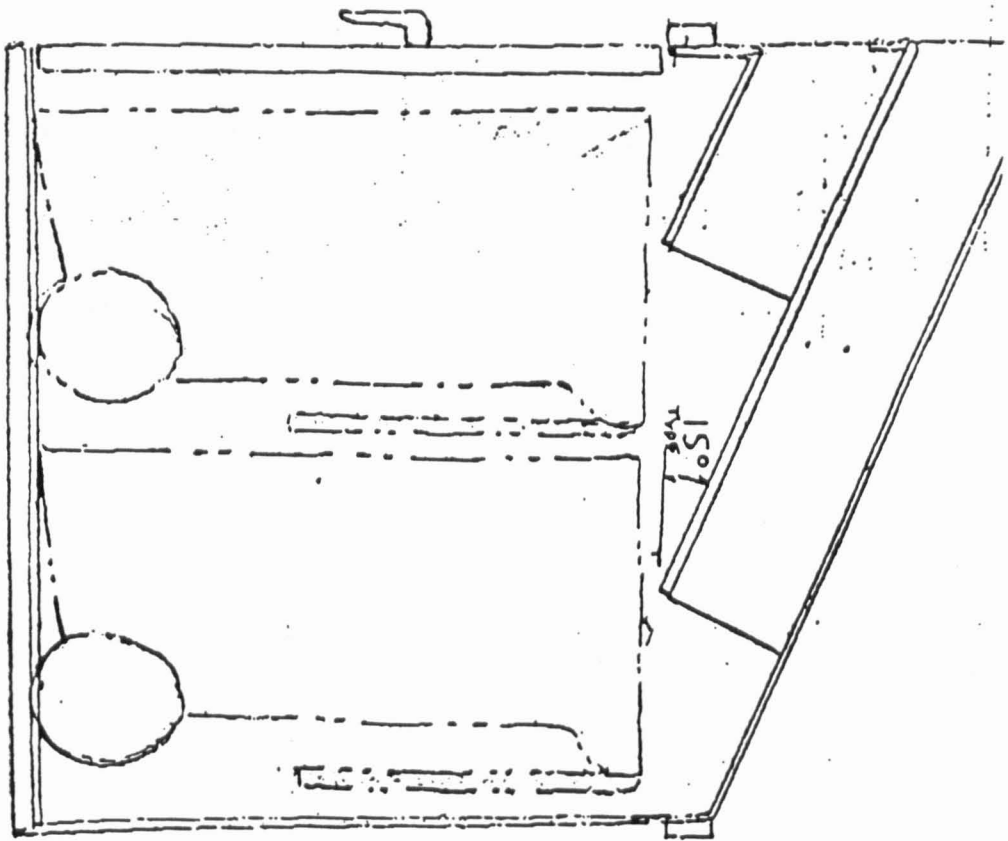
THANK YOU FOR YOUR ASSISTANCE!!

Results and copies of this survey will be available c/o Newport Harbormaster,
Department of Recreation, Spring St. Cottage, Newport R.I., 02840, (401)847-4370. If
you have any comments or suggestions please feel free to do so below.

APPENDIX G



SIDE



APPENDIX H

CONTACT: Chris Beal

Day: 847-4370

Night: 849-5296

RECYCLING INITIATED FOR MARINERS

Common items discarded from boats can become death traps for fish and other wildlife. Many boaters are also impacted by debris which gets sucked up into engine intakes or wrapped around propellers. Public understanding of these impacts will assure wide spread compliance with new laws prohibiting the disposal of plastics and other refuse into the aquatic environment. The City of Newport along with Waste Management of Rhode Island, locally known as Safeway, are working to promote awareness of the problem and its solutions.

Discarded fishing line and net pieces, six-pack rings, and other items are known to entangle fish, birds, and other animals. Pieces of styrofoam and other plastic materials including cigarette lighters have been found in the stomachs of birds and fish, where they can cause lacerations or false feelings of satiation resulting in nutritional problems. Sea turtles are infamous for eating plastic bags which they fatally mistake for their jelly fish food. Whales too have been found with plastic in their stomachs. Parent birds have been observed trying to feed their young plastic "food" items such as bottle caps and children's toys.

A new international law prohibits mariners from disposing of plastics into the ocean and navigable waterways. This law is called Annex V of MARPOL (Marine Pollution Treaty) and has been signed by the United States and 38 other nations. The law also restricts the disposal of other type of refuse including metal, rubber, glass, paper and food within 12 miles of shore. It requires that marinas, ports, fish processors, fuel docks, and any other commercial dock operation provide containers to allow mariners convenient and adequate refuse disposal. The law requires that vessels over 26 ft must display an Annex V placard and vessels over 40 feet must also have a written waste management plan. The Coast Guard is in charge of enforcing these regulations which apply to all vessels no matter how small or large.

Last years beach cleanup in Newport Harbor organized by Kathy Maxwell, Newport Recycling Coordinator, revealed that much of the debris in the harbor is recyclable. Statewide 18% of the debris collected during the Audubon and DEM sponsored beach cleanups was in the form of bottles and cans.

Waste Management of R.I. (Safeway) has donated recycling containers and pickup to initiate recycling for mariners in Newport. They also designed and fabricated a special dumpster for the purpose of recycling at Stone Pier. The project has been coordinated through the Newport Recreation Department, Harbormaster Office.

As of July 1st three trash and recycling disposal sites

have been available for the local boaters: Stone Pier, Ann St. Pier and Long Wharf (near the Harbormaster Office). Brochures asking boaters to separate their trash have been distributed through local businesses, yacht clubs and the Harbormaster.

The July 4th weekend provided the first test of the recycling facilities. "Compliance was very good" stated Christina Beal, Project Coordinator and Assistant Harbormaster. "There was very little debris in the harbor after the 4th and the dumpsters and recycling barrels were heavily used." "If facilities are available I believe the boaters will use them."

The cooperation between the City and Safeway in providing recycling and trash facilities for boaters will reduce the amount of debris in the harbor and Narragansett Bay. Enforcement of Annex V provisions is very difficult, education will be the key to compliance with this law.

Pilot trash project begins in Newport

By Bob Stepno
Staff Writer

Boaters putting in at Newport will find "putting in" has new emphasis this summer — putting bottles, cans and other trash into shoreside containers as part of a harborwide recycling program.

Chris Beal, a new assistant harbormaster, is coordinating the Newport Marine Debris Pilot Project for the harbormaster's office with help from state and local government agencies and the city's major refuse hauler.

Beal, a University of Rhode Island graduate student, is making the project the subject of her master's thesis in marine affairs. In the long run, she would like to see the marine recycling program expanded from Newport's recreational boaters to commercial vessels and other communities.

"I've spent six years of my life as professional crew on charter yachts. I became very concerned when I'd go into my favorite harbors and see plastics and trash," Beal said. "We'd like to make all of Rhode Island and New England aware of the environmental consequences of marine debris and what it does to fish, birds and wildlife."

For a start, the program is placing containers for recyclable cans, bottles and newspapers, as well as non-recyclable trash, at strategic points around the harbor.

- Long Wharf near the harbormaster's office.
- Ann Street Pier, the city dinghy dock in the middle of the harbor.
- Kings Park's stone pier near Ida Lewis Yacht Club.

Waste Management Inc., locally known as Safeway, the trash hauler for the Newport, is donating all of the dumpsters, recycling containers, and pickup services for the program.

There is also a possibility of a floating recycling station and additional facilities in Fort Adams State Park, but negotiations were still in progress at the beginning of May.

Fort Adams is run by the Rhode Island Department of Environmental Management, which has cancelled trash collection at state parks because of budget cuts.

Instead, the state is encouraging visitors to take their trash home with them. That might not be as easy for boaters, Beal noted.

Beal has produced a brochure called "A Mariner's Guide to Recycling in Newport," with information about the pilot program and about the MARPOL regulations prohibiting dumping of plastic trash at sea.

The state Coastal Resource Management Council is paying for the brochures, which will be distributed by the harbormaster's office, customs office, launch services and marinas.

The Rhode Island Sea Grant program, Save the Bay, the state Department of Environmental Management and the Audubon Society have all been supportive, Beal said.

"What we're trying to do is basically educate people and make their trash and recycling facilities as convenient as possible," she said, "so they don't feel the need to throw things overboard." ■

City program encourages boaters to dispose of and recycle their trash

Common trash discarded from boats can become death traps for fish and other wildlife, and boats can also be hurt by debris which gets sucked up into engine intakes or wrapped around propellers. Public understanding of these problems can aid in compliance with new laws that prohibit disposal of plastics and other refuse into harbors, bays, and the ocean. The city of Newport and Waste Management of Rhode Island are working to promote awareness of the problem and its solutions.

The problem has become more serious in recent years. Discarded fishing line and net pieces, six-pack rings, and other such debris can entangle fish, birds, and other animals. Pieces of styrofoam and other plastic materials, including cigarette lighters, have been found in the stomachs of birds and fish where they can cause lacerations or false feelings of satiation resulting in nutritional problems. Sea turtles are infamous for eating plastic bags which they fatally mistake for jelly fish. Whales too have been found with plastic in their stomachs and birds have been observed trying to feed their young plastic "food" items such as bottle caps and children's toys.

A new international law which prohibits mariners from disposing of plastics into the ocean and navigable waterways, Annex V of MARPOL (Marine Pollution Treaty), has been signed by the United States and 38 other nations. The law also restricts the disposal of other type of refuse including metal, rubber, glass, paper and food within 12 miles of shore. It requires that marinas, ports, fish processors, fuel docks, and any other commercial dock operation provide containers to allow mariners convenient and adequate refuse disposal.

The law requires that vessels over 26 feet must display an Annex V placard, and vessels over 40 feet must also have a written waste management plan. The Coast Guard is in charge of enforcing these regulations which apply to all vessels no matter how small or large.

Last year's beach cleanup in Newport Harbor organized by Kathy Maxwell, Newport recycling coordinator, revealed that much of the debris in the harbor is recyclable. Statewide, 18 percent of the debris collected during the Audubon Society and Department of Environmental Management beach cleanups was in the form of bottles and cans.

Waste Management of R.I. is providing recycling containers and pickup to initiate recycling for mariners in Newport. They also designed and fabricated a special dumpster for the purpose of recycling at Stone Pier in a project coordinated through the Newport Recreation Department, harbormaster's office.

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The cooperation between the city and Safeway in providing recycling and trash facilities for boaters will reduce the amount of debris in the harbor and Narragansett Bay, she said. Enforcement of Annex V provisions is very difficult, and education will be the key to compliance with this law, she added.

Newport This Week
July 23, 1991

Harbor master pushes cleanup

By Ryan R. Johnson
Daily News staff

NEWPORT — The city harbor master's office is spearheading an effort encouraging voluntary compliance with an international law designed to clean up the world's waters.

The law, Annex V of the Marine Pollution Treaty, prohibits boaters from dumping plastics into any of the nation's waters. The law also set limits on where other garbage — metal, rubber, glass, paper and food — may be dumped. The law applies to all water vessels, from sailboards to freighters.

Assistant Harbor Master Christina Beal said that, according to answers to a recent survey sent to more than 600 people with private moorings, many boaters don't know about the law, which the United States signed in 1988.

"The best method of enforcing this is education," said Beal, coordinator of the local program in its first year.

The program, the Marine Debris Pilot Project, includes trash and

recycling bins at Long Wharf, Ann Street Pier and Stone Pier, donated by Waste Management of Rhode Island. The city is paying for trash removal.

"The more convenient all these facilities are, the more (boaters will) use them," she said.

The state Coastal Resources Management Council subsidized a brochure with a map of the local dumping areas. Those brochures and others about the treaty are available at local businesses, yacht clubs and the harbor master's office.

The law, while regulating dumping, also requires that marinas, ports, fish processors and fuel and other commercial docks provide disposal containers for boaters. The law also requires vessels longer than 26 feet to display an Annex V placard outlining its provisions. Vessels longer than 40 feet must also have a written waste management plan. Vessels longer than 79 feet also must maintain a Coast Guard Refuse Record Book.

The Coast Guard is in charge of enforcement. Chief Petty Officer

Robert Haggerty, chief marine science technician at the Coast Guard's Port Operations Department in Providence, said this is the first summer the Coast Guard has actively enforced the law on recreational boats.

Fines are stiff, he said. The maximum fine is \$25,000, which has been given twice in the New England area, he said.

Beal said the July 4 weekend, the first test of the local program, ended with very little debris in Newport Harbor. The recycling bins were "heavily, heavily used."

"My feeling is, (the program is) going very well," she said.

She said she wants the program to teach boaters about the effects of pollution on wildlife and boaters themselves. Discarded fishing line and nets and six-pack rings have entangled fish, birds and other animals, she said. Plastic foam and other plastics have caused damage in animals from small fish to whales, she said. And such debris, she said, enters boat engines and snares propellers.

November 1991

*Soundings

Newport Harbor was almost litter-free

By Bob Stepno
Staff Writer

Boaters literally pitched in to make Newport's first summer collecting recyclable boat trash a success, according to the University of Rhode Island graduate student who began the program.

Chris Beal, who plans to graduate from a marine affairs program in January, became an assistant harbor-master for the summer, establishing three waterfront recycling sites and skimming floating refuse from the harbor during her daily patrols.

Her detailed report won't be complete until later in the year, but she said it doesn't take a statistical analysis to see an improvement when your job includes skimming floating trash from the harbor.

"The most noticeable difference is that at the beginning of the summer I was picking up a lot of bottles and cans, a case a day, and now it's barely noticeable," she said.

The cleanup did have a setback when Hurricane Bob came to town, blowing street trash into the harbor.

"The harbor had been cleaned up extremely by the time the hurricane hit. It wasn't back to ground zero, but there was quite a bit of stuff floating around again," she said.

In addition to arranging for recycling containers, dumpsters and pickup service, Beal also informed boaters about the 1988 international Marine Pollution Treaty (MARPOL), which governs what can and can't be dumped overboard.

At the Newport sailboat and powerboat shows in September, she passed out hundreds of recycling guides and free MARPOL placards, she said.

"There's been a really positive response. A lot of people said they didn't even know there was a law."

Besides finishing her graduate work this fall, Beal planned to talk to state agencies and the Rhode Island Marine Trades Association about developing similar recycling collection and education projects in other ports.

She'll also be compiling the results of her second survey of about 600 private mooring holders in Newport to see how well the word is spreading about the dumping rules.

Her survey at the beginning of the boating season got a substantial return rate (40 percent) and revealed that a lot of people did not know about the MARPOL

regulations on board boats over 26 feet.

Jack Farrell, Newport's harbor-master, said the recycling and trash collection program wasn't Beal's only contribution as a summer assistant harbor-master for the summer.

"She's been a good harbor-master, with good seamanship skills and good communications skills with the public; she's been valuable," he said.

Beal said both transient boaters and liveaboards seemed to be using the recycling facilities.

"I've gotten a lot of positive comments in my travels around the harbor doing my thing. Knowing that I'm there picking it up has influenced people," she said.

She said charter boat captains have already started recycling on their boats. Crew on some of the larger powerboats also separate their recyclable trash and want to see recycling facilities at the marinas where they stay as well as the public facilities.

The facilities Beal established were at the stone pier near Ida Lewis Yacht Club, Long Wharf near the Newport Yacht Club and the Ann Street Pier dinghy dock. The Ann Street location was the only one where pedestrians tended to contaminate the recycling containers with the remains of ice cream cones and other trash, Beal said.

The harbor's biggest problem is still floating plastic — 6-pack rings, pieces of bags, straws, spoons and forks that float around until they foul a propeller or get trapped in the eel grass and accumulate, endangering sea birds and other wildlife.

Even with the hurricane's contributions to the harbor flotsam, Beal said she couldn't recall skimming up any outstanding discoveries or valuable mementos of her summer in Newport. On the other hand, things could have been a lot worse. "I only found one diaper in the harbor all summer," she said. ■

APPENDIX J

COMMENTSFirst Survey (sent late June)

Boat to Boat pick up service. Dumpsters need to be monitored so people from land side don't misuse/abuse them. People need information about the importance of reducing the amount of trash they generate in the first place.

There should be an extra tax on throw-aways- plastic particularly- forks, knives, spoons, plates, cups, etc.- the tax will discourage their use and will pay for the extra cost to landfill the items or incinerate them.

Education is the most important tool here. Get people to reduce, reuse and recycle their trash on boats. Maybe they can be an example for people on land.

There should be alot of facilities where people land.

Waste Management Plan? Stupid! Insane!

If our facilities are easily accessible, and we try to accommodate our transient and local boaters, our harbor will be in better condition. Providing services without gauging the public is the key.

I believe that a questionnaire could be completed in the form of a no-nonsense information giving checklist- but required to be checked at the time of every boat registration, and every USCG course. In this way every boat registrant would be amply informed at no extra cost- except for the cost of the paper insert in the registration form.

Fines and penalties are stupid, it only causes people to sneak and dump at night and other stupid things.

A garbage raft near the center of the harbor and another in Brenton Cove. Need a floating pump out station.

Navigation on the bay is a nightmare. All responsible skippers should campaign for minimal standards of seamanship and responsibility- a license examination and a law enforcement agency on the bay.

This year we bought a simple device from a novelty magazine called a "crusher". It crushes cans- we installed one on board. Over the 4th of July we crushed a case of beer and a case of soda and it lowered our trash by 75-80%. Great buy!

People should be more responsible. Not only on the water but on land too. On the one hand too many people throw waste on our streets. On the other hand cities do not provide enough public trash cans. Education should be started at school. But TV, newspapers and radio should play an important role too. If the media would publicize somebody who drops garbage in a public place, probably more people would care about a clean environment.

Thank you for thinking of this. It's an important issue.

To the bright boys of Spring St. Where should I get rid of used oil or fuel? Also get some toilets paid type so as to be clean. Also dumpsters for general use. When you come off your boat what do you do with the stuff?

Have one or two dumpsters on a floating dock similar to what Old Port offers to boaters for water.

Perhaps a garbage launch could tour the harbor on weekends to collect garbage from boats.

Pickup of recyclable- separated trash by division of the harbor master to go to city refuse, as in Edgartown- maybe \$1 charge.

Should be a floating barge or raft that would supply fresh water and collect refuse.

We believe that if facilities for disposal are provided most boat owners will use them.

Why not encourage the city to offer free refuse collection during the summer to those waterfront businesses that offer a dumpster to the boaters. It is an expensive burden on some marinas.

Have convenient locations- even a dump site on a barge on the water. Put some signs on marker buoys. Also need a site for waste oil disposal.

Leave us alone. Dammit!

Should have included some questions about marine heads-holding tanks vs direct overboard.

Most importantly we need a holding tank pump-out somewhere around Newport/ Jamestown.

Plastic bottles used for lobster pots, etc. should not be allowed and harbor masters as well as the marine safety, Fishery Dept. should be empowered to exercise stricter control over offenders. Biodegradable (food stuffs, paper) should be allowed to be disposed of offshore but not in the harbors or near populated areas. Refuse containers should be provided by utilities departments and paid for through general taxation, since not only boaters will use the receptacles but picknickers etc. Advice: don't make it difficult for people to dispose of their refuse within harbors or bays.

People want to keep the waterways clean and enjoyable for use. The stupidest threat to clean water was the state's removal of trash containers at beaches and surrounding parks. Boaters are not responsible for trash in the water.

The problem is great- solutions are not easy- different packaging is necessary as well as in store disposal facilities.

Presently DEM and private facilities have not provided easy access to waste disposal facilities. The facilities that do work are excessive in price or they don't work. Although DEM places fine and boater use taxes they fail to provide little if any service for disposal facilities. The state has mis-allocated the funds which have been already collected.

After any busy weekend all one has to do is witness the mess at major dockside disposal facilities to see where boaters are dumping. Ann St. pier is always a disgusting site. The worst no doubt. King park often times are overflowing. The city fathers should inspect these sites first thing on a Sat., Sun., Mon. morning.

I have sailed the New England coast extensively. Without a doubt, Rhode Island (the Ocean State) is at the bottom of the list for services to boaters- even the smallest Maine or Mass town has a free town dock and encourages you to bring

garbage ashore for collection and disposal. Newport is the best deep water port in Rhode Island- certainly one of the best in all of New England. It is disgraceful that: a. The town dock (Ann St.) charges a landing fee, (not even \$\$ Nantucket\$\$ does this yet). The dumpster is usually full. b. The "3 dinghy" free float near the Treadway has no well marked trash collection point- there is a barrel somewhere in the area, I believe. c. The dinghy dock at Kings Park-Stone Pier is unsafe and there is no trash collection nearby- there are barrels on Wellington Ave. d. No wonder the harbor is full of trash there is no where to get rid of it! My biggest worry is falling overboard!!

Keep lobster pots and buoys out of the channels and out of mooring areas!

Much debris (beer cans etc) are disposed in the harbor by fisherman at docks- general public near barrooms. Keep the streets clean- some of this is tossed in the water. Transient commercial fisherman are the worst offenders not the recreational boater.

The biggest issue facing the harbor in terms of pollution is not even addressed here. People go to the bathroom on boats. They can either flush waste into the harbor or into a holding tank on the boat which is then pumped off at a shore-side facility. Newport has no such facility. In Edgartown you pay \$50 for a mooring and then have free holding tank off-loading. In Newport you can easily pay \$250 or more (due to a recent doubling of fees) and there is nothing to take care of holding tanks. Do you think people will go to Barrington or Block Island to do this? Aluminum cans are not the problem here. Given the huge mooring fees we are paying I would think you would use some of the money to address the problem. Don't patronize us with a token gesture about recycling! Human waste will kill Newport harbor way before plastic does.

The Newport Shipyard is a problem. When they launch ships with their floating dock facility all kinds of debris especially large braces and boards of wood along with the garbage that the workmen leave about, floats off and drifts across the harbor and ends up at Goat Island especially heavy with North East winds. Would appreciate your bringing this to their attention as the lumber can cause damage to propellers and rudders.

In order to facilitate having people dispose of their trash properly on shore a proper system must be established. For

instance, we generally use the Old Port launch. On the launch it says to separate the trash when disposing of it in shore. If one only sees the sign on the return to the dock, it's then already too late to separate the trash. This has to be done on the boat as the trash is generated. Signs at the launch dock would help; and so would brochures. Also, when we go to dispose of the trash at Old Port's dumpster, there is no system of segregated containers. All we can do is lob the trash bags over the enclosure and we assume it lands in the dumpster. This is not meant as a criticism of Old Port. But it shows that a well intentioned system need further refining.

By the same token it would be nice if Newport shifted from talk to action in establishing sanitary pump-out stations. And until there is an adequate number of pump out facilities in the harbor there can't be any realistic enforcement or encouragement for boater implementation. If pumping out is any more of a hassle to a boater than to gas up, then most boater's won't use the pump out facility. You can't establish just one or two facilities and expect a que of several dozen boats on a summer weekend needing to be pumped out.

Keep trash cans on shore next to the recycle bins and trash won't become such a bother.

Glass is made of sand and will return to sand- why is there a question of where to or how to get rid of glass?

Though I believe that marine debris is a problem, why don't we deal with the real issues. ie: stormwater and sewage treatment (or should I say non-treatment) discharges- and I don't mean recreational boat sewage discharges which have little real impact and have been unfairly focused on because boaters are easy prey unlike industries and municipalities.

There are no questions relative to sewage discharge or pump-out facilities. Anyway the boat provided by Block Island for pump-out encourages one to use their holding tank and I hope it is being successful.

I think there is still a discrepancy between availability of pump-out facilities and the law about them being enforced by the Coast Guard on boaters.

I feel an education system should work! I believe most people would and do comply. Eventually penalties may have to be imposed on careless and those who persist in dumping.

City of Newport provide pump-out for visitors and local boats- similar to block island.

It is absurd to not have a marine disposal system in Newport. As for refuse. The word is getting out on pollution, and it is much improved.

More publicity is needed! Sponsor a poster contest- radio talk shows- pictures in the paper- sponsor harbor cleanup days- secure help from yacht clubs.

We spend approx. five days a week in Brenton Cove. Normal disposal was Ft. Adams- there is no way to dispose of refuse this year- we cannot accumulate it onboard. I guess we will have to dump it overboard after dark. Where can we dump it??? Harbormaster boat offers no alternative, we asked them and they didn't know what to do with it. I will not pay Ann St. Pier \$1.00 to tie up so I can dump garbage. It is time Newport gave some thought to the visiting boater and the mooring renter or owner.

No matter what is required by law for debris, whether it is recyclable or put in on shore containers, some people will discard trash overboard. The thought of recycling for boaters will cause more overboard discharge. A heavy fine (150) should be imposed maybe with their name put in newspaper (nobody wants anybody to know that they were bad). Also I believe that the State of Maine just enacted a new law, that does not allow supermarkets to sell certain items such as plastic six pack holders, plastic juice cartons, plastic bags, etc. If the people can't buy it they can not discharge overboard. Good luck!

Second Survey (Sept. 15)

More location publicity including penalties.

My contact with marine debris has primarily been on the shore line. I do not see anywhere as much on the open water as I used to- keep up the good work. Shore side construction sites seem to be a major source of marine debris cups- bags- plastic sheeting blowing in to the water and ignored as part of the acceptable construction and development process.

I hope people realize that the big problem isn't litter and sanitary wastes from boats- the real problem in the bay is stormwater and sewage discharges which are inadequately treated or raw discharges. Let's try to focus on the real priorities!!! Would you swim near the outfall at Long Wharf???

I think the biggest issue is the crowding of mooring the harbor is experiencing- with lack of swing room because vessels aren't placed strategically for this.

The city should have more collection facilities and their location should be posted at all marinas and dinghy landing floats. Recycling must be required.

Recycling facilities are already available and used where we dock. A large portion of plastics in the harbor used to come from sewer discharge during rains. Mew plant might alleviate this.

I keep my boat along with 60-70 others at the sailing center at Fort Adams. It is really absurd that the state will not provide recycling/trash facilities at this site. Especially recycling facilities are needed because boaters use a large volume of plastic and aluminum containers.

R.I. should adopt the returnable bottle/can for beer and soda. People usually want their money back that they spent on deposit, rather than just throw them out. It really cleans up the state.

Maybe the Harbormaster and assistant should go through the anchorage area, transient mooring areas on a regular basis to distribute this information.

Greatly appreciate the dumpster- Recycling bins in Kings Park at Kings Park beach. We use them every weekend. Now if you want a real challenge- how about better dinghy docks, and consider giving mooring owners 30 minutes free at Ann St. so we could dispose of trash or buy a newspaper. Keep up the good work- the harbor is definitely improved.

Newport shipyard still with every launching putting wood braces and garbage into the water.

Why no discussion of pump-out facilities?

Brenton Cove near mule barn is absolutely filthy. Wood, garbage debris etc.

Everything should start with corporations first! Eliminate unnecessary packaging- that is 90% of waste.

Disposal no longer available at Fort Adams- perhaps the city could replace this service. The number of boats in Brenton Cove need someplace to dispose of their garbage. Several harbors I have visited have a launch that pick up garbage in harbor off moored boats.

Please keep the lobster traps out of the mooring area, winter and summer it has cost me \$60 two years running for a diver to find my mooring because they have dropped their pots on my winter mooring stake. Also they have cut my lines.

It would be nice to include results of this survey with mooring fee bills over the winter. Also more trash and recycling bins are needed and signs leading to them. The city should maintain a major facility at each harbor launch location. All locations should be able to handle used oil.

People want to recycle but need good location for trash to be placed/ recycled/ sorted- and not to have it overfull on Sunday.

Since the removal of trash containers in the Fort Adams State Park the water in the cove has become victimized! On several occasions I personally have seen people(on the hill

near the restrooms) stuff their picnic remains under the bushes. It was very obvious after the hurricane that their debris ended up in the water. It is the visitors on land destroying our cove- get trash containers for Fort Adams.

We need trash/recycle center at Fort Adams St. Park!

The trash receptacle at the Armory is tough to get to when more than $\frac{1}{2}$ of the Dinghy Dock is rented to private boat tenders- There wasn't space to tie a dinghy up to put the trash in the receptacle. Newport doesn't seem to want the boat owners to come ashore and spend \$ in town- they don't provide adequate space for dinghys- the cost of the launch for a family of 6 or 7 and the inconvenience of waiting for them to show up is a pain. Eighteen dollars to ride in and out to your boat is ridiculous. It makes for that much less to spend in town.

I believe that all boat owners and their guests should retain their garbage etc. for shoreside or home disposal. In 45 years of sailing in the Newport area I have not seen many boat users disposing of garbage, paper, cans or bottles.(in the water) I believe most refuse and contaminants come from shore side facilities.

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