Draft Study Plan
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Aerial and ground surveys to monitor spatial extent, changes over time, and vegetation characteristics of coastal marsh dieback in Louisiana and east Texas.

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Period of Study: June 2000 through December 2001

Background

Extensive brown patches of *Spartina alterniflora* were first noticed by Greg Linscombe (LDWF) during a helicopter survey in May 2000 south of Blue Hammock Bayou and east of Fourleague Bay, Louisiana. A subsequent fixed-winged aerial survey by Michot the same month resulted in the finding that the brown patches were more extensive than previously thought and that they extended eastward almost to the Mississippi River. On June 4, 2000, Michot and Scott Wilson (USGS, NWRC) conducted an aerial video survey of a small portion of the affected area near Bay Junop. On June 7, 2000, Michot conducted a quantitative fixed-winged survey to document the spatial extent and severity of the affected area in southeast Louisiana (two transects), and established a study site on the ground near Bay Junop (BM2). Michot conducted a second survey in August 2000 on one of the same transects in southeast Louisiana, and initiated a similar survey that same month in southwest Louisiana and southeast Texas. Michot conducted a third survey on the original two transects in southeast Louisiana in September 2000. Michot conducted a second aerial video survey in September 2000 in the Bay Junop area, following one of the transects of Linscombe and Chabreck.

Ground studies were initiated at BM2 in June (transects and interstitial porewater chemistry) and were expanded to include square-meter plots and stem tagging in August. Since August 8, Michot's field crew has been collecting ground data at BM2, and at a nearby healthy reference site (BMGOOD), approximately every 2 weeks (a total of five time periods from August 8 to October 11). Data collection on the ground will continue at two-week intervals until and if vegetation characteristics appear to stabilize, at which time the collection interval will be increased to three or four weeks until Spring, when the interval will again be set at two weeks.

Methods for aerial and ground surveys are presented below. Ongoing surveys to date have been conducted by using limited funds under an emergency spending scheme (i.e., redirected USGS base funds). A proposal has been submitted to request funds for continued and expanded surveys.

Methods

1. Fixed-winged aerial surveys.

A Cessna 185 amphibious aircraft owned by the US Department of Interior (USGS) will be used to conduct surveys. The aircraft is equipped with a built-in GPS/Voice Survey/Moving Map system that geospatially links GPS location, airplane track, time, and recorded voice data. The system automatically logs the aircraft position (latitude and longitude) and time every five seconds and displays the track of the aircraft on a computer screen mounted on the instrument panel. Tracks from previous flights, or any other sets of points, lines, or polygons, can be displayed on the screen during the current flight, and the current track of the aircraft will be displayed in real time and overlayed on the screen. In this way, transects from either straight line surveys or cruise surveys can be tracked and repeated with accuracy and precision in subsequent flights.

Surveys will be conducted from an altitude of approximately 50 m above ground level and at a ground speed of approximately 90 knots. At that speed, observations are made approximately every 250 m over the marsh surface. Two observers (one being the pilot, in the left front seat, and the other being an observer in the right front seat) will record marsh color at five-second intervals. A digital clock on the instrument panel is used to cue the observer to record each observation when the time display ends in a multiple of five. Observations are only made over marsh habitat, not open water, forested, or upland habitat. For each observation, the observer uses a mark on the strut of the airplane to focus on a patch of marsh approximately 50 m from the center of the aircraft, and classifies the patch of vegetation that surrounds that point for a radius of about 50 m. Marsh habitat is classified for each observation as one of four color categories: green (completely green with no brown visible), green/brown (mostly green but with some brown visible), brown/green (mostly brown but with some green visible), and brown (completely brown or black vegetation). Additional modifiers (e.g., plant species, marsh type, physical characteristics, “lodged,” etc.) can be added to each observation as needed.

Surveys to date have established four transects in southeast Louisiana and two transects in southwest Louisiana and southeast Texas; additional transects can be added later as needed. Each transect is conducted in an approximate east-west direction parallel to the coast line, with one transect usually 1 to 5 km from the coast, and another transect farther inland. In the Mississippi River Deltaic Plain of southeast Louisiana, Transect 1 follows the southern extent of the saline marsh zone from Point Au Fer Island to Breton Sound, and Transect 2 is parallel to Transect 1 but farther inland, along the northern extent of the saline marsh zone and the southern extent of the brackish marsh zone. Transects 1 and 2 were established in early June when the affected area did not extend west of Fourleague Bay. Later we established Transects 3 and 4 in southeast Louisiana; they run through mostly fresh and intermediate marsh from Vermilion Bay to Fourleague Bay. A scaled-down version of the survey was conducted in August in the marshes east of the Mississippi River from California Point northward to Lake Borgne, then westward to New Orleans; during the scaled-down survey only green (healthy) and brown (dead) marsh patches were noted, but not intermediate color classes. On the same day, another scaled-down survey was conducted west of the Mississippi River on a transect running parallel to and roughly between Transects 1 and 2. These transects can be re-surveyed later, or new transects can be established to the east, into coastal Mississippi, if needed.

In the Chenier Plain region of southwest Louisiana and southeast Texas we established two transects. Transect 1 runs from about Delcambre, Louisiana, south to Marsh Island, then westward along the coast in the saline marsh zone to San Bernard National Wildlife Refuge (NWR), just across San Luis Pass from the western tip of Galveston Island. Transect 2 in the Chenier Plain runs parallel to and inland from Transect 1 from San Bernard NWR, north of Galveston Bay and across Trinity Bay to Smith Point, then roughly follows the Gulf Intracoastal Waterway to Vermilion Bay, ending near Intracoastal City where marsh habitat transitions into forested and upland agricultural areas. All transects in the Deltaic Plain are surveyed in a single day, and the Chenier Plain transects are also surveyed in a single day.

The number of data points on each of the established transects have ranged from 800 to 1400 for a total of about 6000 on the 6 established transects. Changes in frequencies of the four color classes over time have been analyzed via a binomial analysis where the frequency for Time 1 is subtracted from that for Time 2; the analysis tests whether the resulting change differs significantly from zero. For instance, for Transect 1 in the Deltaic Plain, between June 2000 and August 2000, a significant increase in brown and decrease in brown/green was shown, whereas there was no significant change in the frequency of green/brown or green. In this way we intend to track changes over time for each transect, and to compare transects within the same time period. To increase spatial resolution we can identify and compare intensity of dieback among various segments of a given transect, and for the same segment over different time periods, by dividing each transect into segments (e.g., 0.1-degree longitude segments, or larger segments, or by hydrologic units) and perform the same analysis.

Transects will be surveyed approximately every four to six weeks from Fall 2000 through Winter 2001, or until dieback effects have completely disappeared, whichever is longer. Fixed-winged surveys will also be conducted over a portion of the north-south transects used in the helicopter survey, and at the same time as the helicopter survey, in order to compare results using the two methodologies. As an additional calibration check, ground study sites will be established along the fixed-winged survey transects and the ground sites will be scored from the air during the aerial survey; this will help to characterize each marsh color category as to vegetation and soil characteristics.

2. Aerial videography.

The same aircraft used for the fixed-winged surveys will be used for the aerial videography. In addition to the GPS/Voice Survey/Moving Map system described above, the aircraft is equipped with a photo port and photo mounts for three cameras: a 35mm SLR camera (Pentax ZX-50), a natural-color digital video camera (Canon Elura-A), and an infra-red digital video camera (Duncan MS3100-RGB/CIR). The three cameras are linked to each other and to the aircraft GPS and datalogging system via Horita GPS-3 and GPT-50 encoders.

Videographic data have been collected in the Bay Junop area (including the ground reference site BM2) in June and in September 2000. Transects were flown and

photographed at various altitudes, every 300 m from 15 m to 2500 m above ground level. Photographic data in June were collected in the saline marsh zone, and in September in saline, brackish, intermediate, and fresh zones. These data have not yet been interpreted, but here we propose to process the data from the two flights to determine what altitude gives us the best combination of resolution, pixel size, swath width (field of view), and photo quality to correctly classify marsh vegetation into one of the four color categories as above. In April 2001 and again in August 2001 (same time as the helicopter and fixed-winged surveys), a sample of the north-south transects will be flown to collect aerial videographic images. We will video approximately every 10th transect throughout the Louisiana coast, and all ground reference sites. For each transect, digital images for all frames (approximately 30 frames per second) will be combined into a photomosaic and georectified in a GIS using GPS data from the encoder, ground reference points, and mapping data from previous studies. The images will then be interpreted and checked against ground data to classify all marsh habitats into the four color codes and modifiers as appropriate. Polygons will be digitized and summaries will be made for each transect by marsh type as to aerial extent of each color category. These results will be compared to results from the helicopter and fixed-winged surveys.

3. Monitoring of ground sites.

One ground site (BM2) was established in June 2000 in the Bay Junop area, and an associated healthy reference site (BMGOOD) approximately 7 km away, was established in August 2000. At the impacted site we identified 4 vegetation zones based on color and vegetation characteristics in June; the healthy reference site was considered a single zone. Zones of *Spartina alterniflora* at the impacted site included black standing culms, dark brown with some frayed leaves, light brown with many frayed leaves, and standing black culms with new green shoots. We set up several transects to measure boundaries of the zones and track them over time, and in each zone we randomly placed four square-meter quadrats. In each quadrat we count and record the number and height of live and dead stems. For dead stems we note whether leaf material is present or absent and, if present, whether the dead leaves are intact or frayed. For live plants we count and measure the leaves and classify each live plant as to color category (>90% green, 50 – 90 % green, or <50% green) and tag each live stem. In or adjacent to each quadrat we collect interstitial water samples at depths of 0 cm (surface), 15 cm, and 30 cm below the sediment surface for pore water chemistry (salinity, conductivity, pH, Eh, sulfides, nutrients). Wells were established in each zone to measure water level, salinity, etc., during each site visit. A staff gauge was established to serve as a benchmark and elevations were surveyed in using a laser system and total station surveying equipment. Elevations on the site will be tied in to nearby water level gauges that have been in operation for several years to determine absolute elevations, and water level history for the site will then be backcasted. This ground site will be one of several that we propose to establish under other proposals (see proposals by Howard and Travis, Swarzenski, Cahoon, Twilley, and Nyman). These sites will serve as ground reference sites for the aerial surveys and videography as noted in the above sections.