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Current Status of Vegetation in Herring River

Report to the

Association for the Preservation of Cape Cod

by

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Introduction

This report discusses the changes in vegetation surrounding the impounded area of Herring River, Wellfleet, MA, that have taken place since 1974. The vegetation was surveyed in 1974 by Alison Snow. Some measurements of vegetation were done in 1978, 1980, and 1983 by Elizabeth A. Koulcheras. In late summer 1983 we surveyed the vegetation, obtained estimates of plant biomass and measured water salinity in the same sites examined in 1974, and made some measurements of the extent of excursion of water level due to tides. Below we consider our results in view of the other data available, and make recommendations as to future management of the area.

1974 site
not recorded
for comparison

Vegetation

There have been remarkable changes in the vegetation of the area since 1974 (Figs. 1, 2). There are many kinds of changes that can be documented, but the overall pattern can be summarized as increases in salt marsh cordgrass, change from cattails to reeds, and reduction in salt marsh hay. Some main features of these three changes are described below.

1. Increases in salt marsh cordgrass

The area covered by cordgrass (Spartina alterniflora) increased by over three times between 1974 and 1983. Large islands of cordgrass have appeared and the belt of this species along most of the shore has become more continuous and extensive (compare Figs. 1 and 2). A. Snow measured the width of the belt of cordgrass at various stations in 1974. These stations were surveyed by E. Koulcheras in 1978, 1980, and 1983. We repeated the measurements in 1983. All these data are included in Table 1. Although a trend to lower width may appear at first glance, it is not a significant trend (analysis of variance, $F = 1.544$; 4, 23 degrees of freedom, not significant).

now we
map (Fig 2)
generated
how many
stations
(no more
available)

There is simply too much variability from one station to another to reliably

Station
the same
station

width still
may have increased
since high variability
was not controlled
with intensive
survey effort

This may discrepancy
to explain and DEQ 1983
Station 1974 and 1983
locations of Snow's
transects

measure changes. The method of using belt width is not a reliable way to assess vegetational changes. There is much year-to-year change at any one site, even if exposed to only natural conditions, and if measurements are to be meaningful, they have to be done at exactly the same place and time of the growing season. All in all, this is not a very good way to measure vegetational changes in Herring River. One better way is to compare vegetation maps of the area, as can be done by examining Figures 1 and 2.

Table 1. Width (in meters) of the belt of cordgrass at several stations along the Herring River Shore. The stations are indicated in Fig. 1. All values refer to cordgrass only, except on the two cases indicated. Value for station 9 was not included in statistical analysis.

Station Number	<u>1974</u>	<u>1978</u>	<u>1980</u>	1983 (by E. Koulcheras)	1983 (our data)
Below dike					
1	23.9	-	-	-	32
2	23.3	-	-	-	28
Above dike					
3	18.2	4.5	4.5	1.5	1.5
4	3.7	3.0	1.8	1.5	3.0
5	6.0	6.1	3.9	N.P.	1.5
6	5.5	3.6	2.7	1.5*	2.0
7	3.0	18.2+	10.3	1.5	5.0
8	3.7	4.5	-	3.0	3.0
9	0	-	-	-	5.0
Average	6.7	6.7	4.6	1.8	2.7
Variance	27.64	27.59	8.89	0.36	1.47

* S. alterniflora with some rush

+ S. alterniflora with a small amount of sedges

From the evidence in Figs. 1 and 2 we have to conclude that there was an increase in the area covered by cordgrass. The increase in area covered by this species was not, however, accompanied by significant increases in amount of cordgrass per unit area (Table 2). The weight of cordgrass per unit area did not materially change either below or above the dike in the nine years;

the range of weights in the various stations overlap considerably from year to year (Table 2). This suggests that nutrient conditions in the impoundment have remained about the same, even though the change in cordgrass area demonstrates that the environment has become more marine in recent years.

only nutrient availability is suggested by this.

2. Change from cattails to reeds

Very considerable areas covered by cattails (*Typha* spp.) in 1974 (Fig. 1) have been colonized by reeds (*Phragmites communis*) by 1983 (Fig. 2). This may in fact have been the largest change in terms of area, since it occurred over most of the wetlands to the northeast, upriver from where Mill Creek enters Herring River (Figs. 1 and 2). The cattails are typical of freshwater wetlands, while reeds do very well in brackish conditions. The observed changes in these two plants reflect the increased salinity in the Herring River in recent years.

very famous

Table 2. Amount of cordgrass (grams/meter²) in various stations along the Herring River (see Fig. 1 for specific sites of stations). Estimates were obtained by measuring height of grass, and using a conversion equation height = 0.5 weight + 7759, $r = 0.95$, obtained by A. Snow for Herring River cordgrass. Data for 1978 obtained by E. Koulcheras. Station 9 was not included in the calculation of averages and standard errors. N.D. = no data.

<u>Station numbers</u>	<u>1974</u>	<u>1978</u>	<u>1983</u>
Sites below dike			
1	1329	N.D.	1730
2	1714	N.D.	1680
average + standard error:	1521.5+192.5		1705+25
Sites above dike			
3	856	1990	1480
4	1393	1380	1230
5	1516	1990	1310
6	1278	1580	1230
7	1499	2000	1850
8	2841	2000	1790
9	none	N.D.	600
average + standard error:	1564+273.8	1823+111.6	1356+158.4

3. Reduction of salt marsh hay

The scattered areas covered by salt marsh hay (Spartina patens) in 1974 (Fig. 1) have been reduced by 1983 (Fig. 2). Examination of these sites showed that remnant plants of marsh hay were still present below the reed canopy. There is some new growth of salt marsh hay on sites further toward the sea. At first glance, the reduction in the upriver areas may not seem consistent with an increase in salinity of the water. One may expect increases of all salt marsh species under such conditions, but the sites where salt marsh hay grew in 1974 were probably relicts of a much more extensive earlier salt marsh. The present flow of seawater into Herring River is probably not enough to increase salinity in the high intertidal reaches originally covered by salt marsh hay when the area was an open salt marsh. Currently, little salt water reaches these relict areas of salt marsh hay, and in consequence they are being overgrown by reeds; the latter apparently do considerably better at the prevailing low salinities and can easily overlap and shade the marsh hay. On the other hand, more to seaward, and lower in the intertidal range, we can now find patches of salt marsh hay beginning to develop (see area around mouth of Mill Creek, Fig. 2); in such sites, sediments are probably saltier and marsh hay grows where reeds are inhibited by salt.

Even though the maps of Figs. 1 and 2 appear complicated, they are simplifications. Each of the categories of vegetation depicted contains multiple species, as described in the legend to Fig. 2. The point of this report, however, is to assess what changes have taken place in regard to the freshwater or marine aspects of the vegetation. To do this concisely, we combined all the plant species into three broad categories, based on whether the plants typically were found in fresh, brackish, or coastal wetlands. These broad categories are depicted in Fig. 3 for 1974 and 1983. The

freshwater marsh area present in 1974 was largely replaced by 1983 by brackish marsh species. The area of coastal salt marsh increased by over 300% in the nine year period.

Actual measurement dates?

Salinity of water

We carried out several measurements of salinity of the water in the stations shown in Fig. 2. At low tide in August 1983, salt water was found from the dike up to the mouth of Mill Creek (Table 3, second column). During high tide, the influx of seawater raised salinities up to 26‰, both at the surface and bottom of Herring River (Table 3, third and fourth columns). The incursion of salt was also detectable farther upriver at high tide.

We measured salinities again after the Town lowered the level of the sluice (Table 3, columns 5 and 6). The lowering did not seem to have much of

Table 3. Salinities measured at various stations in Herring River during low and high tides at two dates. "Surface" means water was collected near the surface of the water; "bottom" means water was sampled a few centimeters above the bottom. All measurements were done with a Goldberg refractometer. The locations of the stations are indicated in Fig. 2.

Station #	28 Aug 83			4 Sep 83	
	During low tide	During high tide Surface	During high tide Bottom	During high tide Surface	During high tide Bottom
Below dike:					
A	-	12	-	-	-
Above dike:					
B	11.5	26	26	24	24
C	5	20	26	24	24
D	3	13	-	14	20
E	0	1	23	4	12
F	0	1	-	0	0
G	0	0	-	0	0
H	0	0	0	0	0
Tide height at Wellfleet		9.9 feet		11.3 feet	

compare to historic data 1900-1974

an effect on salinities, even though the tidal range seemed to have been extended by up to 10 cm (Table 4). Differences in the height of the tide may

influence measurements such as those of Table 3. The incursion of salt water into the estuaries will be farthest the higher the height of the tide, as seems to have been the case on the two specific days in which we did measurements. The impact of lowering the sluice level has to be assessed by measurements through a lunar tide cycle.

Table 4. Change in elevation of water surface (in centimeters) at salinity stations (Fig. 2) within the Herring River impoundment. Measurements were obtained by observing the difference in water level between high and low tide.

Station #	28 Aug 83	4 Sep 83
B	32.5	42.0
C	35.8	41.2
D	39.0	41.0
E	33.5	41.3
F	37.0	37.4
G	22.0	27.1
H	21.0	25.8
I		24.0
J		24.0

tide heights?

Future changes and recommendations

If the management goal is to create a rich, productive coastal marsh, the best way to achieve it is by lowering the level of the dike. As more seawater enters the impounded area, more salt marsh plants will dominate vegetation in the shores and contribute to the productivity of the estuary. [There will be shifts in the location of different species because currently the position of cordgrass is somewhat higher ^{elevation} inside the impoundment than outside (Fig. 4).]

Because of the higher level of the sediment accumulated behind the dike, there will be a period of erosion after the dike is lowered. This will continue until the levels of sediment inside and outside the dike are more similar. The readjustment will result in some sediment transport downstream after the lowering of the dike. It would be preferable to have the transport take place in as short a period as possible. It will therefore probably be better to open the entire dike at once. This will not only make the duration of larger

why impact of slow increase in flow are unclear

sediment load shorter, but if done in late spring, will give the vegetation a good chance to regrow quickly and stabilize the surface.

If the level of the dike is lowered, the cordgrass will grow lower in the intertidal zone, and will perhaps be replaced higher in the intertidal range by salt marsh hay. This is the usual zonation observed in New England salt marshes. Currently, much of the upper intertidal is occupied by brackish water species such as reeds. These species are not as desirable for cover and estuarine productivity as cordgrass. Since reeds now occupy a major part of the wetland, a major objective of management should be to allow more salt water into the impoundment so that reeds are replaced by cordgrass.

All the remarkable changes reported above have taken place even though only a small amount of seawater entered the impoundment. The conversion will continue if the dike remains open and will accelerate if the opening is larger. In any case, the changes that take place will continue to be barely perceptible to most laymen. The impounded area may be more rapidly converted to a marine estuary if so desired, by simply opening the dike to the maximum. We anticipate an orderly, but faster replacement, after such an action. The transition might be accomplished in a few years. The relict marsh hay areas show that salt marsh areas can be very much greater than at present. There will be a period during which the dead upland shrubs may be visible as dead bare branches, but these will rot over a few seasons. This transition can be shortened if the maximum amount of seawater is allowed to enter the impounded area.

We have in the past recommended that the gates be opened as much as possible. This would hasten conversion of the impounded area to a very productive salt marsh estuary. Shell and fin fish will benefit, and the area will improve as a bird feeding sanctuary. There will be a time of sediment

transport, but this will be short-lived, and the marsh plants will shortly regrow and stabilize sediments.

There has been some public concern as to the effect of the seawater on the ground water surrounding the impoundment. We expect that the consequences for ground water will be slight and only limited to the near-shore areas of the Herring River impoundment.

Fig. 2. Vegetation distribution of impounded area of Herring River, August 1983. The vegetation types are described according to the dominant species, but each contains other species: 1) Cattail - primarily Typha latifolia, with some Scirpus spp., Juncus spp., Phragmites communis; 2) Reed - mainly Phragmites communis, sometimes with Spartina patens in the understory; 3) Mix - Scirpus maritima and other Scirpus species, Juncus spp., T. latifolia, P. communis, Spartina alterniflora; 4) Salt marsh hay - S. patens, with some J. gerardii, Solidago spp; and upland plants; 5) Cordgrass - primarily S. alterniflora with occasional Scirpus spp. and Juncus spp. The letters refer to stations in which we measured salinity and tide heights. The numbered dots are stations where data on the vegetation were obtained.



Fig. 2

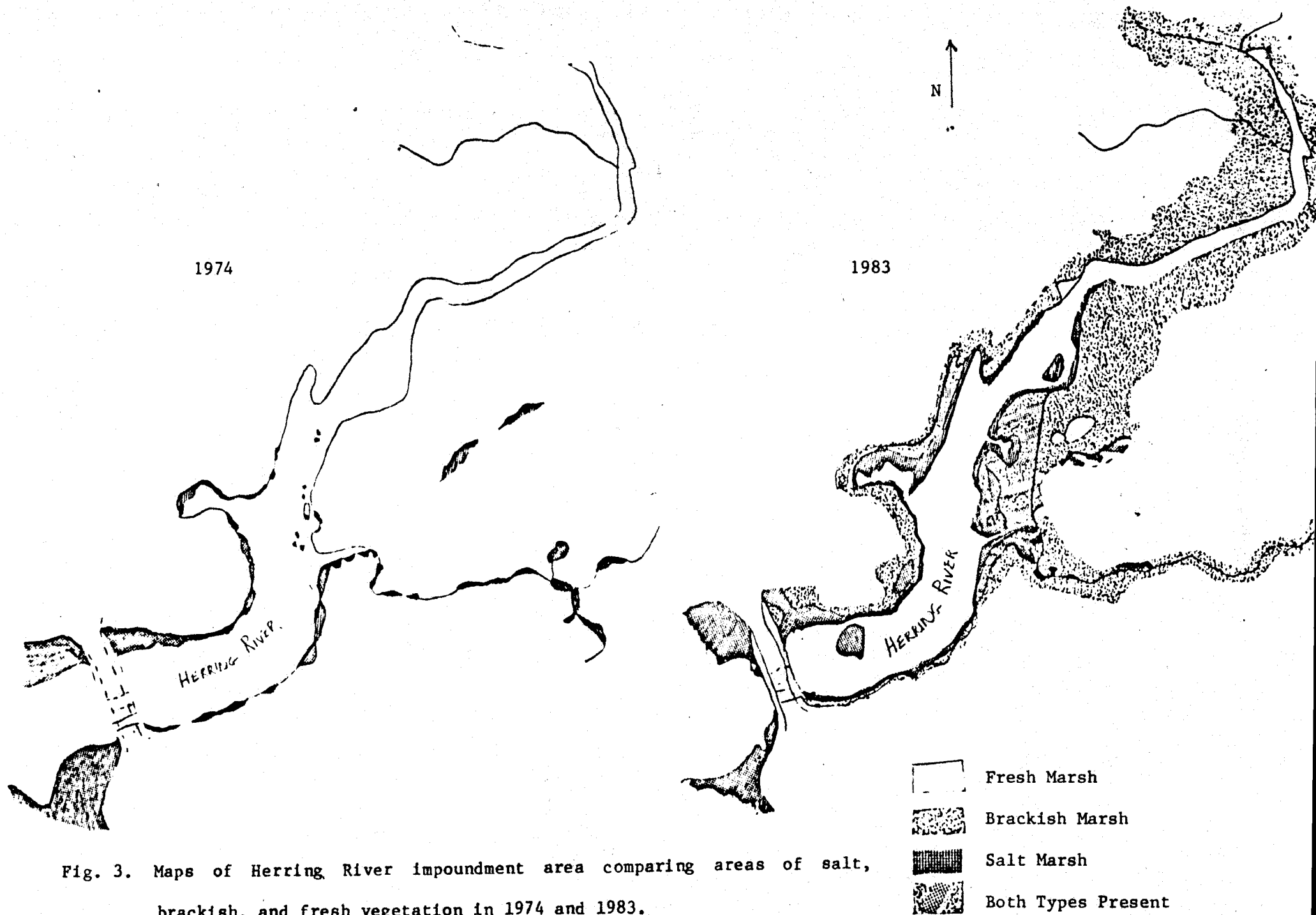


Fig. 3. Maps of Herring River impoundment area comparing areas of salt, brackish, and fresh vegetation in 1974 and 1983.

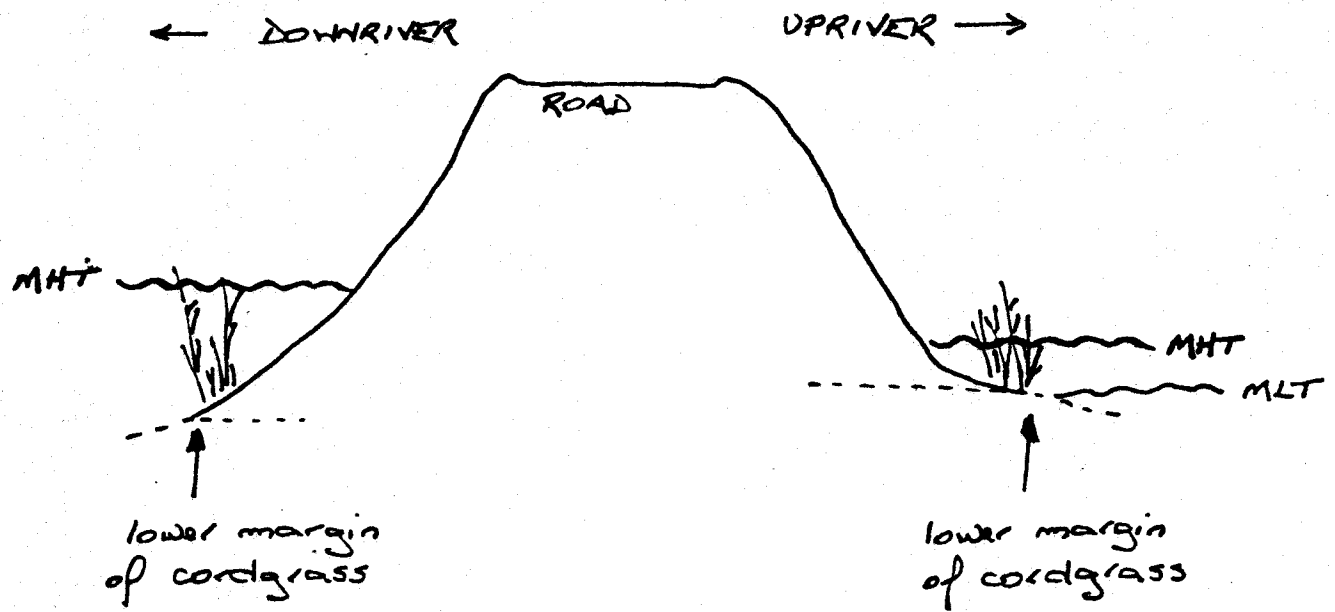


Fig. 4. Cross-section of dike at Herring River showing relative elevations of lower boundaries of cordgrass on bay and impoundment sides.