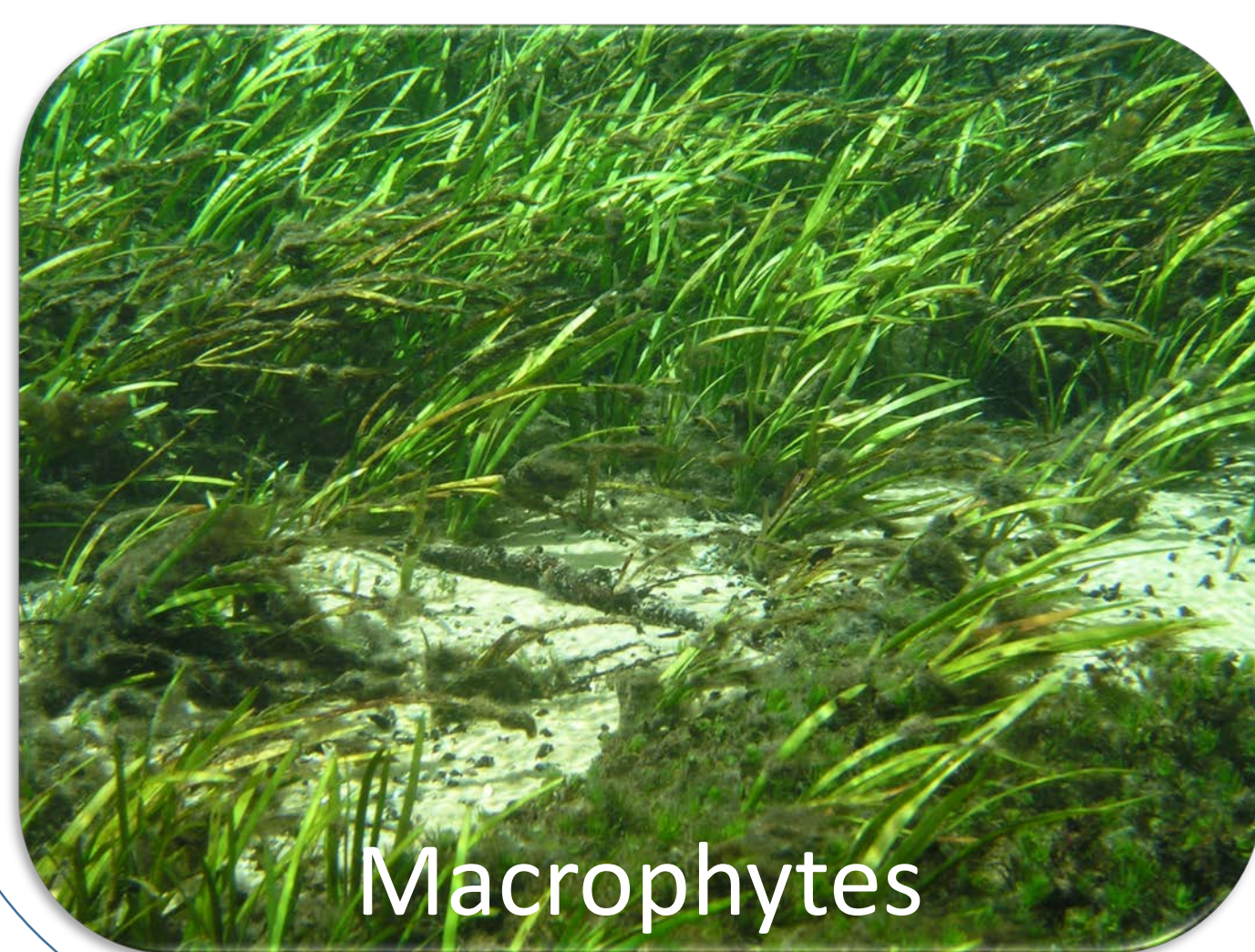


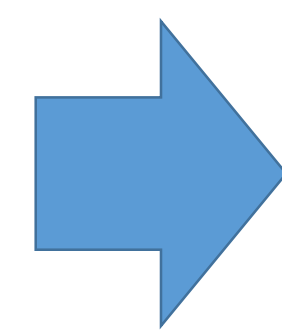
Submerged Aquatic Vegetation Restoration in Florida Spring Systems

Introduction

Submerged aquatic vegetation (SAV) is the foundation of Florida spring ecosystems and provides services that maintain water quality and create habitat for fish and wildlife. Over the past century a variety of drivers have caused a plant community shift from macrophytes to filamentous algae. In 2014, a pilot project was initiated in the Crystal River/Kings Bay spring system to test several innovative techniques to address these drivers and restore the native SAV community.



Macrophytes



Filamentous Algae

Restoration Techniques



Eelgrass sod mats consisted of coconut coir fiber mats (15' x 3') planted on six inch centers with the 'Rockstar' variety of eelgrass (*Vallisneria americana*).



Several hundred eelgrass sod mats were cultivated in a one acre pond at the Duke Energy Mariculture Center in Crystal River.

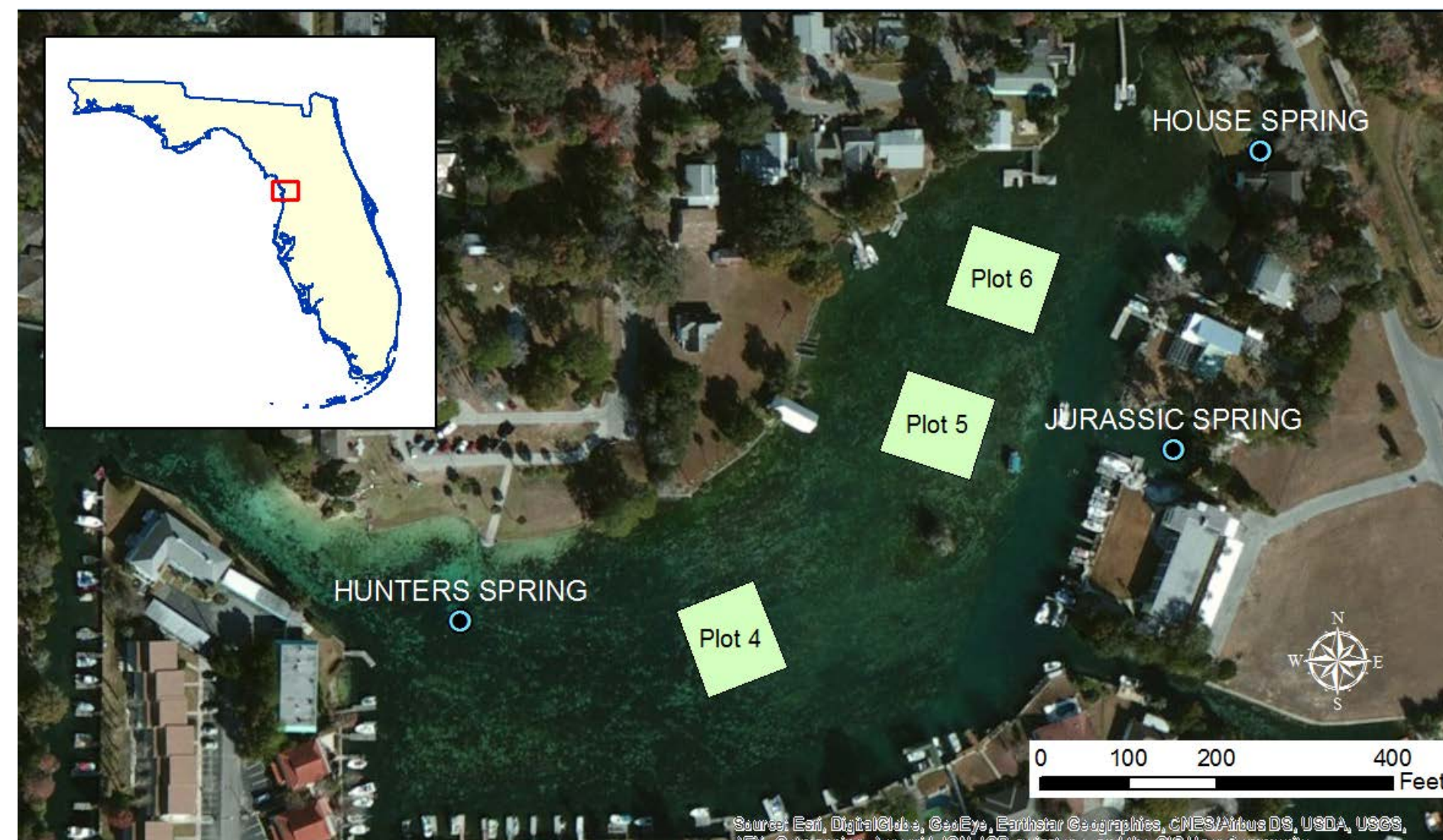


After four months the eelgrass sod mats were fully developed and were rolled up for transportation to the restoration site.

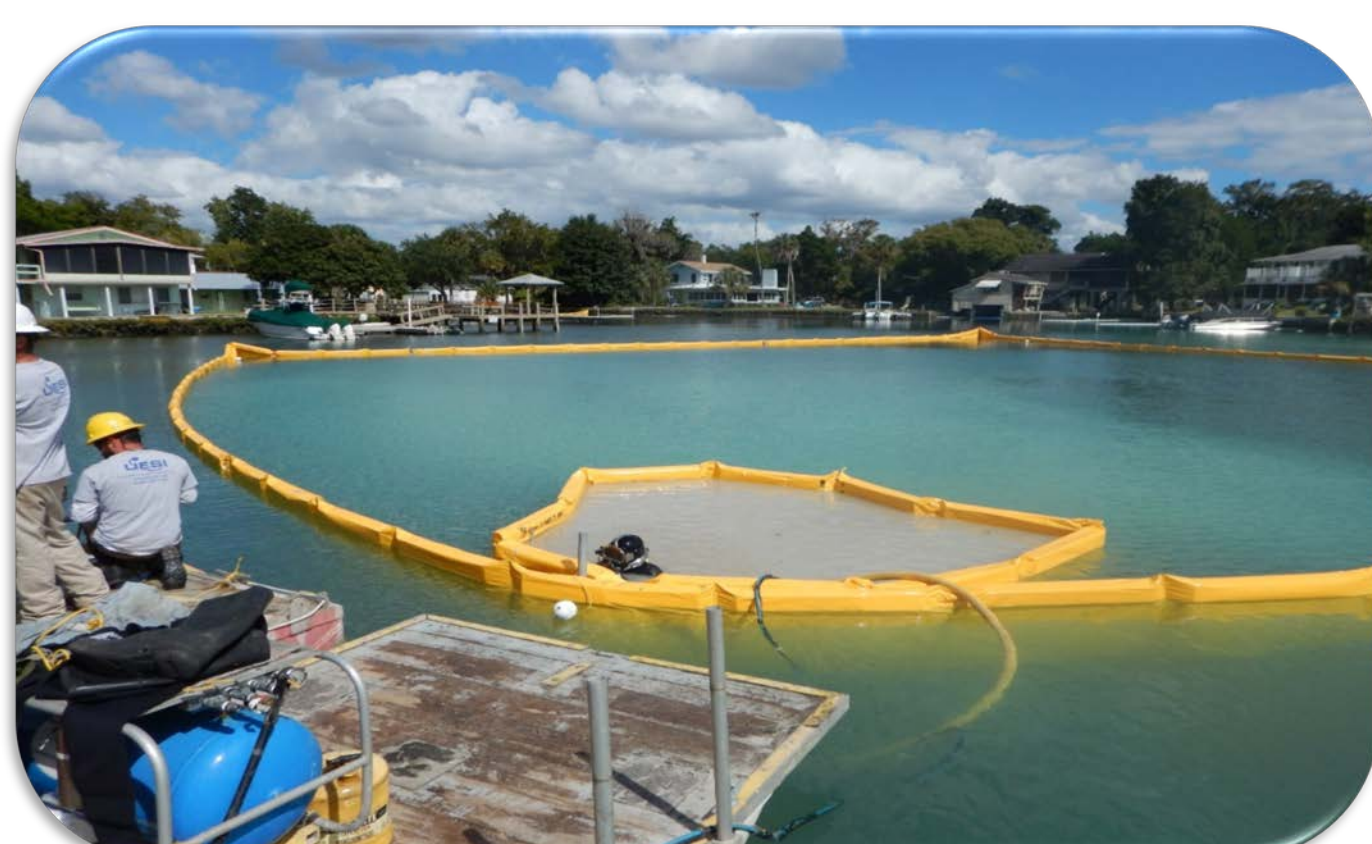


Herbivory exclusion barriers were specially designed to allow for maximum water circulation and wildlife usage while preventing manatee grazing.

Installation



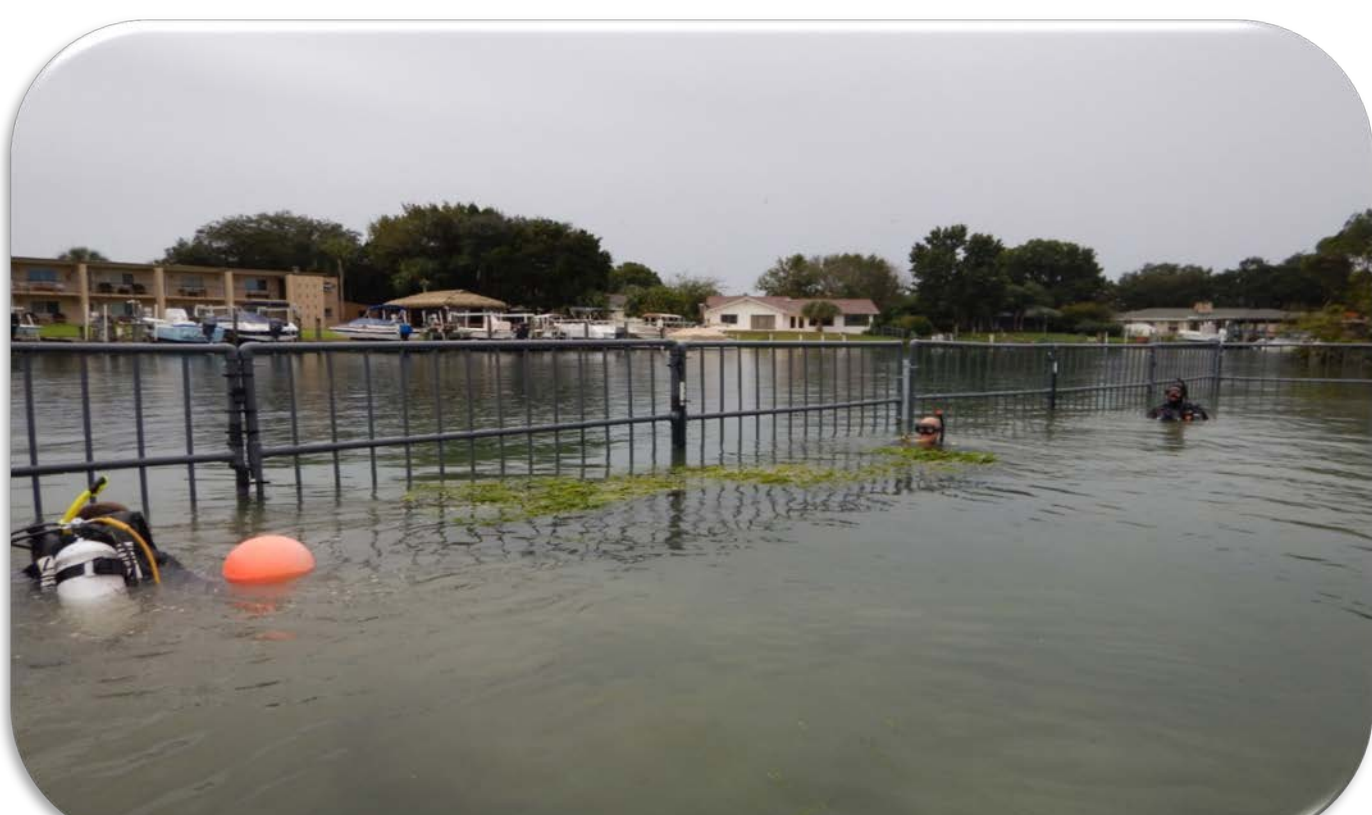
Herbivory exclusion barriers and eelgrass sod mats were installed at three quarter-acre plots in the Hunters Cove area within the Crystal River/Kings Bay spring system in the Fall of 2015. The long-term goal is to rotate the restoration plots until the entire six acre area is planted with eelgrass.



Underwater Engineering Services, Inc. (UESI) was hired to install the herbivory exclusion barriers using a team of SCUBA divers.



The PVC exclusion barriers were designed to conform to the bottom topography and extend >2' above mean high water to prevent manatees from accessing the restoration plots.

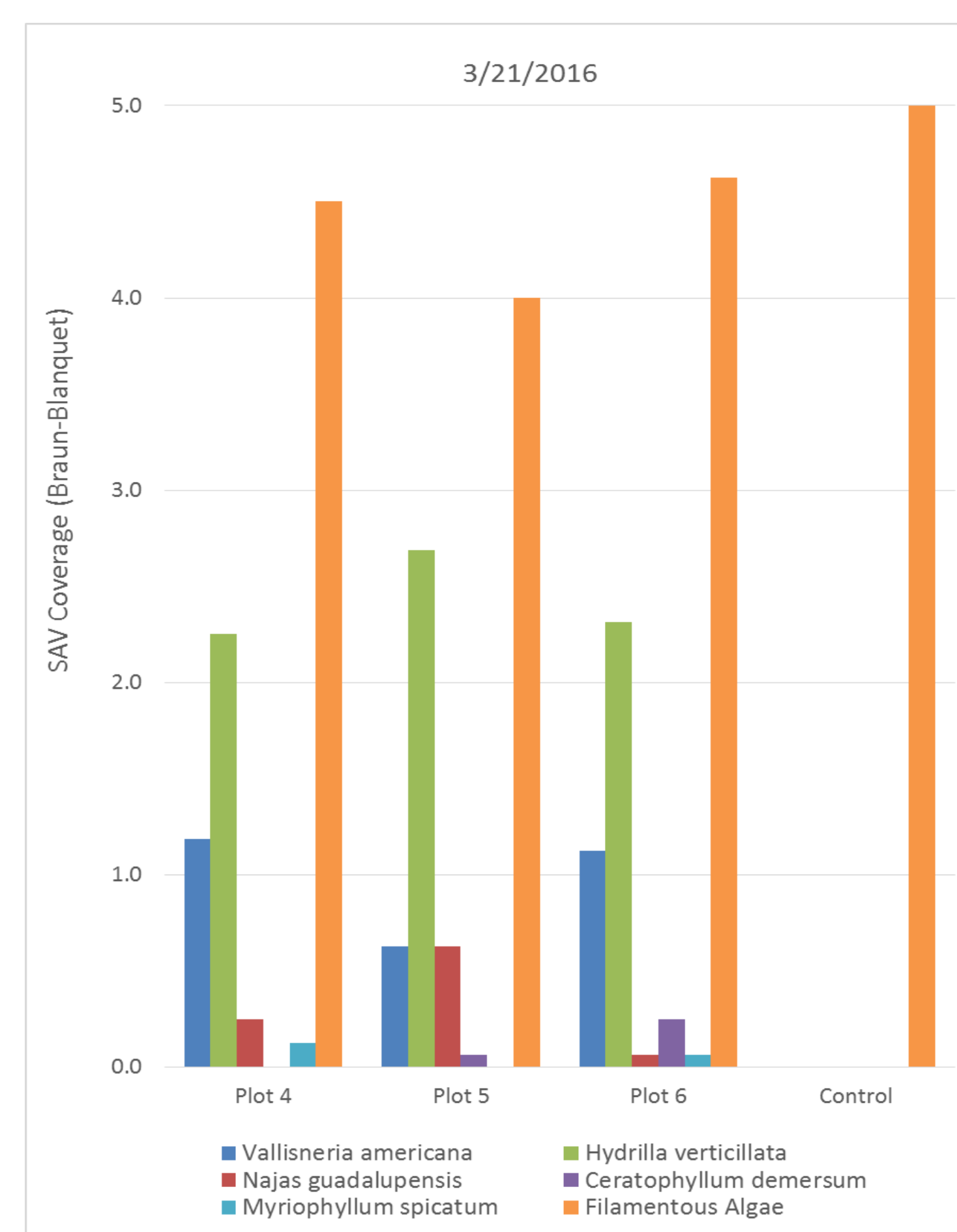


Eelgrass sod mats were installed within a quarter of each plot directly onto the existing substrate in rows with approximately 3' spacing between mats. In April 2016, additional mats and peat pots were installed in each plot.



The eelgrass sod mats immediately created fish and wildlife habitat within a spring system dominated by filamentous algae.

Results



Four months later, eelgrass (*Vallisneria americana*) continues to expand where planted; however hydrilla and filamentous algae are abundant in the unplanted areas. Additional eelgrass installation and maintenance are expected to increase native SAV abundance.



The eelgrass sod mats have expanded by over 2' on each side and are beginning to coalesce into larger eelgrass beds.



Fish Species

- Atlantic Needlefish
- Bowfin
- Largemouth Bass
- Bluegill
- Tidewater Mojarra
- Bluefin Killifish
- Rainwater Killifish
- Striped Mullet
- White Mullet
- Seminole Killifish
- Gray Snapper

FFWCC and SWFWMD staff sampled the fish community within the restoration plots and found 11 species, compared to only 2 species in the control area.

Next Steps

- Continue to manually remove invasive species (e.g. hydrilla, algae)
- Test additional planting techniques (e.g. peat pots, 'mini-mats')
- Monitor and evaluate ecological changes over time
 - SAV, invertebrates, fish, sediments, water quality
- Remove herbivory exclusion barriers in the Spring/Summer of 2017
 - Determine whether well-established SAV will persist despite heavy grazing pressure and competition from algae