Elevation, Inundation and Salinity in Coastal Louisiana Natural and Created Brackish Marshes Influenced by a Freshwater Siphon

Erick M. Swenson, Michael J. Polito, Katherine Loesser, Seth Chapman
Louisiana State University, Baton Rouge, LA

INTRODUCTION

The aim of this study was to investigate marsh elevation, inundation and spatial salinity patterns in created and reference marshes in the outfall area of the West Point a la Hache Siphon.

STUDY AREA

The study area (Fig. 1) has 2 created marshes (LHA, LHB) and 4 references marshes (LCH, WPH1, WPH2 and PS7) that are the focus of an LSU NOAA RESTORE food web project. The area also has historical salinity data (CWPPRA BA-04 Marsh restoration project), and active data sondes which monitor water level and salinity hourly maintained by: (1) LA-CPRA under CRMS, and (2) the USGS.

METHODS

Daily Siphon discharge (Fig. 2 and 3) was computed using Mississippi River stage (USACE) employing a formula developed by LA-DNR (Boshart and McInnes, 2000). RTK marsh elevation surveys were conducted at the LSU sites, 1, 10, 15, 25, 50 and 100 meters inland at three transect at each site. The elevation data was used with CRMS hourly water level data to estimate daily inundation at each survey plot. Sondes deployed at the LSU sites were used to verify the relationship. The historical BA-04, the CRMS and USGS sonde data (from 2010 to 2021) were used with the siphon discharge to investigate the spatial changes in salinity with siphon operation.

RESULTS AND DISCUSSION

The marsh elevation data (Fig. 4) and inundation data (Fig 5) show a range in elevation from ~0.10 m to ~0.29 with an average of 0.17 m. The LSU sites are in the same range as the CRMS sites in the area which have an average elevation of 0.13 m. The marsh inundation at the LSU sites ranges from ~20% to ~65%, with year to year differences being ~10% at a given site. The lowest inundation occurred at site LHA, a created site that was built up fairly high with material from the Mississippi River. The marsh inundation at the CRMS sites range from ~44% to ~60%.

The BA-04 salinity data (Fig. 6) shows a decrease during siphon operations which varies as a function of siphon discharge and distance. The stations in the immediate outfall area (circled in Fig. 6 and Fig. 1) showing the largest impact. The sonde data and the LSU data, analyzed as siphon/siphon off conditions (Fig. 7) also show a strong relationship of salinity drop as a function of distance.

The overall impact is summarized in Fig. 8. The LSU sites in the immediate area show a drop of ~7.0 psu (73%) with the furthest away site (PS7) shows a drop of ~3.2 psu (27%).

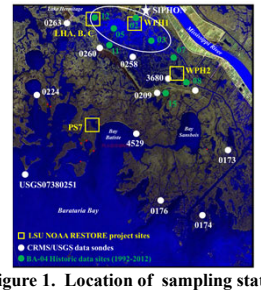

Figure 1. Location of sampling stations in the West Point a la Hache Siphon area.

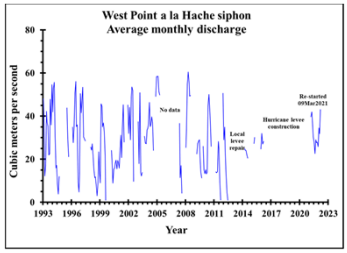

Figure 2. Average monthly siphon discharge.

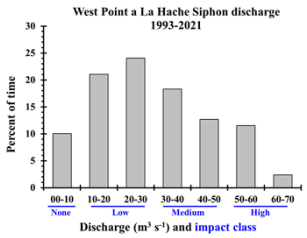

Figure 3. Siphon discharge classes distribution.

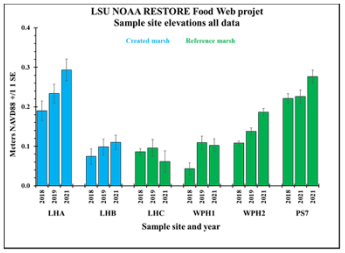

Figure 4. Average elevations of the LSU Sampling sites for 2018, 2019 and 2021.

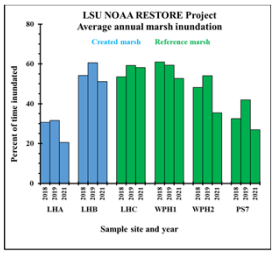

Figure 5. Average marsh inundation at the LSU sites for 2018, 2019 and 2021.

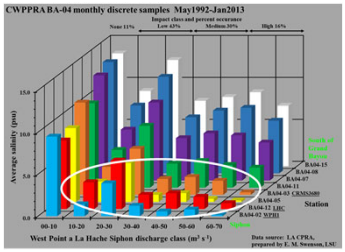

Figure 6. Relationship of discharge class and distance from the siphon to salinity.

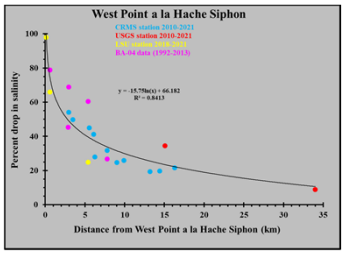

Figure 7. Relationship between distance and percent drop in salinity when the siphon is operating.

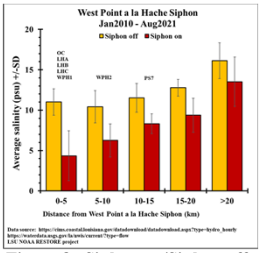

Figure 8. Siphon on/Siphon off salinity comparison. The LSU sites are indicated.

Data sources: Boahsart and MacInnes, DNR Progress Report 3, BA-040MSTY-1298-3, May2000 https://www.mvn.usace.army.mil/Missions/Engineering/Stage-and-Hydrologic-Data/Historical-Discharges/ https://cims.coastal.louisiana.gov/datadownload/datadownload.aspx?type=hydro_hourly https://waterdata.usgs.gov/la/nwis/current/?type=flow LSU NOAA RESTORE Food Web Project (Dr. Michael Polito)

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