MARSH Project

Monitoring the Active Replenishment of Subsiding Habitat Project

A Newsletter and Progress Report — Summer 2002

Some of the Pamunkey River marshes in Virginia's York River Watershed have been undergoing changes in plant community composition for at least the last decade. The taller grasses such as Big Cordgrass, *Spartina cynosuroides*, have been replaced by the lower elevation plant Arrow Arum, *Peltandra virginica*, and, in some cases, by mudflats.

It is thought that the observed changes are a result of rising sea level, potentially combined with local subsidence, making it impossible for the marshes to accumulate surface material fast enough to precisely maintain their position in the intertidal zone. This would explain the transition from a plant community dominated by Big Cordgrass to one dominated by Arrow Arum. Researchers have three primary questions: 1. What would be the ecological significance of the change in marsh character?; 2. Could anything be done to maintain or restore the original plant community structure?; and 3. Can a management strategy be developed that will counter this change?

How can this be done?

The resulting project was designed to accomplish several things: 1. Document the differences between Big Cordgrass and Arrow Arum communities; 2. Evaluate several methods of raising the marsh surface incrementally to keep pace with sea level rise; and 3. Assess the potential for unintented expansion of the invasive Common Reed grass *(Phragmites australis)*.

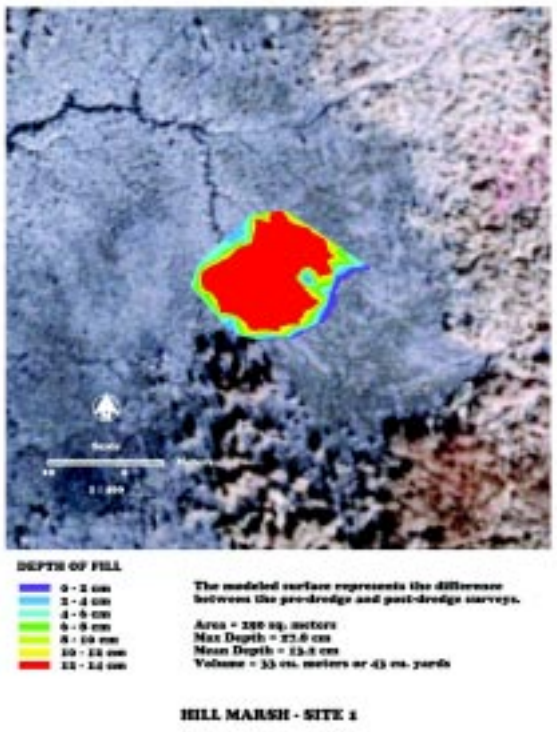
Scientists at VIMS are studying the effect of spray dredging a thin layer of material on the marsh surface in three locations. At the same time, other smaller scale experiments involving Koir logs and mesh were installed to test sediment trapping effectiveness.

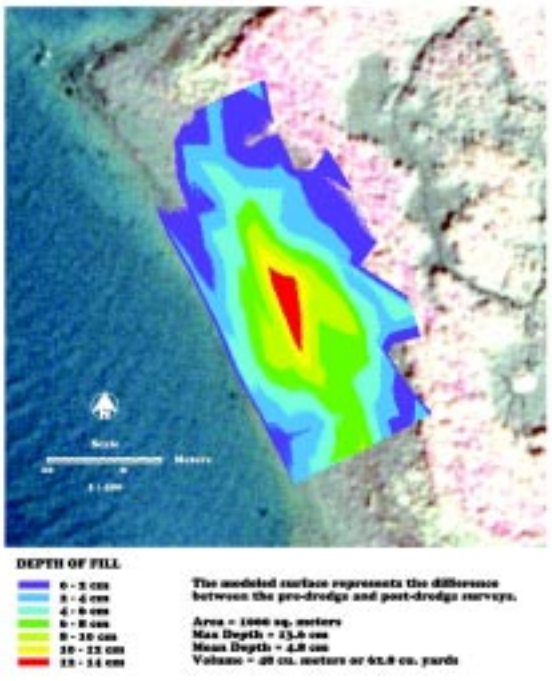
What is being studied?

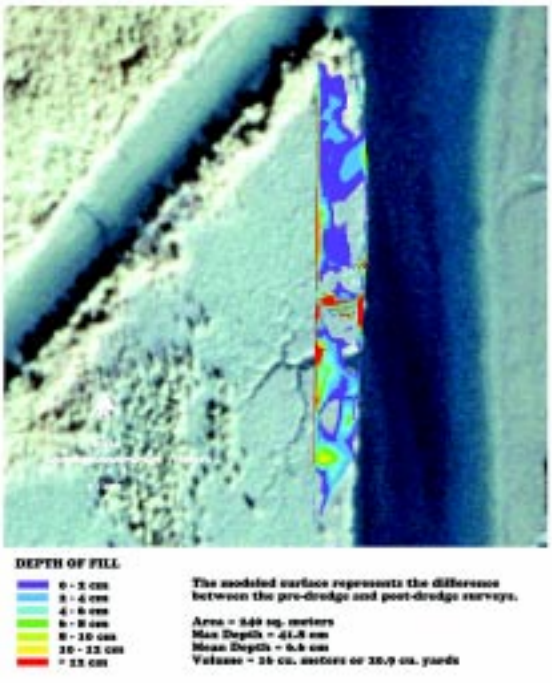
The types and abundances of plants were sampled prior to the spray dredging operation. In addition, the bottom dwelling animals were sampled and the bottom contours were measured in the area where the dredge was to operate prior to spray dredging. Finally, detailed elevations were taken in the proposed dredge spray areas. Water quality monitors were established both prior and after the dredging activity. Other sampling included bird communities, fish communities, and insect communities.

Elevation Survey

To evaluate the success of the spray dredging experiment, very detailed surveys of the marsh surface were required before and after the dredging operation. Since anticipated changes would be very small, a technique that could measure very slight elevation changes over time was required. To accomplish this a GPS survey using dual frequency, carrier phase measurements and Real Time Kinematic (RTK) positioning was employed. Carrier phase measurements provide accuracy at the centimeter level. RTK surveys use a radio link between the base station receiver and the roving receiver so corrections are made as the points are logged in the field. In this project a base station receiver was established near the marsh sites. The rover receiver, or the unit on the marshes, occupied multiple locations on the marsh surface where the dredge sprayed material would be deposited. Approximately 80 points were measured at each experimental site. The resulting coordinates were used to generate the marsh surface topography. The experimental sites were resurveyed after the dredge spray activity to produce contoured before and after maps. Spray dredging using fine silt and mud from the marsh creeks is not a particular effective method of increasing marsh surface elevation. Based on calculations of material accumulation the amount of material successfully placed on the marsh surface was very modest, given the amount of material originally excavated. The material available in the marsh creeks is so fine-grained, that it does not settle out on the marsh surface quickly enough to accumulate. The experimental sites will be resurveyed each year to determine the stability and longevity of the material that did settle on the marsh surface.







Vegetation Survey

The objective of this research is to determine whether a layer of sediment sprayed over the marsh to increase the surface elevation will result in a change in the existing plant communities within portions of the Lee and Hill marshes, which have been recently dominated by Arrow Arum (*Peltandra virginica*).

During the early summer of 2001, replicate transects were established at three locations within the study area; one within Lee marsh (Lee-1) and two within Hill marsh (Hill-east and Hill-west).

Transects within Lee marsh were established adjacent to one of the larger tidal creeks running through the marsh. Transects within the Hill-west site were established adjacent to the Pamunkey River while transects within the interior Hill site (Hill-east) were established approximately 200m from the river. Five, 50 meter (m) transects were established early in 2001 at each study site. Transects were aligned parallel to the source of hydrology and placed 10m apart. The odd numbered transects were labeled A, B, and C and sampled using $1m^2$ quadrats placed every 5m along their entire length. Sampled plots were randomly selected on either the left or right side along the transect to remove any sampling bias. Percent cover (total amount of vegetation found within each quadrat) was recorded along with the percentage of each species comprising the total vegetated portion of each quadrat. VIMS scientists identified plants in the field to the maximum extent possible and species level identifications were later determined or confirmed in the lab when possible.

Vegetative sampling of the three sites was first conducted during July and August of 2001 prior to the application of the spray dredge material. The purpose of this initial sampling was to characterize the existing plant communities within each site. This information also provided baseline data for future comparison of plant communities following the disturbance associated with the application of the spray dredge material. Surface elevation data for each site was also collected during the summer of 2001 prior to disturbance using a Trimbell© Global Positioning

System (GPS). Initial data show all three study sites were dominated by Arrow Arum although sedge *(Carex comosa)* and Big Cordgrass *(Spartina cynosuroides)* comprised a major percentage of numerous plots within the Hill-west and Lee sites respectively. Wild Rice *(Zizania aquatica)* comprised a large percentage of quadrats within the Hill-east interior site.

Following the application of the spray dredge material in early October 2001, a second survey of surface elevations was conducted at each site. Although the average accumulation of dredge material on the marsh surface at each site was less than 10 in., VIMS scientists were interested in whether the increased surface elevation would result in a change of the dominant plant species. The objective was to convert an Arrow Arum marsh to habitat dominated by another plant species more valuable to waterfowl, such as a Wild Rice and/or Big Cordgrass marsh.

VIMS scientists recently conducted the first of several samplings planned during the second year of the vegetative community study. For direct comparison, the same 50-m transects and sample plots established last year during the initial sampling

protocol were utilized. Data collected during the 2002 early season sampling show that Arrow Arum remains the dominant plant species found within each of the three sample sites, while sedge and Big Cordgrass continue to comprise a large percentage of the quadrats sampled at the Hill-west and Lee marsh sites respectively. Although early season 2002 data (post-spray dredge) appear to indicate no significant change in the plant communities within the three sample sites, VIMS scientists will conduct additional sampling later this summer and continue to evaluate whether species such as Wild Rice and Big Cordgrass increase in abundance in the experimental area. Another post-dredge physical survey will also be conducted later this summer to determine the relative permanence of artificially raising the elevation of the marsh surface. It is hoped that our continued study will provide valuable insight into the feasibility of successfully altering an existing plant community with the application of sprayed dredge material or that when performed correctly, this technology represents an acceptable method for the disposal of dredged material without long-term adverse environmental effects.

Benthic Survey

A seasonal benthic macroinvertebrate study is being conducted near the Lee and Hill Marsh dredge sites. Samples were collected from both the edges of the creek and the creek channel. Samples are processed through a 710 mm sieve to remove fine sediments and reduce the sample. A solution of formalin and Rose Bengal stain was added to the sample to preserve and add a pink tint to any living organisms. In the laboratory, the sample was then mixed with water to further break apart the mud clods and again put through the sieve. The remainder was then scanned under low power magnification to pick out the delicate organisms with fine-tipped forceps. The organisms were then viewed under a high power microscope so they could be identified.

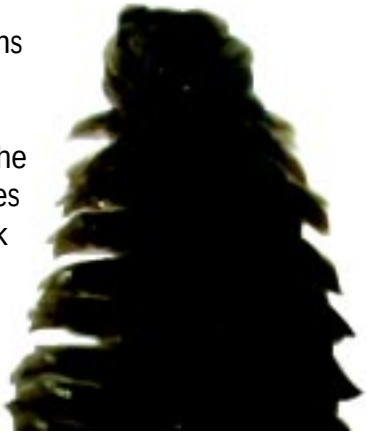
The samples that have been processed thus far have contained very few organisms and very little diversity. For the most part, polychaetes (bristle worms) were the most prevalent. These worms are often found buried in or crawling on the mud in search of algae and small soft-bodied invertebrates. Other macroinverte-brates found in the marshes include amphipods and fishfly larva. Amphipods, such as Scuds, primarily live in shallow waters where they eat algae and detritus. Fishfly larva are predacious organisms that are most often found under rocks in fast-flowing streams. There is however, a genus that lives in pooled water, under leaf detritus. These organisms have breathing tubes that allow them to survive in waters with lower oxygen content.

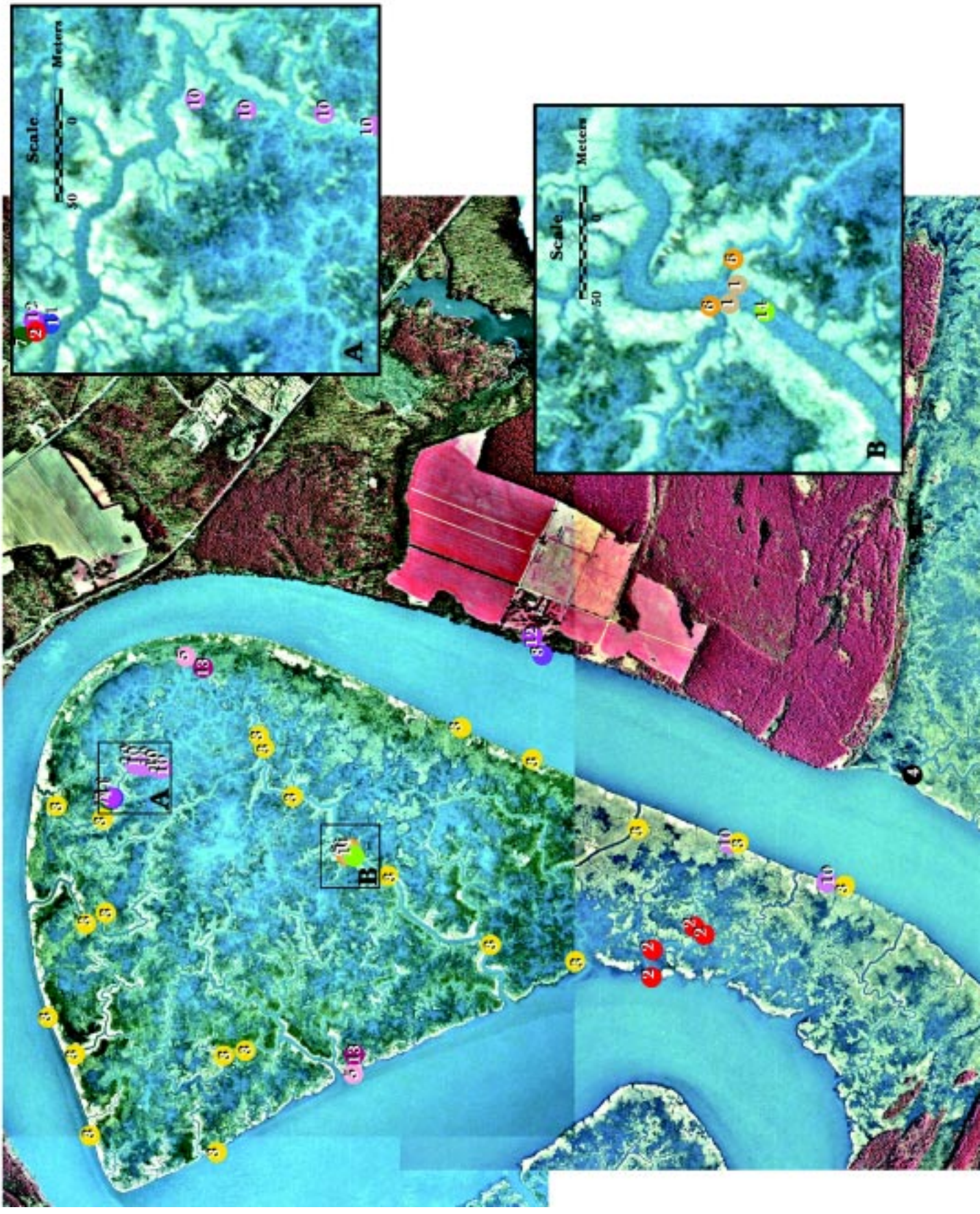

Eckman Grab


Scuds


Fishfly Larva

All of the organisms presented here, have been found in the samples collected in the creek channel. Samples collected on the creek edge have contained no benthic macro-invertebrates.


Polychaete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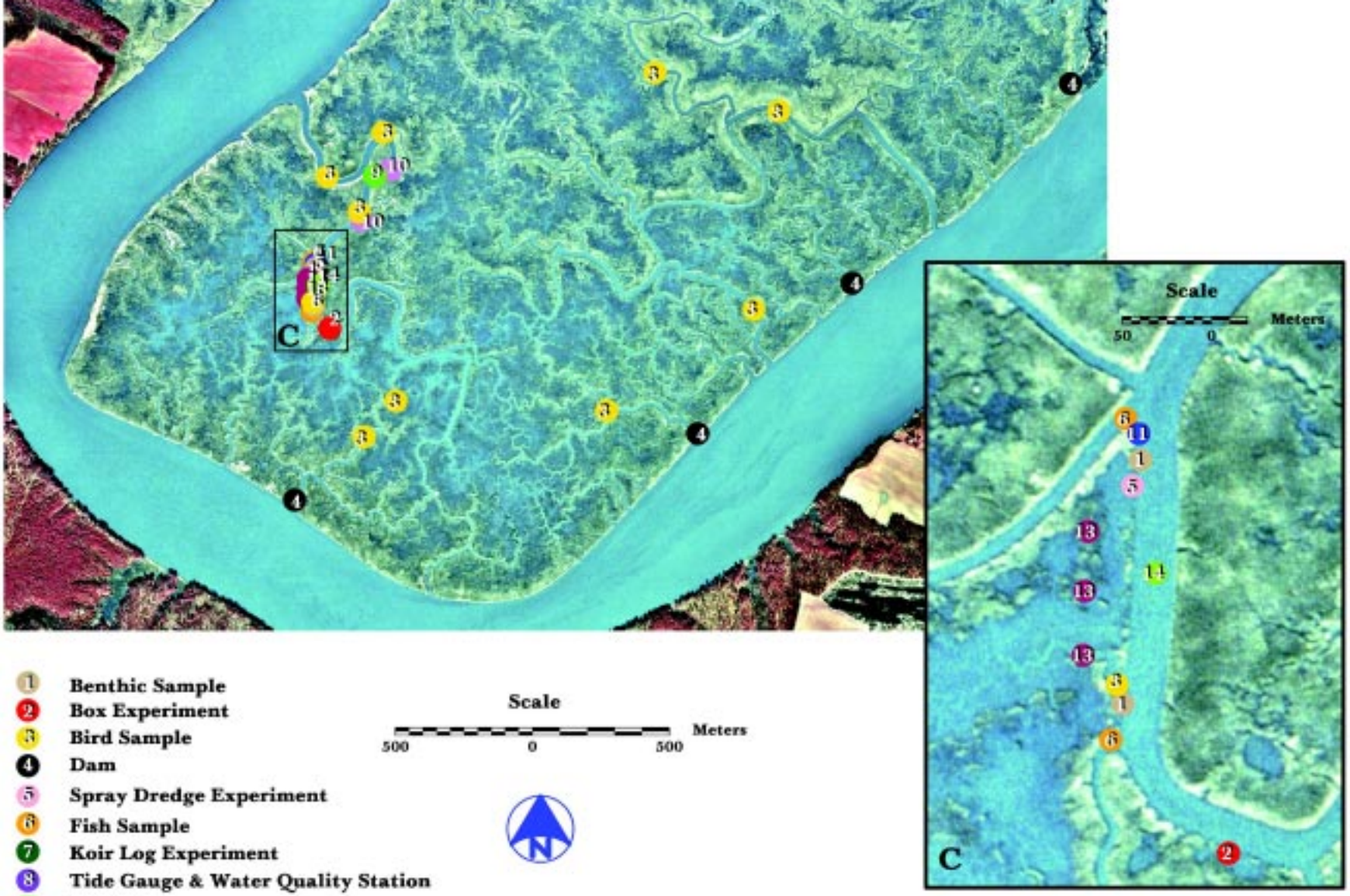

1 Benthic Sample
2 Box Experiment
3 Bird Sample
4 Dam
5 Spray Dredge Experiment
6 Fish Sample
7 Koir Log Experiment
8 Tide Gauge & Water Quality Station
9 Gill Net
10 Insect Sample
11 Water Quality Station
12 Benchmark
13 Vegetation Sample
14 Zooplankton Sample

Scale
500 0 500 Meters

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M.A.R.S.H. PROJECT SITE MAP

Hill and Lee Marshes

Pamunkey River

CCRM
Center for Coastal Resources Management

William & Mary VIMS
Virginia Institute of Marine Science
School of Marine Science

Insect Survey

A seasonal insect survey is being conducted in four plant communities within the Lee and Hill Marshes. The communities being sampled include Arrow Arum (*Peltrandra virginica),* Big Cordgrass (*Spartina cynosuroides),* Reed Grass (*Phragmites australis),* and Wild Rice (*Zizania aquatica)*. To collect the insects, a tent-shaped net is erected with three black light collecting buckets surrounding it in

a triangular outline. The lights are left on for a period of 24 hours. The insects trapped in the buckets are combined with those on the net to be treated as a sample of the insect population that lives in that particular plant community.

The fall season study was conducted during October 2001. The results of this study showed that the Arrow Arum plant community not only had the highest insect population but also was the most diverse. Nearly every order of land dwelling insects was represented by at least one species. These representatives live in this community because it is the closest to the water's edge and it is a collecting point for decaying marsh plants, the preferred habitat for detritus consuming insects.

True Bugs are those that feed by piercing their food, either plants or other insects, liquefying it and then sucking it up. Representatives of this type of insect present in the Arrow Arum plant community included the meadow plant bug, ambush bug, aphids, and leafhoppers. Beetles, insects whose front wings are merely hard coverings for the membranous back wings used for flight, were also abundant in the Arrow Arum plant community. Groups of beetles present included rove beetles, ground beetles and leaf beetles. As expected, True Flies were also abundant in the Arrow Arum community. Representative species of this insect group, which are identified by their lack of hind wings, included house flies, mosquitoes, midges, crane flies, and gnats. Flying ants, Caddisflys and Moths were also present in the Arrow Arum plant community.

Leafhopper

The Big Cordgrass plant community had much fewer total insects with moths being the most abundant. Only a few leafhoppers, one ground beetle and a few flies were collected. Additionally, two meadow grasshoppers were collected in the Cordgrass community.

The Reed Grass community yields yet fewer total insects with mosquitoes and flies being the most abundant.

The Wild Rice community, similar in elevation to the Arrow Arum community, similarly exhibited a larger variety of insects with the leafhoppers and gnats being the most prevalent. Mosquitoes were also plentiful. One additional bug, a backswimmer, was collected at this site.

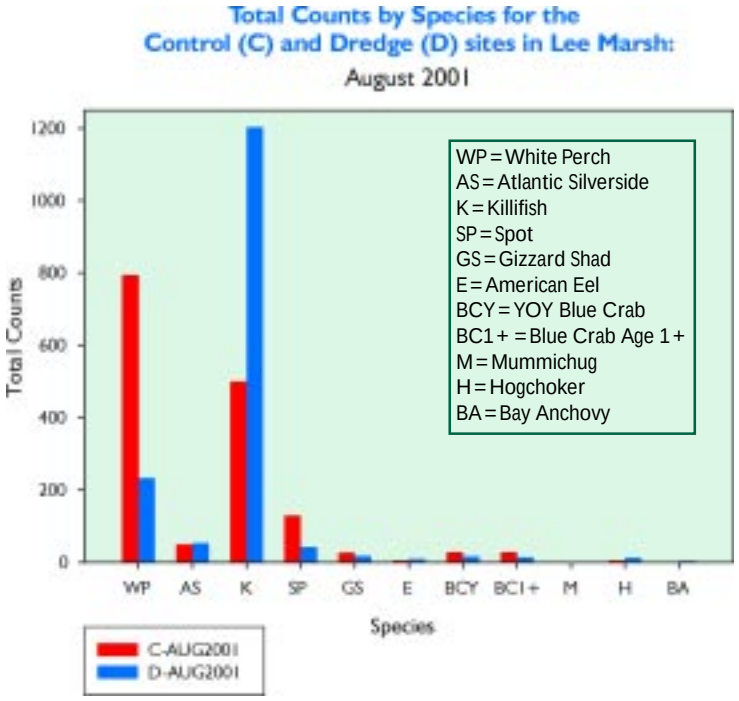
Ambush bug

Seasonal fish surveys were conducted within Lee Marsh on the Pamunkey River, Virginia in July, August, and December 2001 and March 2002. Hill Marsh was sampled September 2001 and March 2002. Sampling occurred with modified Fyke nets. Each fyke net was placed at the mouth of a tidal creek within the emergent marsh system at peak flood tide, allowed to fish for the duration of the tidal cycle and retrieved at low tide after the creek had drained. The sites were chosen to coincide with the spray dredge locations.

The emergent marshes of the Pamunkey are valuable nursery areas for numerous fish. The many small creeks and abundant and varied vegetation provide foraging opportunities for both juvenile and adult fish.

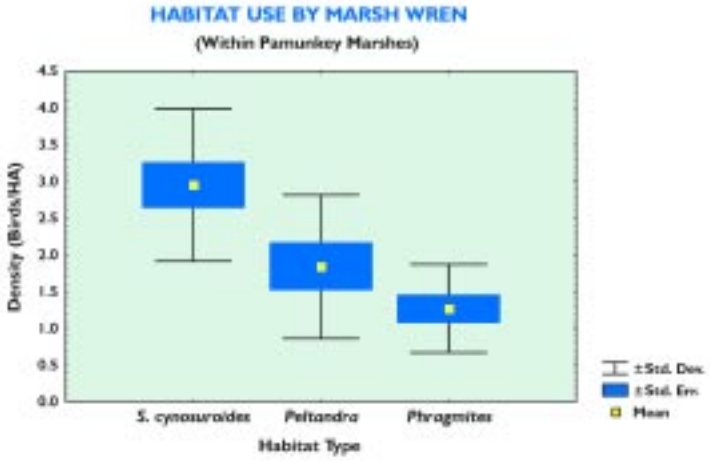
The typical fish community within Lee and Hill marshes include the following:

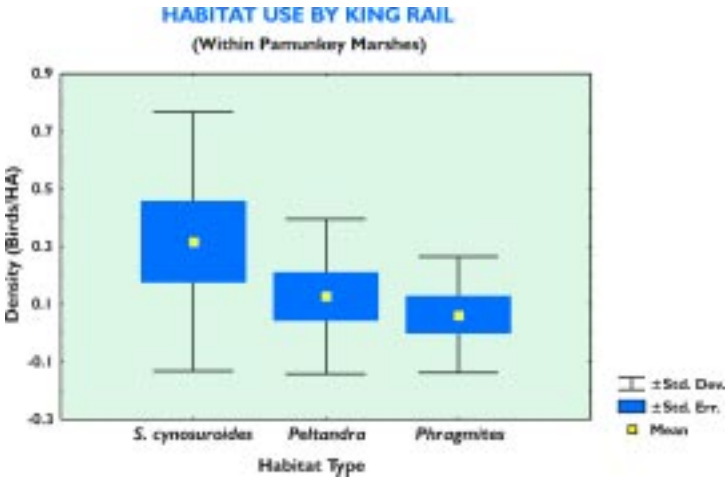
White Perch	*Morone Americana*
American Eel	*Anguilla rostrata*
Atlantic Silverside	*Menidia menidia*
Spot	*Leiostomus xanthurus*
Atlantic Croaker	*Micropogonias undulatus*
Hogchoker	*Trinectes maculatus*
Gizzard Shad	*Dorosoma cepedianum*
Herring	*Alosa* spp.
Bay Anchovy	*Anchoa mitchilli*
Killifish	*Fundulus* spp.
Catfish	*Ictalurus* spp.
Spottail Shiner	*Notropis hudsonius*
Mosquitofish	*Gambusia affinis*
Mummichug	*Fundulus heteroclitus*



Bird Survey

Birds were surveyed within Hill and Lee marsh through a network of about 30 survey plots. Sample plots were surveyed three times during the breeding season and three times during the winter. Sample plots were established in different vegetative communities to assess the relationship between breeding/wintering bird communities and plant associations (i.e. *Phragmites* vs Arrow Arum vs Big Cordgrass). Aerial surveys during the winter to determine the general use by waterfowl were also conducted. Below is a summary of the types of birds identified and some of the data associated with plant community and bird use relationships.



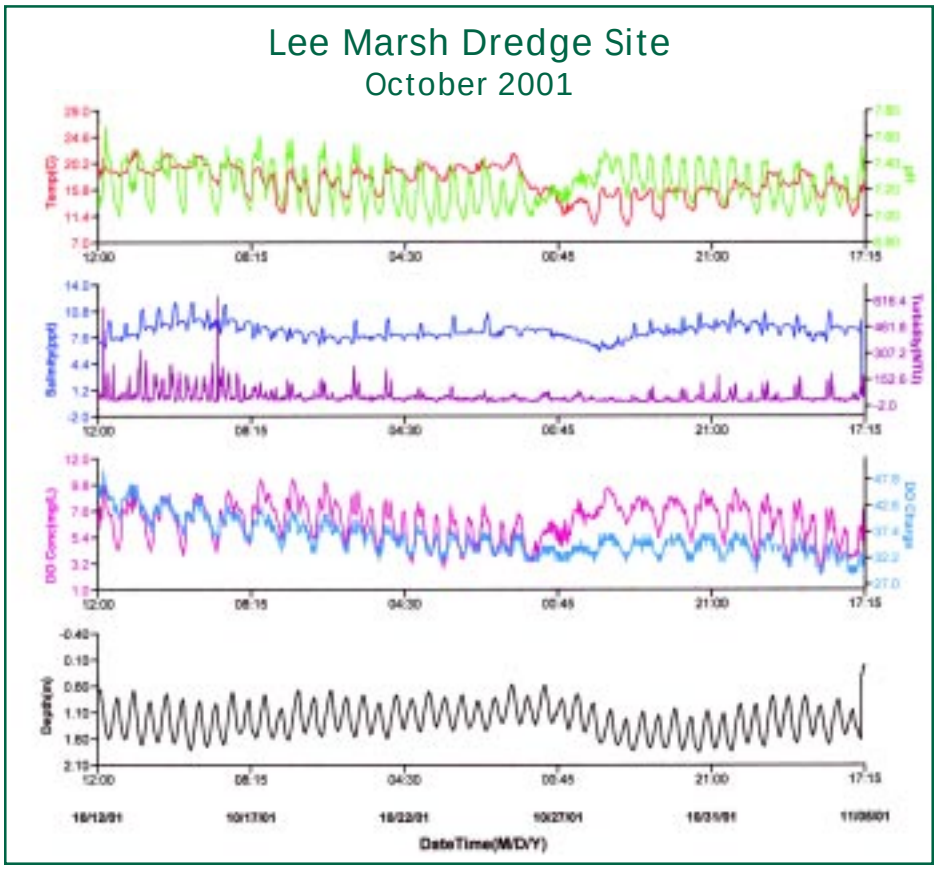


Hill Marsh Species	Winter	Summer
American Black Duck	X	
Mallard	X	
Green-winged Teal	X	
Wood Duck		X
Canada Goose	X	X
Herring Gull	X	
Ring-billed Gull	X	
Great Blue Heron	X	
Virginia Rail	X	
King Rail	X	X
Least Bittern		X
Common Snipe	X	
Greater Yellowlegs	X	
Lesser Yellowlegs	X	
Least Sandpiper	X	
Killdeer	X	
Dunlin	X	
Northern Harrier	X	
Red-tailed Hawk	X	
Bald Eagle	X	
American Crow	X	
Red-winged Blackbird	X	X
Common Grackle		X
Song Sparrow	X	
Savannah Sparrow	X	
Swamp Sparrow		X
Purple Martin		X
Barn Swallow		X
Bank Swallow		X
Cliff Swallow		X
Tree Swallow	X	X
Common Yellowthroat		X
Marsh Wren	X	X

Lee Marsh Species	Winter	Summer
American Black Duck	X	X
Great Blue Heron		X
King Rail	X	X
Common Snipe	X	
Lesser Yellowlegs	X	
Spotted Sandpiper		X
Killdeer	X	
Belted Kingfisher	X	
Osprey		X
Brown-headed Cowbird		X
Red-winged Blackbird	X	X
Song Sparrow	X	
Swamp Sparrow	X	
Purple Martin		X
Barn Swallow		X
Tree Swallow		X
Common Yellowthroat		X
Marsh Wren	X	X

Water Quality Survey

Three water quality stations have been established. One in Lee Marsh, one in Hill Marsh and one on the Olsson Pier. The Olsson pier also supports a real-time, satellite uplink, high accuracy tide gauge. The water quality stations monitor temperature, the amount of oxygen in the water (dissolved oxygen), depth, pH, turbidity, and salinity. The water quality stations will provide continuous monitoring of water conditions. A recent trip by VIMS researchers on the Pamunkey revealed salinity measurements of almost 5 parts per thousand above Sweethall marsh.



Project Sponsors

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What's Next?

VIMS researchers are presently assimilating and analyzing data collected over the last year and a half. A website which will house all the data collected for the project and will allow interested individuals to view the information is being developed. Additional experiments on raising the marsh surface to a level appropriate for species such as Big Cordgrass and Wild Rice are planned. These experiments include biodegradable biolog plots, some of which will be sprigged with Big Cordgrass, utilizing biodegradable sediment bags, and soil amendments such as wood chips and koir matting. In addition, experiments on reducing *Phragmites* in the marshes by planting wax myrtle within *Phragmites* stands are planned.

As with any research project of this size and effort, our expanded understanding has raised additional questions. The rise in sea level and the extended draught have resulted in increased saltwater intrusion further up the Pamunkey River. This project has positioned VIMS researchers in such a way that changes in vegetative communities along this stretch of river can be observed as they occur and has allowed scientists to seek additional research funding to study the effects of saltwater intrusion further up the Pamunkey River.