Historical Distributions of Eelgrass (*Zostera marina*) in Narragansett Bay, Rhode Island, 1850-1995

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TABLE OF CONTENTS

I. INTRODUCTION .................................................................................................................. 1
II. METHODS ............................................................................................................................ 7
III. ANALYSIS OF METHODS ................................................................................................. 11
IV. RESULTS ............................................................................................................................. 14
V. DISCUSSION ......................................................................................................................... 20
VI. CONCLUSION ..................................................................................................................... 24

SELECTED BIBLIOGRAPHY

VII. APPENDICES
A. Maps of Historic Eelgrass Locations
B. Comprehensive Description of Eelgrass Locations
C. US Coast & Geodetic Survey Eelgrass Locations
D. Herbarium Records
E. Oral History Eelgrass Locations by Geographical Area
F. Oral History Eelgrass Locations by Time Period
G. Literature Descriptions of Eelgrass Locations
H. Archives Searched
I. INTRODUCTION

Eelgrass (*Zostera marina* L.) is a subtidal marine angiosperm with a slender, branching stem arising from a rhizome, linear leaves up to 60 cm long and unisexual flowers. Eelgrass has been well documented as playing a key role in chemical, physical and biological coastal processes (Thayer et al. 1984, Brasier 1975, Burkholder and Doheny 1968, Short 1984). It provides critical nursery and feeding grounds for many organisms, including coastal fish, lobsters, crabs, scallops, Canada geese, American brandt and black ducks. Eelgrass serves as a biological filter, creating a microenvironment with increased water column light attenuation and thus allowing existing beds to persist in fluctuating conditions and potentially affecting water quality on a larger scale.

This study focuses on Narragansett Bay, defined as the area between the mouth of the Narrow River and the head of the Providence River. With the exception of two surveys in 1989 and 1994, there have been very few efforts to document the distribution of eelgrass in Narragansett Bay (Harlin and Rines 1993). Even in the 1930’s when many studies of eelgrass distributions were conducted due to a nationwide population decline, Narragansett Bay received little attention. This study had four objectives: 1) to define historical distributions of eelgrass in Narragansett Bay; 2) to determine if the “wasting disease” of the early 1930’s affected eelgrass distributions in Narragansett Bay; 3) to identify possible causes for changes in eelgrass distribution in Narragansett Bay and 4) to identify historical ecological sources suitable for defining past distributions of eelgrass.
Information on historical distributions of eelgrass is important for several reasons. Distributions of eelgrass beds are highly dynamic, continually changing in extent and shape in response to environmental influences (Nienhuis). Since eelgrass has such a significant effect on its environment, tracking the history of its spatial fluctuations can help us to understand trends in water quality, populations of organisms that live in eelgrass beds or sediment grain size and susceptibility to erosion.

Since eelgrass is light limited, past locations and depths at which eelgrass beds were found provide an indication of the amount of total suspended solids and degree of eutrophication in the estuary. Information on the historical locations of eelgrass locations is also important since many organisms are affected by the presence of eelgrass and trends in populations of these organisms can be correlated with trends in eelgrass distributions. In addition, changes in historic eelgrass locations can help to further define the functional niche of eelgrass. Historical locations of eelgrass beds also aid in understanding changes in local sedimentation rates, sediment grain size and sediment stability.

In this study, historical eelgrass locations were investigated in order to define areas for potential eelgrass restoration (Fonseca et al. 1987). In addition to data on wave exposure indices and light attenuation, this historical information was used at a April 19, 1995 conference attended by local policy makers and marine scientists levels to identify potential eelgrass restoration sites in Narragansett Bay. Locations of historical eelgrass beds identified in this study proved especially useful in identifying restoration sites which, on the basis of wave exposure and light attenuation, would otherwise not have been considered.
The second objective of this study was to determine whether the "wasting disease" of 1931-32 significantly affected eelgrass populations in Narragansett Bay. During this time period at least 90% of all eelgrass in the Western Atlantic was killed by an infection, evidenced as black lesions on the leaves, that eventually caused the entire leaf to senesce and slough off (Costa 1988). The cause of the wasting disease has never been proven although a saprophyte, Labyrinthula macrocystis, was found associated with dying eelgrass blades and was thought to be the causative agent (Thayer et al. 1984). However, Labyrinthula is commonly found on healthy eelgrass blades and has been found to penetrate eelgrass leaves only as the leaves are dying (Muehlstein et al. 1991). Short et al. (1988) state that the wasting disease can be considered as a host-parasite interaction, where under normal environmental circumstances the parasite infection weakens the eelgrass but does not destroy it. Rasmussen has shown that the decline was associated with a period of warm winters and mild winters which may have weakened the eelgrass sufficiently for the Labyrinthula to kill it (Thayer et al. 1984). Short has recently shown that in high salinity or high nutrient waters (Short et al. 1993) strains of Labyrinthula can induce the characteristics of the wasting disease.

The third objective of the study was to identify possible causes for changes in eelgrass distribution in Narragansett Bay. Factors that can influence the distribution of eelgrass include changes in background environmental conditions, natural and anthropogenic disturbances and seed and rhizome dispersal.
II. HISTORICAL RESEARCH METHODS

To gain information on the historical locations of eelgrass in Narragansett Bay, I consulted the following resources: historical nautical charts including original survey sheets, herbarium specimens, oral interviews, literature reviews and archival searches. Other tools for reconstructing historical eelgrass locations include analyzing sediment cores for macrofossil remains and historical aerial photography for evidence of eelgrass (Davis 1982, Costa 1988). All of the data on historical eelgrass distributions in Narragansett Bay was displayed using ASAMAP, a GIS based mapping program (Appendix A).

National Ocean Service (U.S. Coast & Geodetic Survey)

The U.S. Coast & Geodetic Survey (currently part of the National Ocean Service) performed hydrographic analyses including depth and bottom type of various locations in Narragansett Bay. All of the original survey sheets and available descriptive reports covering areas of Narragansett Bay from 1832-1948 were analyzed for markings or descriptions of eelgrass locations. Markings of "eelgrass," "grass" and "grs." that were written in water deeper than the low tide shoreline were judged to indicate eelgrass locations (Appendix C).

All areas of survey sheets that included eelgrass markings were xeroxed. Using these copies, polygons were drawn on ASAMAP to represent eelgrass locations which corresponded to the position and size of the word "eelgrass," "grass" or "grs." that was written on the survey sheet. Some interpolation was made when "eelgrass," "grass" or "grs." was written multiple times in close proximity. Each polygon was overlaid
with an icon of a down-facing white triangle to represent the source of the data as National Ocean Service survey sheets.

**Herbarium Records**

Requests were made at eleven herbariums for preserved specimens of eelgrass or widgeon grass (Ruppia maritima) collected from Narragansett Bay. The majority of the herbariums in New England were contacted, in addition to major herbariums such as the United States Herbarium (Smithsonian), the Philadelphia Academy of Natural Sciences Herbarium and the New York Botanical Garden Herbarium (Appendix D).

**Personal Testimony from Marine Tradespeople and Scientists**

People such as marine scientists, shellfishermen and divers who had spent significant amounts of time on the water in Narragansett Bay were seen as an important source of information. To identify individuals who might be knowledgeable regarding eelgrass locations, nearly all of the fish and shellfish wholesale stores in Rhode Island were contacted and asked to provide names of people who might be knowledgeable about eelgrass locations. The R.I. Shellfisherman's Association, the R.I. Divers Association, R.I. Fish and Wildlife employees and several marine researchers affiliated with the University of Rhode Island were also contacted.

Interviews were conducted with approximately thirty people who knew either past or present eelgrass locations. Face-to-face interviews were held with twelve people and were audio-taped and transcribed.
Phone interviews were held with nineteen people and were not taped although notes were taken.

During the face-to-face interviews which lasted from 20 minutes to 2 hours, the interviewees were shown color pictures of eelgrass and were told the differences between *Spartina* and *Zostera* to ensure that the person was referring to eelgrass and not cordgrass or marsh hay. They were also asked to describe the organisms they saw in the grass beds and the type of activities that people were involved with inside the grass beds. Thus, if the interviewee indicated that they scalloped in the grass beds or referred to the grass beds as being on the beach, a distinction could be made to whether the interviewee understood the difference between subtidal eelgrass and intertidal *Spartina*. Interviewees were asked to describe the locations, dates of existence, depths and possible causes for decline of eelgrass beds and then to draw the locations of the beds on a chart of Narragansett Bay.

Each location that a person described was assigned a reliability score on a scale of 1-3 with 1 representing fair secondhand information, 2 representing fair firsthand or good secondhand information and 3 representing good firsthand information. Reliability was based on the apparent ability of the person to distinguish eelgrass from *Spartina* and on the vividness of their memory. The data from all of the interviews were organized by location (Appendix E) and date (Appendix F) and grouped into twenty-year intervals.

All of the data that had dates and locations well described were plotted using ASAMAP. If the eelgrass bed was drawn by a subject on a
map, an equivalent polygon was drawn using ASAMAP. If the eelgrass bed was described verbally or was very small, it was represented by a circle icon. A circle icon was also placed on top of each polygon to designate the data source as being the oral interviews.

**Literature References**

A search was conducted in the *Biological Abstracts* for studies performed on eelgrass or in Narragansett Bay from 1910 -1950. The indices for every issue of *Rhodora*, which focuses on botany research in New England, were also checked for eelgrass references. Cross-references from various reports regarding historical distributions of eelgrass were also investigated. Cottam's reports in *Plant Disease Reporter* on the impact of the wasting disease in the 1930's were also examined for references to Narragansett Bay. (Appendix G)

**Archival Research**

Six archives were searched for records relating to eelgrass distributions in Narragansett Bay (Appendix H).
III. ANALYSIS OF METHODS

USCGS

Although the charts published by the U.S. Coast and Geodetic Survey very rarely included eelgrass locations, the survey sheets written in the field and currently stored in the National Ocean Service Archives contained the locations and depths of some historical eelgrass beds. However, the absence of notations (e.g., “Eelgrass,” “Grass” and “Grs.”) on the survey sheets cannot be interpreted as a lack of eelgrass. For example, the descriptive report 3995-6 (1917) states that “In Nannaquacket Pond and in the Cove there is a growth of eelgrass which necessitated doing the hydrology there at high water,” yet there are no marks on the survey sheet which indicate the presence of eelgrass in either location (Appendix C). The fact that the survey sheets often did not include bathymetry information for near-shore areas indicates that the survey parties did not always investigate the shallow areas where eelgrass might have been located.

The extent of the eelgrass beds were not drawn on the survey sheets. In order to map the USCGS data onto ASAMAP-GIS, the size and shape of the eelgrass beds were estimated using the placement and size of the words “Eelgrass,” “Grass” and “Grs.” written on the charts. In many cases, there were multiple eelgrass markings in an area. However, in cases in which there was only one marking of eelgrass, it is not known whether there was only a small eelgrass bed present or if the hydrographic surveyors were trying to reduce map clutter by using one eelgrass marking to signify its presence in a larger area.
By noting the depths at which the words "Eelgrass," "Grass" or "Grs." were placed on the survey sheets, the approximate range of depths at which each eelgrass bed was living were deduced (Appendix C). At some locations, the eelgrass symbols were placed at depths up to ten feet at mean low tide. This depth information can be used to determine the light attenuation and thus the approximate levels of suspended solids and phytoplankton at that time in history.

**Herbarium Records**

Unfortunately, there were not many herbarium samples of eelgrass collected from Narragansett Bay; only twelve samples were found in the eleven herbariums that were contacted (Appendix D). The usefulness of herbarium samples was further reduced since many of the labels contained vague descriptions of where the specimen were collected (i.e. "Jamestown").

**Oral Interviews**

By asking people who have spent significant amounts of time in near-shore waters to draw or describe the locations of historical eelgrass locations, it is possible to get information that is not available elsewhere. Reliable personal testimony included locations of recent eelgrass beds in the upper bay that were not found in either the 1989 Narragansett Bay Project Habitat Inventory (based on analysis of aerial photography) or the 1994 AquaFund survey (based on visual inspection from a low-flying airplane). At least one of the locations that was described by an interviewee but was not included in the surveys has since
been verified. In addition, the interviewees were often able to give suspected causes for the declines in specific eelgrass populations.

Although the information obtained through oral interviews can be useful, several precautions should be kept in mind when interpreting the data. In some areas and time periods, several people report the same locations and thus this information should be viewed as more reliable than reported locations from only one person's testimony. Other limitations to the usefulness of the testimony from the marine tradespeople and scientists include: popular shellfishing and recreational regions are overrepresented; people tend to want to please the interviewer by providing many locations and assigning dates to vague recollections; and there is a decrease in representation the further back in time one goes.
IV. RESULTS

The main outcome of this study was the identification of historical eelgrass locations which were used in the process of choosing potential eelgrass restoration sites. (A comprehensive description of all eelgrass locations identified in this study is included in Appendix B; corresponding maps are located in Appendix A.)

Locations of historical eelgrass beds identified in this study proved especially useful in identifying restoration sites which, on the basis of wave exposure and light attenuation, would otherwise not have been considered. Although light attenuation will vary over time according to the amount of nutrients and suspended solids in the water column, wave exposure will not vary much with time. In some situations current light attenuation values were in the acceptable limits for eelgrass survival, but the wave exposure index was higher than normal for eelgrass survival. When this study did show that there was a historical eelgrass bed in the region, the high wave exposure index was ignored and the region was chosen as a potential restoration site. Since the wave exposure index does not change much over time, the location of a historical eelgrass bed indicates that wave exposure conditions in the area are suitable for eelgrass growth.

This study does indicate that some shallow embayments in the northern part of Narragansett Bay used to have eelgrass beds, but either most likely no longer have eelgrass or have experienced declines in the extent of the eelgrass patches. Such locations include the Providence River, the Barrington River, Hundred Acre Cove, Potter Cove (Prudence
Island), Greenwich Bay and Nannaquaket Pond. These locations are likely
to have been affected by reduced light attenuation due to increased
loadings of suspended solids or nutrients (with corresponding
phytoplankton blooms and increase in epiphytes). In addition, due to
predominantly southerly currents in the upper bay, seed or rhizome
dispersal from eelgrass beds in the lower bay is inhibited. Therefore,
even though current light conditions are suitable for eelgrass growth,
recolonization of the areas may be prevented due to lack of seed or
rhizome dispersal.

The depths at which the eelgrass was living are known for the
eelgrass beds from the USCGS survey sheets (1865-1913) and some of the
personal testimony. Thus, calculations of light attenuation coefficients
based on the maximum depths of eelgrass survival could only be made for
select regions and time periods.

Did the wasting disease devastate eelgrass populations in
Narragansett Bay in 1930-31 like in other areas of the Atlantic Coast?
Oddly, Narragansett Bay was ignored in all of the surveys of eelgrass
populations on the Atlantic Coast that Clarence Cottam conducted in the
1930's and 1940's. In support of the presence of the wasting disease in
Narragansett Bay, Russel Wallis (77 year-old shellfisherman) describes
classic symptoms of the wasting disease as being universally present
before a major demise which he thinks occurred around 1945:

Tops of all eelgrass was pretty near black. About 3 inches of
it was dark, dark brown or black and then it started to turn
green as it went down toward the bottom . . . It looked like that
even when it was good and healthy. But when it disappeared, it
disappeared all at once. (Wallis)
As part of a study conducted by John Lynch of the U.S. Biological Survey in June 1936, "reports and hurried inspection yielded no eelgrass" in neither Greenwich Bay nor Wickford, "a matter of concern since the beds had heretofore furnished excellent natural protection to young lobsters introduced from the state hatcheries." (Renn 1937) Don Wilcox, a 78 year-old shellfisherman who grew up near and worked in Greenwich Bay, remembers eelgrass disappearing from Wickford Harbor sometime between 1932 and 1941. Another statement that Wilcox makes, "I can remember the '30's all right, but I don't remember the eelgrass so it died before then," implies that eelgrass disappeared in the early 1930's. Based on this evidence, there is a high probability of the wasting disease having affected eelgrass populations in Narragansett Bay.

There is evidence from the oral interviews on eelgrass locations in the 1930's that eelgrass either recovered fairly rapidly in some locations (Nannaquaket Pond, Providence River, Kickimuit River, Palmer River, west side of Prudence Island) or that these eelgrass populations were never affected by the wasting disease. Interestingly, all of these locations are in the mid to upper bay where salinities are lower. Based on Short's study which indicated that high salinities make eelgrass more susceptible to demise in the presence of Labrynthula (Short 1988), some of the eelgrass beds in the lower salinity regions of Narragansett Bay may not have been affected as much by the wasting disease.

Many old marine tradespeople cite the 1938 hurricane as being a major force in killing eelgrass populations or as Arthur Ganz, R.I. Fish and Wildlife biologists, who had heard stories from many oldtimers put it, "It seems like a chapter of the book was closed with the '38 hurricane."
Although the 1938 hurricane may have had an impact on eelgrass populations living in regions with higher wave exposure indices, a large amount of the eelgrass may have actually disappeared prior to then from the wasting disease in 1931-32. The 1938 hurricane caused the oyster industry to decline and the shellfishermen may have become accustomed to blaming many environmental problems on the destructive forces of the 1938 hurricane of which they have vivid memories. Bill Noland, a 70 year-old shellfisherman, alludes to this point by saying:

Don't forget now, you don't realize it when you got it [eelgrass] and then you start thinking, well, we had a few hurricanes and that could do it . . . [after the 1938 hurricane] we were looking for parts of our houses, not really eelgrass. (Noland)

Ed Guay considers the decline of eelgrass in the Providence River to be the fault of various storms:

I would attribute it to the hurricanes. Let's say the '38 hurricane wiped it out and the in '54 it got taken out again. Of course we had another one in '60. It doesn't take that long for it to grow back, but when you get a tidal surge it chews it up. (Guay)

Robert Rayhill believes that the silt deposited after major storms had a significant impact on eelgrass populations.

Besides hurricanes and the wasting disease, the personal testimony by the marine tradespeople and scientists suggested several other causes for the demise of specific eelgrass populations. Two obvious causes for the decline of eelgrass are dredging and filling activities which can destroy eelgrass habitat. Ed Guay (68 year-old shellfisherman) remembers eelgrass growing around Starve Goat Island in the Providence River which was filled in to create Field's Point. Wilcox believes that the
eelgrass south of Quonset Point died when the area was filled in. In addition, Guay testified that a dredging project in Bullock's Cove in 1958 killed the extensive eelgrass bed within the cove. Finally, Gammell attributes the decline in eelgrass in the Potowomut River to a natural silting process that has been taking place since the river was dredged around the time of the Spanish-American War:

I do know that it had a discernible channel in the 30's and 40's and it has since silted up . . . when I was a kid the channel was 5-6 feet at mid-tide. Now, at low tide it is a foot deep. (Gammell)

Another suggested cause for the decline of eelgrass was the presence of oil on the water which was partially due to the inefficiency of the outboard motors. Russel Wallis directly relates the decline of eelgrass around 1945 to the rise in the amount of outboard motors on the bay:

Everyone else used to think that it was the diesel that was killing off the eelgrass when it was happening . . . When you let an outboard motor idle, in them days, you used to mix the oil with the gas, you weren't burning the oil enough and the oil was going through the exhaust overboard. That's why you always had a film of oil on the water when outboards were idling . . . It must have been around '45 when it really started to take off and beat it. That's about the time everybody started to get outboards and use diesel fuel. (Wallis)

Robert Rayhill (73 year-old shellfisherman) remembers encountering thick oil slicks less than ten times:

In them days, we used to have oil once in a while too. Oil on the water, oh yeah, we used to have it on Rocky Point many a time . . . It was thick. You used to get it on your hands, on your rope, on your boots and aprons. (Rayhill)
The importance of oil in affecting the eelgrass populations is not known. However, the oil could affect light attenuation and seed survival.

Some of the testimony from marine tradespeople indicates that some eelgrass populations were affected by increased nutrient and/or suspended solids inputs. Arthur Ganz, a R.I. Fish & Wildlife biologist testified that Nannaquaket Pond, the Cove in Portsmouth and Warren Cove all used to have eelgrass, but they have "a whole different bottom now. It has Ulva and ooze," indicating that those regions probably have experienced increased nutrient inputs. Bill Noland, 70 year-old shellfisherman, states that there was a tremendous amount of eelgrass in the Palmer River from before 1945 until 1965-70 when it began decreasing until it was completely gone in 1980. This gradual decline suggests that it may be the result of increased nutrient and/or suspended solids inputs.
V. DISCUSSION

In addition to changes in background environmental conditions, the absence of eelgrass can be caused by natural or anthropogenic disturbances or by lack of effective seed or rhizome dispersal. This study suggests that several of these mechanisms operated in Narragansett Bay to prevent the presence of eelgrass at specific times and locations.

Costa found that in Buzzards Bay, Massachusetts, eelgrass populations generally recovered from natural disturbances within ten years (Costa 1988). The most common natural events which cause decreases in eelgrass abundances are disease, storms, ice scour and herbivores.

Severe storms such as those which occurred in 1938, 1954, and 1960 may have significantly reduced eelgrass populations in Narragansett Bay. Storms can have harmful effects on eelgrass populations by increasing the speeds of waves and currents which can mechanically break off portions of the plants or bury the eelgrass with suspended solids. Orth suggests that a cause for a recent decline in eelgrass in the Chesapeake Bay was due to the sudden freshening of the lower Chesapeake Bay by Hurricane Agnes floodwaters (Davis 1982). The change in the salinity nearly eliminated Deastroma spp., a small snail that grazes on epiphytes attached to eelgrass leaves. Released from grazing pressure for the rest of the season, epiphytes may have reached densities where light blockage was lethal to eelgrass beds (Davis 1982).
Although no data was found on its effect on the eelgrass populations in Narragansett Bay, the formation of ice and its movement with the tides can have significant harmful effects on eelgrass populations. In Nova Scotia, in order for the eelgrass to survive winter ice disturbances, it tends to allocate more resources to developing large root and rhizome structures (Robertson and Mann 1984). Finally, another natural event which can impact eelgrass populations is the predation by herbivores such as brandt, Canadian geese or mute swans.

The main anthropogenic causes for eelgrass decline which were stated in the personal testimony were gradual declines associated with decreased water clarity, dredging and filling activities, and oil slicks. In several upper bay locations (Nannaquaket Pond, the Cove in Portsmouth, Warren Cove, and the Palmer River), personal testimony indicates that eelgrass populations experienced a gradual decline which was often associated with increases in algae concentrations. These declines signify that there have been increased nutrient or suspended solids inputs into the upper bay. The addition of fertilizers to the soil or the water results in increases in biomass and leaf length, suggesting that the habitats of many eelgrass beds are nutrient limited (Harlin and Thorne-Miller 1981, Orth 1977). However, the increase in nutrients in the water column also allows phytoplankton and macroalgae to grow more, resulting in a decrease in the light attenuation and thus in eelgrass survival (Harlin and Thorne-Miller 1981).

Personal testimony by several marine tradespeople indicates that the dredging project in Bullock’s Cove and the filling activities at Field’s Point and Quonset Point caused the demise of surrounding eelgrass
populations. In addition, oil slicks caused in part by inefficient outboard motors were cited as being a cause for eelgrass decline.

Other possible anthropogenic causes for the demise of eelgrass include high boating activity, which increases the amount of suspended solids in the water, high amounts of shellfishing (Costa 1988), and chlorine levels as low as 0.05-0.125 ppm, which can impair or eliminate SAV growth (Davis 1982). Since chlorine is often used in waste water treatment, it may be a significant concern in regions around waste water treatment facilities. Herbicides were not found to be a significant factor in decreasing SAV populations in Chesapeake Bay (Kemp et al.).

Although a natural or anthropogenic disturbance which caused the demise of an eelgrass bed may no longer be acting on the region, a limiting factor on the establishment of a new population is the effectiveness of transport of seeds or uprooted rhizomes to the site. Moore et al. (1993) conclude that the survival of eelgrass seeds in the natural seedbank for more than one year is rare. Thus if a disturbance kills a population of eelgrass and prevents survival for more than a year, the ability of the population to recover through germination and development of seedlings is reduced.

Effective transport of seeds or uprooted rhizomes depends on the proximity of existing eelgrass beds and the direction of currents. If there are no eelgrass beds nearby or if there are no eelgrass beds upstream of the currents, colonization of the bare site will be rare (Orth et al. 1994). Since ripe seeds (2 mm long) sink quickly to the bottom, they have limited dispersal distances with 80 percent of seeds falling within 5 meters of
the parent (Orth et al. 1994). In contrast, when flowering shoots containing seeds are broken off, long range dispersal is possible.

The declines in eelgrass populations in the upper bay are significant since northward transport of seeds or rhizomes into the upper bay is rare due to predominantly southerly currents. Thus, the reestablishment of upper bay populations will be impeded due to lack of colonizing seeds or rhizomes. Fortunately, a R.I. Fish and Wildlife biologist, Arthur Ganz, reports that there have been eelgrass beds in Occupasituxet Cove and in the southern Palmer River in the past ten years. If these beds are still living, they can provide critical seed or rhizome stock for dispersal to other upper bay locations.
VI. CONCLUSIONS

This study identified historical eelgrass locations in Narragansett Bay in order to define areas which have been habitable for eelgrass in the past as an indicator of where it may be restored in the future. In addition, the historical locations which are plotted on ASAMAP-GIS can serve as a tool for future research on historical trends in water clarity, organisms that are associated with eelgrass beds (e.g. scallops, brandt, and mute swans) and local changes in sediment grain size and stability. The historical data proved to be especially useful in cases in which regions had high wave exposure indices, indicating that it may not be habitable for eelgrass. If these regions had evidence of historical eelgrass beds, the high wave exposure index was ignored and the region was chosen as a potential restoration site.

The wasting disease of the early 1930's did affect eelgrass populations in Narragansett Bay, although eelgrass beds in the less saline waters were not affected as much. Other suggested causes for eelgrass decline include dredging and filling activities, severe storms and oil slicks. This study does indicate that some shallow embayments in the northern part of Narragansett Bay used to have eelgrass beds, but either most likely no longer have eelgrass or have experienced declines in the extent of the eelgrass patches. These declines in the upper bay are most likely due to increased loadings of nutrients and suspended solids.
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Appendix B: Comprehensive Description of Eelgrass Locations

PROVIDENCE RIVER AREA

Seekonk River, Providence River, Palmer River and Hundred Acre Cove

1840-1919

Based on the U.S. Coast & Geodetic Survey (USCGS) survey sheet number 878, in 1865 eelgrass grew at various locations in the Providence River from the mouth of the Seekonk River to north of Gaspee Point at depths from 1-4 feet at mean low tide.

In 1913 the USCGS survey sheet number 3565 has "grass" written from Nayatt Point to the Barrington Beach area and also along the coast south of Conimicut Point.

Russel Wallis (77 year-old shellfisherman) reports that his father and grandfather and many of the residents along the shores of the Palmer River used to harvest eelgrass from the Palmer River in the 1910's to use as insulation. He also remembers commercial harvesting of the eelgrass for fertilizer.

1920-1939

The oral interview data indicates that the 1938 hurricane significantly damaged eelgrass locations in the Providence River region. Robert Rayhill (73 year-old shellfisherman) scalloping in
eelgrass beds west and northwest of Greene Island (midwestern portion of Providence River) and north of Conimicut Point in 1935. He also remembers eelgrass living east of Nayatt Point in the Barrington Beach area sometime between 1935-1951. Ed Guay (66 year-old shellfisherman) remembers eelgrass being in the Providence River. Arthur Ganz (R.I. Fish and Wildlife biologist) was told by "oldtimers" that eelgrass was in the Providence River from the 1920's until the 1938 hurricane. Wallis also was told by "oldtimers" that the Providence and Seekonk Rivers used to have eelgrass (reliability 2). Guay (reliability 1) remembers eelgrass in the Providence River as far north as the Mobile docks until the 1938 hurricane. Wallis remembers eelgrass in the Warren River until 1940. According to Wallis, there was eelgrass in the Palmer River in the late 1930's and less in the 1940's. Rayhill remembers eelgrass at Barrington Beach east of Nayatt Point sometime between the late 1930's to 1950.

1940-59

Guay remembers eelgrass living around Starved Goat Island until the land was filled in to create the current Field's Point shoreline. He also recalls eelgrass living around Greene Island and in Occupessatuxet Cove and in Bullock Cove (low reliability 1). Wallis remembers small amounts of eelgrass which disappeared around 1955 in the Barrington River and in Hundred Acre Cove. Wallis reports that the Palmer River was filled with eelgrass in the 1930's and less in the 1940's. Bill Noland (70 year-old shellfisherman)
recalls eelgrass in the Palmer River before 1945 which he thinks began to decrease in 1965-70 until it was completely gone in 1980.

1960-95


MOUNT HOPE BAY

The Kickamuit River had eelgrass along its western side in the 1930's according to Rayhill. Noland recalls seeing eelgrass at Bristol Narrows at the mouth of the Kickamuit River and along Chase Cove in the southeastern portion of the river in 1940-63. Noland remembers the Cole River having eelgrass in the 1930s. As part of a study on the phenology of eelgrass, Setchell refers to eelgrass growing around the most southern road bridge of the Lee River in 1921-23. (Setchell 1929)

BRISTOL

In 1901 a brown algae is noted to appear on eelgrass in Bristol Harbor. (Schuh 1901) A USCGS study (3571) in 1913 indicated eelgrass in the northern portions of Bristol Harbor. Along the shore of Colt's State Farm/Park, Setchell found eelgrass in 1921 (verified by 1921 herbarium sample). (Setchell 1929) Noland remembers

**PRUDENCE, PATIENCE AND HOG ISLANDS**

**Patience Island and Western Prudence Island**

The cove on the west side of Providence Point had eelgrass in 1865 according to USCGS survey 880. Eelgrass was living between Patience and Prudence Islands in 1913 (USCGS 3572). Noland remembers eelgrass in Coggshall and Sheep Pen Coves in the period 1945-60. Ganz thinks that eelgrass has been between Prudence and Patience Islands up through the early 1970's at least. Luther Blount remembers eelgrass at Jenny's Creek in the mid western part of Prudence Island.

**Eastern Prudence Island**

Wallis remembers eelgrass in Potter Cove in 1939-41. George Drew (>65 year-old shellfisherman), Don Wilcox (78 year-old shellfisherman) and Rayhill all recall eelgrass in Potter Cove prior to 1945. Ganz thinks that there was eelgrass in the northern part of Potter Cove until the early 1970's at least. Rayhill remembers eelgrass at Mt. Tom before 1950 and along the mid west shore in 1939 to before 1949. David Esau (quahoguer) remembers eelgrass on the mid western portion of Prudence Island north of Homestead until 1970.
Johnson and John Langella (diver, biology teacher) both remember seeing eelgrass on the south side of Prudence in the 1990's.

**Hog Island**

USCGS survey 3571 in 1913 indicated eelgrass on the northern and southwestern portions of Hog Island. According to Ganz, the west and the southeast corners of Hog Island used to have eelgrass from the late 1960's to the early 1970's. Noland also remembers eelgrass in the southeast cove of Hog Island in 1965. Johnson recalls seeing eelgrass around Hog Island in the 1990's.

**GREENWICH BAY TO ALLEN HARBOR**

**Greenwich Bay**

Based on the USCGS survey 3572 performed in 1913, there was eelgrass in many parts of Greenwich Bay at that time: the southeastern portion of Apponaug Cove, west of Cedar Tree Point, south of Oakland Beach, north and northeast of Chepiwanoxet Point, and east of Sally Point. Wilcox was told by his father that the entire coastline from Apponaug Cove to Warwick Neck was filled with eelgrass before 1920.

"Reports and hurried inspection" of the shallow portions of Greenwich Bay in June 1936 by the U.S. Biological Survey yielded no eelgrass. (Renn 1937) Rayhill remembers eelgrass living in almost every part of Greenwich Bay prior to the 1938 hurricane up to depths of 15 feet at mean low tide. Rayhill recalls scalloping in a eelgrass
bed north of Chepiwanoxet Point in the mid 1940's and Ed Agin (54 year-old shellfisherman) recalls two eelgrass beds between Sally and Sandy Points which existed between 1945-65. Ganz remembers a patch of eelgrass from the mouth of Brushneck and Buttonwoods Coves to the mouth of Warwick Cove in the 1960's. North of Chepiwanoxet is reported to have had eelgrass from 1975-90s (Robert Fitzpatrick), before 1987 (Langella) and in 1992 (Mark Lapteau, underwater photographer). Langella also reports to have seen eelgrass west of Sally Point in the 1990s.

Potowomut River

Based on the USCGS survey conducted in 1913, there was eelgrass on both sides and at the mouth of the Potowomut River at that time. Middleton Gammell (property owner) was told that there was eelgrass in the river from prior to 1900 until 1940. Wilcox was told by his father that the Potowomut River had eelgrass before 1935. Ganz, Agin and Gammell recall eelgrass being in the Potowomut River in the 1960's until as late as 1975. Langella remembers eelgrass in the river from the late 1980's to 1994.

Between the Potowomut River & Allen Harbor

USCGS survey 3572 indicates that there was eelgrass south of Tibbet's Creek between the Potowomut River and Allen Harbor in 1913. Rayhill recalls eelgrass in the same location prior to 1951 while Lapteau and Langella recall eelgrass growing there in 1970-90.
Allen Harbor

USCGS survey 3572 shows eelgrass growing at the mouth of Allen Harbor in 1913. Wilcox was told that there was eelgrass in the harbor prior to 1935. Langella remembers seeing eelgrass in the western portions of the harbor in 1994.

WICKFORD AND QUONSET POINT

USCGS survey 992 shows eelgrass growing on either side of Quonset Point in 1868 (the shoreline was significantly different then.)

USCGS survey 992 indicates eelgrass in the northern portion of Fishing Cove located in the northwest portion of Wickford Harbor and south of Wickford Harbor along Poplar Point in 1868. A 1936 study by the U.S. Biological Survey based on "reports and hurried inspection" yielded no eelgrass in Wickford, "a matter of great concern since the beds had heretofore furnished excellent protection to young lobsters." (Renn 1937) Wilcox reports that there has been eelgrass in Wickford Cove by the yacht club since 1935 and that there was eelgrass in the northern portion of Fishing Cove and between Vile's Creek and Sauga Point between 1937-45. Rayhill reports that there was eelgrass between Vile's Creek and Sauga Point in 1950. Ganz recalls seeing eelgrass in Fishing Cove in 1965-75. Four people (Ganz, Noland, John Karlsson, Wilcox) remember seeing eelgrass in Wickford Cove by the yacht club in the general time of 1970-85.
WEST PASSAGE

North Kingston and Narragansett

A 1868 survey by the USCGS (992) indicates that eelgrass was living outside of Bissel Cove between Wild Goose Point and south of Rome Point and also north and east of Plum Point. Wilcox was told by his father that Bissel Cove had eelgrass before 1920. Perry Jeffries (URI professor) remembers seeing eelgrass/Spartina mixture around Lone Tree Point and the cove south of Cold Spring Rock and in Bissel Cove in the early to mid 1970's.

Sheldon Pratt (URI researcher) recalls seeing eelgrass at Baby Beach at the URI Bay Campus and on Bonnet Shore at the end of John Gardner Rd. since 1992, while John Plikus (shellfisherman) remembers seeing it south of Bonnet Point since 1985. Langella also remembers seeing eelgrass on both sides of Bonnet Point until the early 1980's.

Jamestown

The USCGS survey 992 performed in 1868 indicates that eelgrass was living on the northwestern part of Conanicut Island and also from south of Hull Ledge to the current location of the Jamestown Bridge on Conanicut Island. A 1912 survey by the USCGS (3403) showed eelgrass living on the southern side of Dutch Harbor. The east side of Dutch Island had eelgrass before 1935 according to Wilcox. Pratt remembers eelgrass growing on the west side of Beaver Neck south of Austin Hollow since 1960.
Langella recalls seeing eelgrass on the north and northwest parts of Conanicut Island in 1990. Both David Swain (diver) and Charles Walpole (diver) report seeing eelgrass in Dutch Harbor in the 1990's.

WEST PASSAGE

Jamestown

Two herbarium samples from 1879 were collected in Jamestown (no detailed description of location). Langella recalls various patches of eelgrass on the east side of Conanicut Island in the 1990's. Potter Cove is said to have had eelgrass since 1980 (Lapteau) and since the 1970's, but not much lately (Langella). A herbarium sample was taken from East Ferry in 1969. Lapteau recalls seeing eelgrass on the south side of the Newport Bridge in Jamestown from 1985-94. Wilcox recalls seeing eelgrass at the Dumplings since 1965-70 and Swain, Carney and Warnock recall it there in the 1990's.

Many people remember seeing eelgrass at Fort Wetherhill at various times; since the late 1960's (Langella), since the 1970's (Swain), since the early 1980's (Krueger and Mather) and in the 1990's (Walpole, Carney and Plikus). Mackeral Cove is also well remembered by several people; since 1975 (Langella) and in the 1990's (Walpole and Plikus). Langella reports having seen eelgrass in Hull Cove on the southeast side of on Beaver Neck from 1975-90's although he thinks there hasn't been as much lately.
Newport

A herbarium sample from 1848 is labeled as having been taken from Newport (no detailed location). East of Coaster's Harbor Island had eelgrass markings on the 1880 USCGS survey sheet 1468. Mendosa also remembers eelgrass living near King's Park off Wellington Ave from 1925 until 1975-80. Ganz remembers eelgrass growing in the same location in 1970-75.

On the outer coast of Newport there have been numerous reports of eelgrass. In 1921-23 Setchell performed phenological observations on a patch of eelgrass in a small cove between Brenton Point and Price's Neck and took four herbarium samples from this location (Setchell 1929). Mendosa recalls seeing eelgrass around Price's Neck since 1925 although in some years he remembers "little decreases." At Castlehill inside of Butter Ball Rk. Langella remembers patches of eelgrass from the 1970's to 1990. The Green Bridge area west of Price's Neck had eelgrass in 1975 according to Silvia and in the 1990's according to Lapteau and Swain. Ganz remembers eelgrass at Cherry Neck since the early 1970's. Between Brenton Reef and Price Neck there has been eelgrass since 1985 according to Plikus. Eelgrass is also reported between Price Neck and Seal Rock recently by Langella.

SAKONNET RIVER AREA

The Cove (Portsmouth)
In 1917, the descriptive report accompanying USCGS survey 3995-6 indicated eelgrass growing in the Cove in Portsmouth. A 1923 herbarium sample was taken from the Hummocks at the Cove. Ganz remembers seeing eelgrass around Spectacle Island in the Cove and in the western portions of the Cove from 1970-90s.

**Nannaquaket Pond**

In 1917, the descriptive report accompanying USCGS 3995-6 indicated eelgrass growing in Nannaquaket Pond. Mendosa recalls eelgrass being in the pond consistently during the 1930's. Nannaquaket Pond was said to have eelgrass in 1945 (Wallis), 1955 to after 1960 (Noland), 1950-60s (Ganz).

**Sakonnet River**

Rayhill recalls eelgrass living in 1951 from Portsmouth Park to Island Park south of the Cove, the areas north and south of McCurry Point, around Black Point and in the cove south of Fogland Point. Mather remembers seeing eelgrass at Island Park south of the Cove in the 1980s. Ganz remembers seeing eelgrass at the Sapowet Marsh area after 1970 and at the mouth of the Nonquit River in the early 1970s.
Appendix D: Herbarium Records

Sept 15, 1848
Newport
Brown University Herbarium

July 1879
Jamestown in 4 feet of water (2 samples)
Brown University Herbarium

June 19, 1921
Newport (outer coast)
collected by W. A. Setchell (U of California)
United States Herbarium

June 25, 1921
salt inlet (enclosed mostly), west side, Bristol
collected by W. A. Setchell (U of California)
United States Herbarium

July 6, 1921
Newport (outer coast)
collected by W. A. Setchell (U of California)
United States Herbarium

July 27, 1922
washed ashore on Newport Beach, Newport
collected by G. S. Torrey
UConn Herbarium

June 17, 1923
Newport (outside coast)
collected by W. A. Setchell (U of California)
United States Herbarium

June 30, 1923
Washington Co., "The Hummocks" (inlet from Narr. Bay)
collected by W. A. Setchell (U of California)
United States Herbarium

July 1, 1923
Newport (outer coast)
July 22, 1923 (2 samples)
Clara Pt., Newport
collected by W. A. Setchell (U of California)
United States Herbarium

July 17, 1969
Jamestown at East Ferry in 2-3 feet of water
collected by Richard Champlin
Grey Herbarium at Harvard University

Herbariums Covered

Brown University
Grey & Farlow Herbarium (Harvard University)
*Philadelphia Academy of Natural Sciences
*Roger Williams State Park Herbarium (RI)
United States Herbarium (Smithsonian)
University of Connecticut
*University of Massachusetts
*University of Michigan, Ann Harbor
*University of New Hampshire
*University of Rhode Island

* denotes no specimen found in Narragansett Bay (excluding the Salt Ponds in So. County)

Note: All eelgrass samples from the U S Herbarium also have air and water temperatures and remarks on phenology.

Ruppi a maritima samples in Narragansett Bay

August 1845
by Field Point (Providence)
Brown University Herbarium

August 1878
Kickamuit River, Warren
Brown University Herbarium

July 4, 1883
East Providence by the Providence & Maine Railroad tracks
Brown University Herbarium

1890
Seekonk River at Bucklives Isle
collected by J. F. Collins
Brown University Herbarium

Sept 14, 1890
Seekonk River, Providence
collected by J. Franklin Collins (Providence)
Appendix E:  
Oral History Information on  
Historical Eelgrass Locations  
Listed by Geographical Location

Confidence Scale  
3 = Good firsthand information  
2 = Fair firsthand information or vivid secondhand info  
1 = Fair secondhand info

PROVIDENCE RIVER AND NORTH OF RUMSTICK NECK  
Bullock Cove (south of Riverside)-in shallow water lining the banks on both sides there was Spartina/eelgrass mixture prior to 1958 (when the cove was dredged).

Upper western section of Bullock Neck had eelgrass (there before 1938 hurricane, might have come back afterwards, but 1954 hurricane and 1960,1961 storms made it decline.) (Guay, 2)

South of Sabin Point might have had some eelgrass (unsure about the dates) (Guay, 1-2)

Providence River as far north as the Mobile docks had eelgrass which was there before 1938, may have come back, but the 1954, 1960, 1961 storms probably caused it to decline. (Guay, 1-2)

Watchamoket Cove had some eelgrass, but date unknown (at least prior to 1938) (Guay, 1-2)

Starved Goat Island/Sunshine Island (now Fields Pt.) had eelgrass all along the island “always,” but Guay thinks that it was filled in around 1970. (Guay 1-2)

Pawtuxet River didn’t have eelgrass. (Guay 1-2)

Behind the breakwater north of Passeonkquis Cove there was grass in 1994, but it may be Spartina. (Guay 1)

On either side on Greene Island and in Occupessatuxet Cove there was always eelgrass. (Guay 1-2)
At the mouth of Old Mill Cove ("Bucky Brook") there was eelgrass. (Guay 1-2)

**UPPER EAST SIDE (GR. BAY, ALLEN HARBOR)**

**Greenwich Bay**
There was eelgrass along the whole coastline from Apponaug Cove to Warwick neck at least before 1920. (Wilcox 3) Wilcox doesn't remember any eelgrass on the west side of Gr. Bay along Chepiwanoxet even though he used to swim in the area as a kid in the 1920's.

**Potowomut River**
There was an extensive bed of eelgrass in the Potowomut River at least before 1935. (Wilcox 2)

**Allen Harbor**
All of Allen Harbor was eelgrass at least before 1935. (Wilcox 1)

**UPPER MIDDLE BAY (PRUDENCE, PATIENCE, HOG, BRISTOL HBR)**

**Prudence Island**
Between Prudence and Patience Island had eelgrass (?date) (Wilcox 1) Potter’s Cove had eelgrass at least before 1945.

**Hog Island**
The southeast cove of Hog Island had eelgrass in 1965. (Noland 3)

**Palmer River**
The entire river was full with SAV (?eelgrass or widgeon grass) before 1945 and began to decrease in 1965-70 until it was completely gone in 1980. (Noland 5)

**MOUNT HOPE BAY AND TRIBUTARIES**

**Kickamuit River**
At Bristol Narrows, just before the Kickamuit River and in the Kickamuit River along Chase Cove there was eelgrass

**Cole River**
The Cole River used to have eelgrass (?widgeon grass) in 1930. (Noland 4)
Bristol
In Walker Cove in Bristol Harbor there was eelgrass from 1945-1965.

WEST PASSAGE (QUONSET PT. TO THE NARROW RIVER)
Wickford Area
From Viles Creek (current sewer marker on NOAA chart) south to the breakwater at Sauga Pt., there was eelgrass that disappeared ~1945. (Wilcox 4) Wilcox thinks that the dredging to make fill for Quonset Pt. made the eelgrass disappear.

In Wickford Cove between the yacht club and Gardner’s Wharf there has been eelgrass (Wilcox)

Fishing Cove was full of eelgrass 1937 ~1945 (Wilcox 4)

Lone Tree Pt and the cove just south of Cold Spring Rock had mostly Spartina, but some eelgrass in the early-mid 1970’s. (Jeffries-3)

Bissel Cove had a Spartina/eelgrass mixture in the early-mid 1970’s. (Jeffries-3)

Bissel Cove “used to have a lot of eelgrass in it.” (Wilcox 1)

Arcund Dutch Island (especially on the east side) there was eelgrass at least before 1935. (Wilcox 1)

Jamestown
At the Dumplings, eelgrass has been there at least since 1965-1970. (Wilcox 3)

SAKONNET RIVER
Nanaquaket Pond
Nanquacket Pond had eelgrass all along the shores 1955-1960 -->?. (Noland 4)
Appendix F: Oral History Eelgrass Locations by Time Period

Confidence Scale
3 = Good firsthand information
2 = Fair firsthand information or vivid secondhand info
1 = Fair secondhand info

1900-1919
There used to be eelgrass in the Palmer River in the 1910’s which was harvested for fertilizer and insulation (secondhand-father and grandfather). (Wallis 2)

There was eelgrass along the whole coastline from Apponaug Cove to Warwick neck at least before 1920 (secondhand-father). (Wilcox 2) Wilcox doesn’t remember any eelgrass in Greenwich Bay even though he used to swim in the area as a kid in the 1920’s (born 1917).

Prior to 1900 the Potowomut river had a lot of eelgrass (secondhand) and there were patches of eelgrass in the river until WWII (Gammell 2).

Bissel Cove “used to have a lot of eelgrass in it,” disappeared around 1920 (secondhand-father). (Wilcox 2)

1920-1939
Eelgrass was in the Providence River from the 1920’s until the 1938 hurricane (secondhand info). (Ganz 2)

Providence River as far north as the Mobile docks had eelgrass which was there before 1938 and may have come back, but the 1954, 1960, 1961 storms probably caused it to decline. (Guay, 1)

West and northwest of Greene Island (located between Gaspee and Conimicut Pts.) there was eelgrass in 1935. (Rayhill 3)

North of Conimicut Pt. there was some eelgrass in 1935. (Rayhill 3)

Watchamoket Cove had some eelgrass, but date unknown (at least prior to 1938) (Guay, 1)
Upper western section of Bullock Neck had eelgrass (there before 1938 hurricane, might have come back afterwards, but 1954 hurricane and 1960,1961 storms made it decline.) (Guay, 2)

South of the marsh area east of Nayatt Pt. (Barrington Beach) there was eelgrass during scalloping time (1935-41, 46-51) (Rayhill 3)

The Warren River had eelgrass that disappeared prior to 1940. (Wallis 3)

There was eelgrass in the Palmer River in the late 1930's and less in the 1940's. (Wallis 3)

The following areas in Greenwich Bay had eelgrass before the 1938 hurricane and may have had some eelgrass afterwards, but were gone before 1951. (Rayhill 3)

1) the upper part of Apponaug Cove
2) from just south of Arnold Neck to the north part of Chepiwanoxet
3) from Long Pt to Sally Rock Pt
4) from Sally Pock Pt to just west of Clump Rock
5) all of Buttonwoods Cove and the southern part of BrushNeck Cove
6) the southeastern portion of Warwick Cove
7) the southeastern shore of Greenwich Bay to the northeastern shore, excluding a trough of deep water (>15 feet) in the mideastern side.

The Sandy Pt. area had eelgrass in the early 1930's before the 1938 hurricane. (Rice 3)

Prior to 1900 the Potowomut river had a lot of eelgrass (secondhand) and there were patches of eelgrass in the river until WWII (Gammell 2).

There was an extensive bed of eelgrass in the Potowomut River at least before 1935 (secondhand-father). (Wilcox 2)

All of Allen Harbor was eelgrass at least before 1935 (secondhand-father). (Wilcox 1)

Potter's Cove (Prudence Island) had eelgrass in 1939-41. (Wallis 3)
At Bristol Narrows, just before the Kickamuit River and in the Kickamuit River along Chase Cove there was eelgrass (1940-63). (Noland 3)

The Kickamuit River had eelgrass on the western side sometime between 1930-1941 although it was not necessarily present the entire time period. (Rayhill 3)

The Cole River used to have eelgrass (?widegon grass) in 1930-1940. (Noland 3)

North of Wickford Harbor from Viles Creek (current sewer marker on NOAA chart) south to the breakwater at Sauga Pt., there was eelgrass that disappeared at least before 1945. (Wilcox 3) Wilcox thinks that the filling activity at Quonset Pt. may have made the eelgrass disappear.

Fishing Cove (Wickford) was full of eelgrass until 1937 –1945 (Wilcox 4)

In Wickford Cove between the yacht club and Gardner’s Wharf there has been a patch of eelgrass since the mid 1930’s. (Wilcox 2)

Around Dutch Island (especially on the east side) there was eelgrass at least before 1935 (secondhand info). (Wilcox 1)

King’s Park near the Ida Louis Yacht Club in the southeast corner of Newport Harbor off of Wellington Ave. had a patch in 1925 and has been there fairly steadily until 1975-1980. (Mendosa 3)

Price’s Neck off Ocean Drive in Newport has had eelgrass since 1925 although in some years there have been “little decreases.” (Mendosa 3)

Nannaquaket Pond had eelgrass consistently during the 1930’s. (Mendosa 3)

1940-1959

Starved Goat Island/Sunshine Island (now Fields Pt.) had eelgrass all along the island “always,” but Guay thinks that it was filled in around 1970. (Guay 1)
On either side on Greene Island and in Occupessatuxet Cove there was always eelgrass. (Guay 1)

Old Mill Cove ("Bucky Brook") had eelgrass sometime between 1945-1960. (Noland 3)

Bullock Cove (south of Riverside)-in shallow water lining the banks on both sides there was Spartina/eelgrass mixture prior to 1958 (when the cove was dredged). (Guay 2)

South of the marsh area east of Nayatt Pt. there was eelgrass during scalloping time (1935-41, 46-51) (Rayhill 3)

There never was much eelgrass in the Barrington River (last seen in 1955). (Wallis 3)

There was eelgrass in Hundred Acre Cove very seldomly on one side of Peck's Pt. and on the east side of the tongue (last seen in 1955). (Wallis 2)

The entire Palmer River was full with SAV (?eelgrass or widgeon grass-said that it was much finer than Spartina) before 1945 and began to decrease in 1965-70 until it was completely gone in 1980. (Noland 3)

There was eelgrass in the Palmer River in the late 1930's and less in the 1940's. (Wallis 3)

Greenwich Bay used to be full of eelgrass, but it has been gone since 1945-55. (Bennett 1)

North of Chepiwanoxet there was a small patch of eelgrass in 1946-7. (Rayhill 3)

There were two patches of eelgrass west of Sandy Pt. from the late 1940's to the early 1960's. (Agin 3)

There was some eelgrass in the Potowomut River in the 1960's. (Ganz 3)

Marsh Pt. (up to a depth of 4 feet) had eelgrass in the early 1960's. (Agin 3)
The Potowomut River had eelgrass on either side just east of Bluff Pt. in the early 1960's. (Garin 3)

At the mouth of the Potowomut River on both sides there were patches of eelgrass until sometime between 1965-75 (Gammell 3).

The area between Tibbets Creek and the rocks north of Calf Pasture Pt. had eelgrass before 1951. (Rayhill 3)

Coggeshall Cove and Sheep Pen Cove on Prudence Island had eelgrass sometime between 1945-1960. (Noland 3)

Near Pine Hill Pt. down to the Homestead area (but on the west side) had eelgrass from 1939 until 1946-9 at the latest. (Rayhill 3)

Outside of Jenny's Creek on Prudence Island had some eelgrass sometime during 1945-1960. (Noland 2)

Potter's Cove had eelgrass in 1939-41. (Wallis 3)

Potter's Cove had a large amount of eelgrass in the early 1940's. (Drew 3)

All of Potter's Cove had eelgrass at least before 1945. (Wilcox 2)

The western side of Potter's Cove had eelgrass in 1945 (Rayhill 3)

From Mount Tom to Jenny Pond had eelgrass until 1949-50. (Rayhill 3)

In Walker Cove in Bristol Harbor there was eelgrass from 1945-1965. (Noland 3)

At the head of Bristol Harbor at the Bristol Yacht Club had eelgrass 1955-65. (Noland 3)

At Bristol Narrows, just before the Kickamuit River and in the Kickamuit River along Chase Cove there was eelgrass (1940-63). (Noland 3)

North of Wickford Harbor from Viles Creek (current sewer marker on NOAA chart) south to the breakwater at Sauga Pt., there was eelgrass that disappeared at least before 1945. (Wilcox 3)
Wilcox thinks that the filling activity at Quonset Pt. may have made the eelgrass disappear.

From Sauga Pt. to Vile's Creek there was eelgrass in 1950. (Rayhill 3)

Fishing Cove was full of eelgrass until 1937 - 1945 (Wilcox 4)

Fishing Cove had eelgrass 1946-7. (Rayhill 3)

In Wickford Cove between the yacht club and Gardner's Wharf there has been a patch of eelgrass since the mid 1930's. (Wilcox 2)

King's Park near the Ica Louis Yacht Club in the southeast corner of Newport Harbor off of Wellington Ave. had a patch in 1925 and has been there fairly steadily until 1975-1980. (Mendosa 3)

Price's Neck off Ocean Drive in Newport has had eelgrass since 1925 although in some years there have been "little decreases." (Mendosa 3)

From Portsmouth Park to Island Park south of the Cove, there was eelgrass in 1951. (Rayhill 3)

The areas north and south of McCurry Pt. had eelgrass in 1951. (Rayhill 3)

Around Black Pt. had eelgrass in 1951. (Rayhill 3)

Nannaquaket Pond had eelgrass in 1945. (Wallis 3)

Nannaquaket Pond had eelgrass all along the shores 1955-1960 -- > ?. (Noland 3)

Nannaquaket Pond used to have eelgrass in the 1950's and 1960's, but doesn't have any now (ulva rich presently). (Ganz 3)

The cove south of Fogland Pt had eelgrass in 1951. (Rayhill 3)

1960-1979

On either side on Greene Island and in Occupessatuxet Cove there was always eelgrass. (Guay 1-2)
Bullock's Cove had eelgrass (?late 1960's to early 1970's). (Ganz 2)

Bullock's Cove had eelgrass in the 1960's. (Brassard 3)

The entire Palmer River was full with SAV (?eelgrass or widgeon grass-said that it was much finer than Spartina) before 1945 and began to decrease in 1965-70 until it was completely gone in 1980. (Noland 3)

At Bristol Narrows, just before the Kickamuit River and in the Kickamuit River along Chase Cove there was eelgrass (1940-63). (Noland 3)

On both sides of the b.eakwali at the Warwick Pt. Lighthouse there was eelgrass in 1965. (Fitzpatrick 3)

There was a patch of eelgrass from the entrance to Buttonwoods Cove to the entrance to Warwick Cove (in the Oakland Beach area) in the 1960's. (Ganz 3)

There was eelgrass north of Chepiwanoxet from 1975-1985 and there were still some patches in the 1990's. (Fitzpatrick 3)

There were two patches of eelgrass west of Sandy Pt. from the late 1940's to the early 1960's. (Agin 3)

There was some eelgrass in the Potowomut River in the 1960's. (Ganz 3)

Marsh Pt. (up to a depth of 4 feet) had eelgrass in the early 1960's. (Agin 3)

The Potowomut River had eelgrass on either side just east of Bluff Pt. in the early 1960's. (Agin 3)

At the mouth of the Potowomut River on both sides there were patches of eelgrass until sometime between 1965-75 (Gammell 3).

The area between Tibbets Creek and the rocks north of Calf Pasture Pt. had eelgrass from the 1970's to 1990. (Langella 3)

Between Prudence and Patience Islands had eelgrass up through the early 1970's at least. (Ganz 2)
Jenny's Creek had eelgrass in 1978. (Blount 2)

The north end of Potter's Cove had eelgrass up through the early 1970's at least. (Ganz 3)

North of Homestead to the end of Chase Avenue used to have eelgrass until 1970. (Esau 2)

The southeast cove of Hog Island had eelgrass in 1965. (Noland 3)

The west side and the southeast corner of Hog Island used to have eelgrass in the late 1960's-early 1970's. (Ganz 3)

In Walker Cove in Bristol Harbor there was eelgrass from 1945-1965. (Noland 3)

At the head of Bristol Harbor at the Bristol Yacht Club had eelgrass 1955-65. (Noland 3)

The southern side of Fishing Cove had eelgrass in the late 1960's to early 1970's. (Ganz 3)

There used to be some eelgrass in Wickford in front of the yacht club in the 1970's (last seen 1974-75). (Ganz 3)

There was eelgrass near the Wickford Yacht Club in the 1970's. (Karlsson 3)

In Wickford Cove between the yacht club and Gardner's Wharf there has been a patch of eelgrass since the mid 1930's. (Wilcox 2)

There was thick eelgrass in Wickford Cove from 1969-70 until the mid 1970's. (Karlsson 3)

Lone Tree Pt and the cove just south of Cold Spring Rock had mostly Spartina, but some eelgrass in the early-mid 1970's. (Jeffries-3)

Bissel Cove had a Spartina/eelgrass mixture in the early-mid 1970's. (Jeffries-3)
Outside the entrance of the lower Narrow River where the river cuts through the Narragansett Beach there is a cove with eelgrass which has been there since the 1960's. (Pratt 3)

There has been a fringe of eelgrass on the west side of Beavertail south of Austin Hollow since the 1960's. (Pratt 3)

Potter Cove (Jamestown) north of the Newport Bridge has had patches of eelgrass since the 1970's, but there was not much in 1994. (Langella 3)

At the Dumplings, eelgrass has been there at least since 1965-1970 below a little stone dock. (Wilcox 3)

The Dumplings area had eelgrass in the mid 1970's. (Ganz 3)

The west cove at Fort Wetherhill has had eelgrass since the late 1960's. (Langella 3)

Fort Wetherhill has had eelgrass since the 1970's. (Swain 3)

The southeastern side of Mackeral Cove has had eelgrass since 1975. (Langella 3)

Hull Cove on Beaverneck in Jamestown has had eelgrass from 1975-90's although there hasn't been much lately. (Langella 3)

King's Park near the Ida Louis Yacht Club in the southeast corner of Newport Harbor off of Wellington Ave. had a patch in 1925 and has been there fairly steadily until 1975-1980. (Mendosa 3)

In Newport Harbor where the big gazebo sticks out into the water near the yacht club in the shoal water there was eelgrass in the early 1970's. (Ganz 3)

At Castlehill, Newport inside of Butter Ball Rock there had been patches of eelgrass from 1970's-1990. (Langella 3)

Price's Neck off Ocean Drive in Newport has had eelgrass since 1925 although in some years there have been "little decreases." (Mendosa 3)

The Green Bridge area in Newport had eelgrass in 1975. (Silvia 3)
Newport outer coast east of Cherry Neck off Ocean Drive there has been eelgrass since the early 1970's. (Ganz 3)

In the western portion of the Cove (Bristol???) and surrounding Spectacle Island eelgrass has been living from the early 1970's to the present. (Ganz 3)

Nannaquaket Pond used to have eelgrass in the 1950's and 1960's, but doesn't have any now (ulva rich presently). (Ganz 3)

The Sapowet marsh region around the Sapowet Bridge is pretty full of eelgrass (early 1970's -?present). (Ganz 3)

There used to be some eelgrass at the mouth of Nonquit neck in the early 1970's. (Ganz 3)

**1980-1995**

Behind the breakwater north of Passeonkquis Cove there was grass in 1994, but it may be Spartina. (Guay 1)

Occupasituxet Cove had eelgrass at least before 1985. (Ganz 3)

The Warren River had bits and pieces of eelgrass around Jacob's Point and Adam's Point in 1994. (Ganz 3)

Belcher's Cove (Palmer River) had eelgrass in 1993. (Ganz 3)

There was eelgrass north of Chepiwanoxet from 1975-1985 and there were still some patches in the 1990's. (Fitzpatrick 3)

There was eelgrass north and south of Chepiwanoxet before 1987. (Langella 3)

North of Chepiwanoxet there was eelgrass in 1992. (Lapteau 3)

West of Sally Rock Pt. there was eelgrass in the 1990's. (Langella 3)

Around the Warwick Lighthouse on Warwick Pt. there has been eelgrass recently (1990-95). (Cudworth 2)
Marsh Pt. at the northern side of the mouth of the Potowomut River had eelgrass in 1985. (Fitzpatrick 3)

The Potowomut River had eelgrass from the late 1980's to 1994. (Langella 3)

The area between Tibbets Creek and the rocks north of Calf Pasture Pt. had eelgrass from the 1970's to 1990. (Langella 3)

The back areas of Allen Harbor had eelgrass in 1994. (Langella 3)

The south side of Patience Island has had eelgrass since the late 1980's. (Johnson 3)

Sheep Pen Cove and the southern side of Coggeshell marsh had eelgrass in 1983. (Satchwill 5-documented scientific survey)

Coggeshell marsh had bands of eelgrass in 1994. (Langella 3)

The south side of Prudence has had eelgrass in the 1990's. (Johnson 3)

Both sides of the T wharf on the south side of Prudence had eelgrass in 1994. (Langella 3)

The west side of Hog Island has had eelgrass in the 1990's. (Johnson 3)

Near Colt State Park where the rocks start for the the park there was eelgrass in 1980. (Johnson 3)

The west side of Bristol Harbor has had eelgrass since 1985. (Johnson 3)

In Wickford Cove between the yacht club and Gardner's Wharf there has been a patch of eelgrass since the mid 1930's. (Wilcox 2)

In Wickford Cove along Gardner's Wharf there was eelgrass in the early 1980's. (Satchwill 3)

There has been a small patch of eelgrass on Bonnet Shore at the end of John Gardner Road since 1992. (Pratt 3)
South of Bonnet Pt. there has been eelgrass since 1985. (Plikus 3)

Both sides of Bonnet Pt. have had thin patches of eelgrass until the early 1980's. (Langella 3)

There has been a patch of eelgrass at Baby Basin at Baby Beach of the URI Bay Campus since 1992. (Pratt 3)

Outside the entrance of the lower Narrow River where the river cuts through the Narragansett Beach there is a cove with eelgrass which has been there since the 1960's. (Pratt 3)

There has been a fringe of eelgrass on the west side of Beavertail south of Austin Hollo since the 1960's. (Pratt 3)

Dutch Harbor in Jamestown has had eelgrass in the shallows in the 1990's. (Swain 3)

The Fort Getty side of Dutch Harbor has had eelgrass in the 1990's. (Walpole 3)

The west passage side of Jamestown near Main St. has had eelgrass in the 1990's. (Plikus 3)

The northeast side of Conanicut Island near a retaining wall of a house had eelgrass in 1994 (from the depth reading of 64 to 48 on NOAA chart 40th edition). (Langella 3)

The northshore of Jamestown at Pirate's Landing has had a patch of eelgrass since 1980. (Lapteau 3)

Potter Cove north of the Newport Bridge has had patches of eelgrass since the 1970's, but there was not much in 1994. (Langella 3)

Potter Cove north of the Newport Bridge has had eelgrass since 1980. (Lapteau 3)

From Potter Cove to Cranston Cove on the western side of Conanicut Island had eelgrass in the late 1980's. (Bennett 2)

The south side of the Newport Bridge in Jamestown has had a patch from 1985-94. (Lapteau 3)
At the Dumplings, eelgrass has been there at least since 1965-1970 below a little stone dock. (Wilcox 3)

The Dumplings area has had eelgrass in the 1990’s. (Swain 3)

The Dumplings area has had eelgrass in the 1990’s. (Carney 3)

The Dumplings area has had eelgrass in the 1990’s. (Warnock 3)

The west cove at Fort Wetherhill has had eelgrass since the late 1960’s. (Langella 3)

Fort Wetherhill has had eelgrass since the 1970’s. (Swain 3)

Fort Wetherhill has had eelgrass since the early 1980’s. (Krueger 3)

Fort Wetherhill has had eelgrass since 1980. (Mather 3)

Fort Wetherhill has had eelgrass in the 1990’s. (Walpole 3)

The cove with the boat ramp at Fort Wetherhill has had eelgrass in the 1990’s. (Carney 3)

Fort Wetherhill has had eelgrass in the 1990’s. (Plikus 3)

The southeastern side of Mackeral Cove has had eelgrass since 1975. (Langella 3)

The west side of Mackeral Cove has had eelgrass in the 1990’s. (Walpole 3)

Mackeral Cove has had eelgrass in the 1990’s. (Plikus 3)

Hull Cove on Beaverneck in Jamestown has had eelgrass from 1975-90’s although there hasn’t been much lately. (Langella 3)

To the north of Rose Island had eelgrass in the shoal water in the late 1980’s. (Ganz 3)

At the torpedo station at Goat Island there has been eelgrass recently (in the last ten years). (Wallis 3)

King’s beach in Newport near the boat ramp had eelgrass in 1985. (Mather 3)
Along the shallows away from the boats in Newport Harbor there has been eelgrass in the 1990's. (Swain 3)

Fort Adams State Park near the boat launch in Newport has had eelgrass in the 1990's. (Plikus 3)

At Castlehill, Newport inside of Butter Ball Rock there had been patches of eelgrass from 1970's-1990. (Langella 3)

Between Brenton Reef and Price Neck in Newport there has been eelgrass since 1985. (Plikus 3)

Between Price Neck and Seal Rock there are patches of eelgrass (Langella 3)

Price's Neck off Ocean Drive in Newport has had eelgrass since 1925 although in some years there have been "little decreases." (Mendoza 3)
Along the coves and shallows of the Greenbridge area (west of Cherry Neck) in Newport has had eelgrass recently. (Swain 3)

The Green Bridge area off Ten Mile Drive past Price and Cherry Neck in Newport had eelgrass in the 1990's. (Lapteau 3)

Around the rocks north of Gooseberry Island there still is eelgrass. (Langella 3)

Sheep Pt. Cove in Newport has had eelgrass in the 1990's. (Plikus 3)

In the western portion of the Cove (Portsmouth) and surrounding Spectacle Island eelgrass has been living from the early 1970's to the present. (Ganz 3)

Island Park in Portsmouth had eelgrass in the 1980's. (Mather 3)

The Sapowet marsh region around the Sapowet Bridge is pretty full of eelgrass (early 1970's -?present). (Ganz 3)

Sakonnet Point in Little Compton has had eelgrass in the 1990's. (Warnock 3)
The south side of Sakonnet Point has had eelgrass in the 1990’s. (Johnson 3)

There used to be eelgrass in Quicksand Pond until mid 1980’s. (Ganz 3)

**Oral Interview Subjects**

Ed Agin p130-1 (54 yr old shellfisherman)
Clarence Bennett p85 (90 yr old scallop/shellfisherman)
Luther Blount p40 (property owner-Prudence Is.)
Tim Brassard p26 (38 yrs old, grew up near Bullock’s Cove)
Brian Carney p45 (diver)
David Cudworth p39 (diver)
George Drew p128 (scallopsHELLfisherman)
David Esau p47 (quahauger)
Bob Fitzpatrick p84 (swimmer, snorkeler)
Middleton Gammell (property owner/recreational user of Greene R.)
Arthur Ganz (Fish & Wildlife)
Eddie Guay (66 yr old shellfisherman)
Perry Jeffries (URI researcher)
Shirley Johnson p52(quahauger)
John Karlsson p41 (?Wickford DEM)
Bill Krueger p27 (fish researcher at URI)
John Langella p64-7 (diver, biology teacher)
Mark Lapteau 70-1 (underwater photographer)
John Mather p57 (spearfisherman)
George Mendosa (72 year old fisherman)
Bill Noland (70 yr old scalloper/shellfisherman)
John Plikus p 48 (spearfisherman)
Sheldon Pratt p24 (URI researcher)
Robert Rayhill (73 yr old shellfisherman)
Jim Rice p94 (76 yr old shellfisherman)
Dick Satchwill p53 (Fish & Wildlife-conducted study in 1983)
Larry Silvia Jr. p72 (diver)
David Swain p42 (diver)
Charles Walpole p 43 (diver)
Ted Warnock p 51 (diver/spearfisherman)
Russel Wallis (77 yr old shellfisherman)
Don Wilcox (78 yr old shellfisherman/boat builder)
Appendix G:
Historical Eelgrass Distributions In Narragansett Bay
Cited in Literature References
Listed in Chronological Order

April 1899
"Laminaria Agardhii Kjellm forma Zoastericola, n.f. very delicate form, growing on Zostera marina L., Newport Harbor, RI." Noted by Mrs. W. C. Simmons.


1899
“I have found numerous specimens (of Polysiphonous), always on Zostera, along southern New England... About 1899 I collected in Narragansett Bay a scantily fruited Polysiphonous specimen.”


summer 1901
“Rhadinocladiad farlowii found in summer on Zostera in Narragansett Bay, Bristol”
“Rhadinoclada cylindrica is always on Zostera in midsummer and autumn, in Bristol Harbor, RI”


1921-23
“I was able to follow the course of behavior and associated temperatures in a very small cove between two small points near Newport, RI. This small indentation has no name on the map, but is readily located as about halfway between Brenton Point and Price’s Neck. The small belt of eel grass is well below the lowest tide limit of the year. Observations were possible for me on three successive years (1921-1923), but only from early May to late July. These months, however, cover the most critical periods. The early
May (1921) observation, being unpremeditated, was not accompanied by temperature record, but no erect stems could be seen or obtained. . . While the temperature may rise to or slightly above 20 C in August or September, according to general data, heat rigor is probably slight. . . The Newport locality allows of little, if any, heat rigor, but for abundant cold and recrudescet rigor, with full opportunity for vegetative and reproductive activity.”

“Zostera marina occurs abundantly in the inner waters of Narragansett Bay as well as in the large protected salt-water ponds of southern Rhode Island. Observations have been made by myself on several of these and temperatures taken from time to time. . . on June 25, 1921, near Bristol, I found no erect stems along the shore of “Colt’s Farm.” I found there rhizome plants but lacking any trace of erect stems, dead below and mostly dead above, but with only ripe or very nearly ripe fruits.”

“At Sakonnet Pt, R. I., (eastern entrance to Narragansett Bay and exposed to the colder outer water on flood and the warmer inner water on ebb tides) I found on June 10 1923 a very interesting condition of Zostera marina. The Zostera grew in sand in a small, shallow pool protected from the outer water by a series of large rocks, so that at low water during my visit, the shallow water was protected from outside overflow and was exposed to full insolation. Ther Zostera grew only in the shallow pool whose temperature (at low tide) was 20C,. . . The Zostera had very short erect stems (about 25 cm high) but showed about seven internodes. The older inflorescences were in the second stage of anthesis (anthers protruding). This seemed to be due to the intermittent warming of the waters at periods of low water.”

“On the innermost northeastern arm of Narragansett Bay is the inlet known as Lees River. It is in the town of Somerset, Massachusetts. At the most southern road bridge frequent observations were made on the phenologic behavior of Zostera marina from May 12, 1921 to February 15, 1922 and again in June and July, 1923. The greater portion of the observations were made by myself, but for autumn and winter observations I am indebted to my brother-in-law and sisiter, Mr. and Mrs. Charles L. Davis, and to my nephew, Charles E. Davis of Providence, RI. . . The fruiting season at Newport is in late July while at Lees River it is in May and June.”

1932
Includes a map of United States with geographical range of *Z. marina* which has poor resolution, but shows whole coastline of ME, NH, MA, RI (including in the bay), much of Long Island and NY shaded (p. 77).


June 1936
“Early in June, hoping to discover something of these factors (extent of new beds since wasting disease), a short intensive field search was made of the shallow bays from Greenwich, RI to Great Bay, NJ. This was made possible through the kind cooperation of Mr. John L. Lynch of the U. S. Biological Survey.”

“Along the Rhode Island coast conditions for growth seemed much more favorable than farther south. In Narragansett Bay proper, at Greewich and Wickford, however, reports and hurried inspection yielded no eel-grass, a matter of concern since the beds had heretofore furnished excellent natural protection to young lobsters introduced from the state hatcheries. At Point Judith, in Fish Pond and westward in Charlestown Pond, Quanochontaug Pond and Winnapaug Pond, there were scattered plants and small, separated beds from a foot to a yard in diameter. These were in good condition, leaves from ten to fifteen inches long, with only a small proportion showing any symptoms of the disease... Abundant growth of vigorous plants in relatively dense, though scattered beds prevailed in the extensive shallows of the western half of Little Narragansett Bay. The leaves were large—a meter long and a quarter of an inch wide; many plants were in seed. This area presented the most favorable redevelopment observed, though streaking and blackening of the leaves was common.”

“Specimens of diseased plants were taken from all beds and examined microscopically for the parasitic *Labyrinthula* ... (which) was present without exception in grass showing spotting or streaking.”

Appendix H: Archives Searched

- R.I. State House Library (Annual Reports of the Commissioners of Inland Fisheries, Shell Fisheries and Department of Agriculture and Conservation)
- R.I. State Archives
- R.I. Historical Society (including the graphics department)
- Woods Hole Oceanographic Institute Archives
- Providence Athenaeum
- National Archives (Department of Agriculture and U.S. Fish & Wildlife record groups.)