

Lessons Learned from Two Decades of In-Situ Burning of Oil Spilled into Wetlands in Louisiana

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Photo credit: NOAA

Louisiana Marsh ISB Case Studies (8)

| Name | Date | Spill Type/Bbl | Marsh Type | Acres Oiled/Burned |
|--------------------------|---------|-------------------|----------------------------|-----------------------|
| Louisiana Point | 2/2000 | Condensate/? | Brackish high marsh | 13/135 |
| Mosquito Bay | 4/2001 | Condensate/>1,000 | Brackish intertidal marsh | 12/98 |
| Empire (Katrina/Rita) | 10/2005 | SLC/? | Brackish high marsh | 38/20 |
| Octave Header | 11/2014 | SLC/100 | Phragmites, tidal fresh | 15/5 |
| XTO Point a La Hache | 11/2017 | SLC/30 | Intermediate marsh | 3/2 |
| Delta Farms, Bayou Perot | 12/2017 | SLC/50 | Flotant intermediate marsh | 0.5/3.3 |
| Dulac | 11/2018 | Condensate/40 | Flotant fresh marsh | 0.3/0.3 |
| Time Energy, Cox Bay | 8/2019 | SLC/20 | Intermediate marsh | 0.84/0.84 |



Louisiana Point

Date of Spill: 23 February 2000

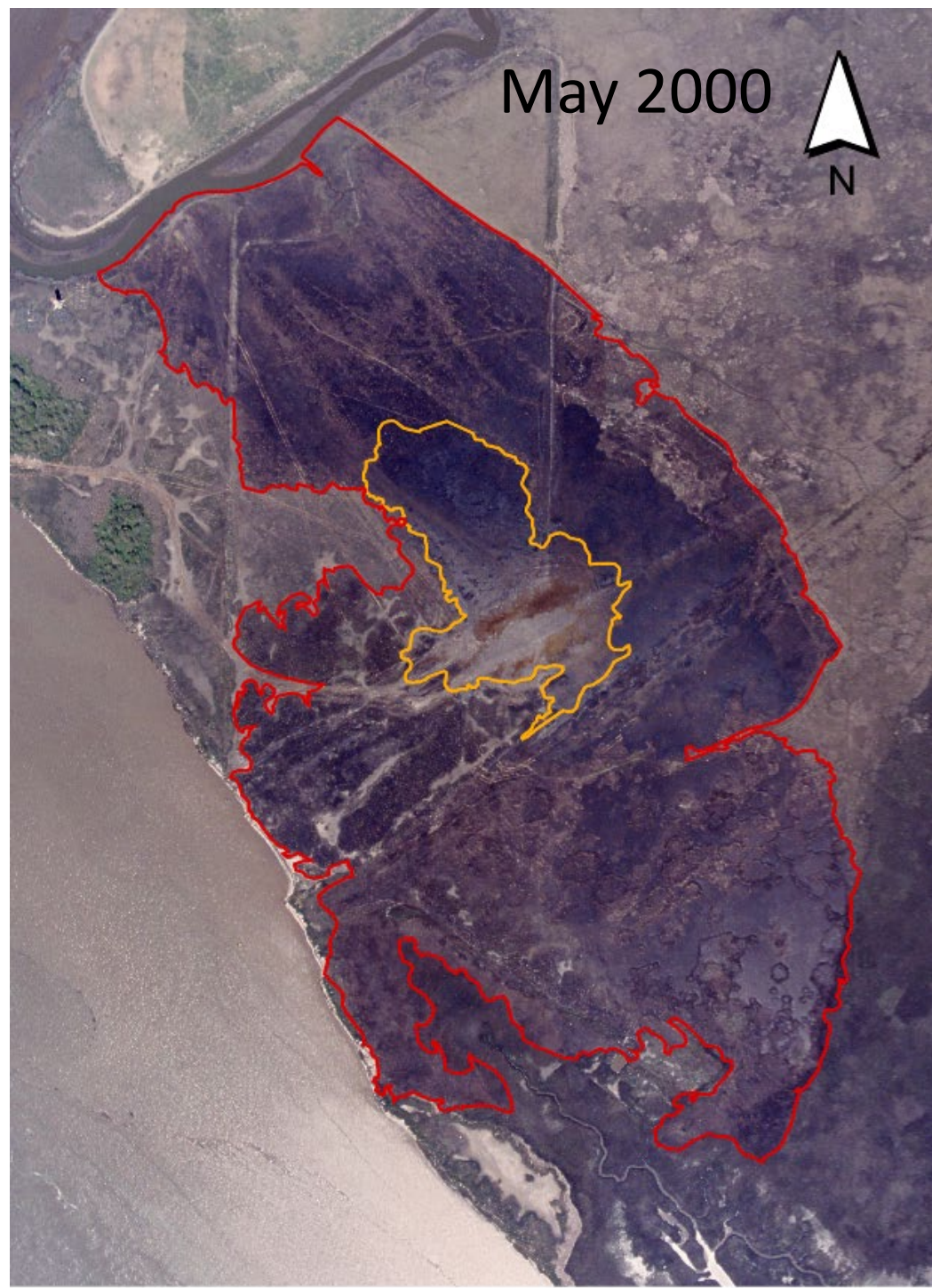
ISB Conditions: Unknown quantity condensate burned 26 February (3 days post-spill)

Oiled area = 13 acres; **burned area = 135 acres**

Habitat: Brackish high marsh (*Distichlis*, *Borrichia*, *Batis*, *S. patens*)



Photo credit: USCG



May 2000



200 0 200 Meters



□ Burned area
□ Oiled area



Sept 2001



200 0 200 Meters



□ Burned area
□ Oiled area

Burn area = 10x
oiled area

1-2 cm water layer

No oil residues;
burning did not
reduce toxic
effects of the oil

Batis recovered in
2 yr;
Borrchia and
Distichlis
recovered more
slowly (>2 yr)

Image credit: LOSCO



Mosquito Bay

Date of Spill: 5 April 2001

ISB Conditions: >1,000 bbl condensate burned on 12 and 13 April (7-8 d post-spill)

- Oiled 12 acres
- **Burned 98 acres**

Habitat: Brackish intertidal marsh (*S. alterniflora*, *S. patens*, *Distichlis*)





Red = Oiled/Burned

Yellow = Not Oiled/Burned



LOSCO RESPONSE
4/26/2001 11:16



LOSCO RESPONSE
4/26/2001 11:16



Subsurface oil,
even in burrows,
won't burn

April 2001



March 2003



Photo credit: LOSCO

Mosquito Bay ISB: Lessons Learned

- Burned area was 8x oiled area
- Oil penetrated burrows and root cavities during low water over 7-8 d period post-spill
- Burning was effective in removing surface oil but not subsurface oil
- Vegetation died in areas of heavy oiling; good vegetative recovery in light oiling and unoiled



6 months post-burn



Empire (Katrina/Rita)

October 2005

- Burned 1 month after Hurricane Rita
- 20 acres burned (all H/M oiled areas)
- Brackish marsh: *S. patens*, *Schoenoplectus americanus* (bulrush)
- Big effort on burn control (success!)
- Most effective burn on Day 1 in area of heaviest oiling
- Day 2 burn was shorter and less intense, due to less oil



Photo credit: NOAA

Day 1
Burn

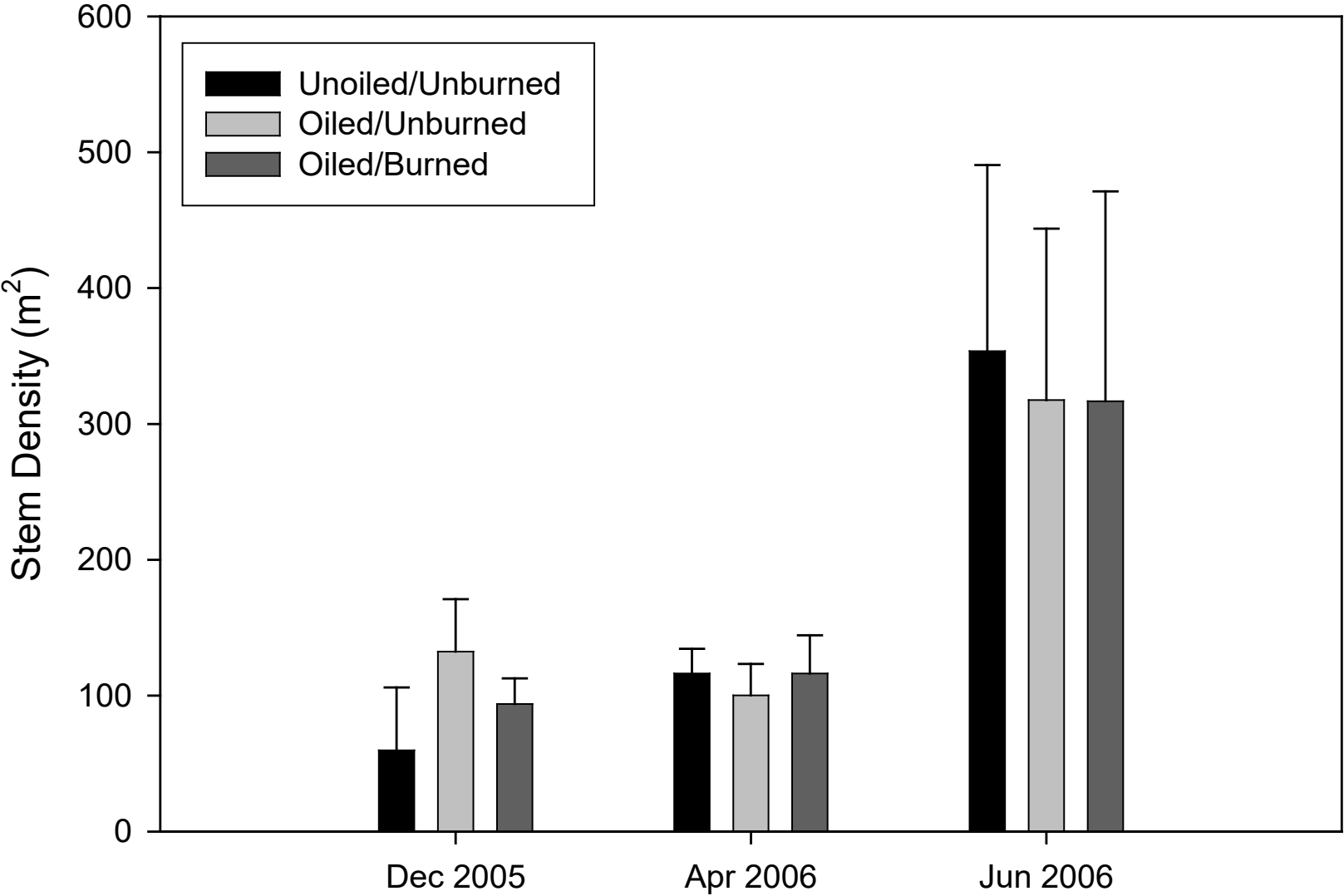


Day 2
Burn



Photo
credits:
NOAA

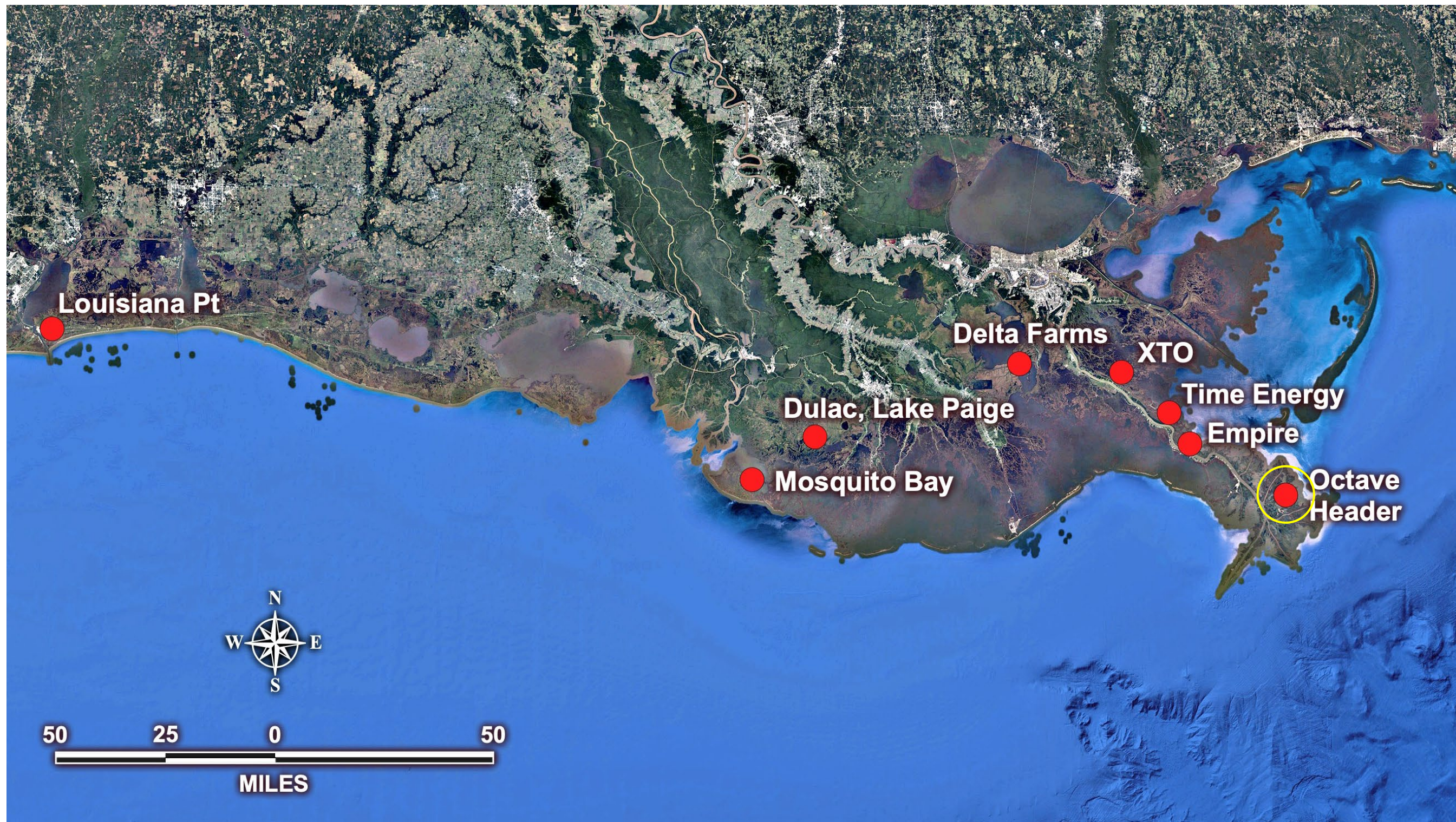
Average Stem Density (*S. americana*)



Burn 10/2005

Baustian et al. 2010. Environmental Management 46:781-789





Octave Header

Date of Spill: 28 May 2014

ISB Conditions: 100 bbl SLC

Oiled area = 15 acres

Burned area = 6 acres, 3-4 June 2014

Habitat: *Phragmites australis* tidal freshwater marsh in the Mississippi River delta region

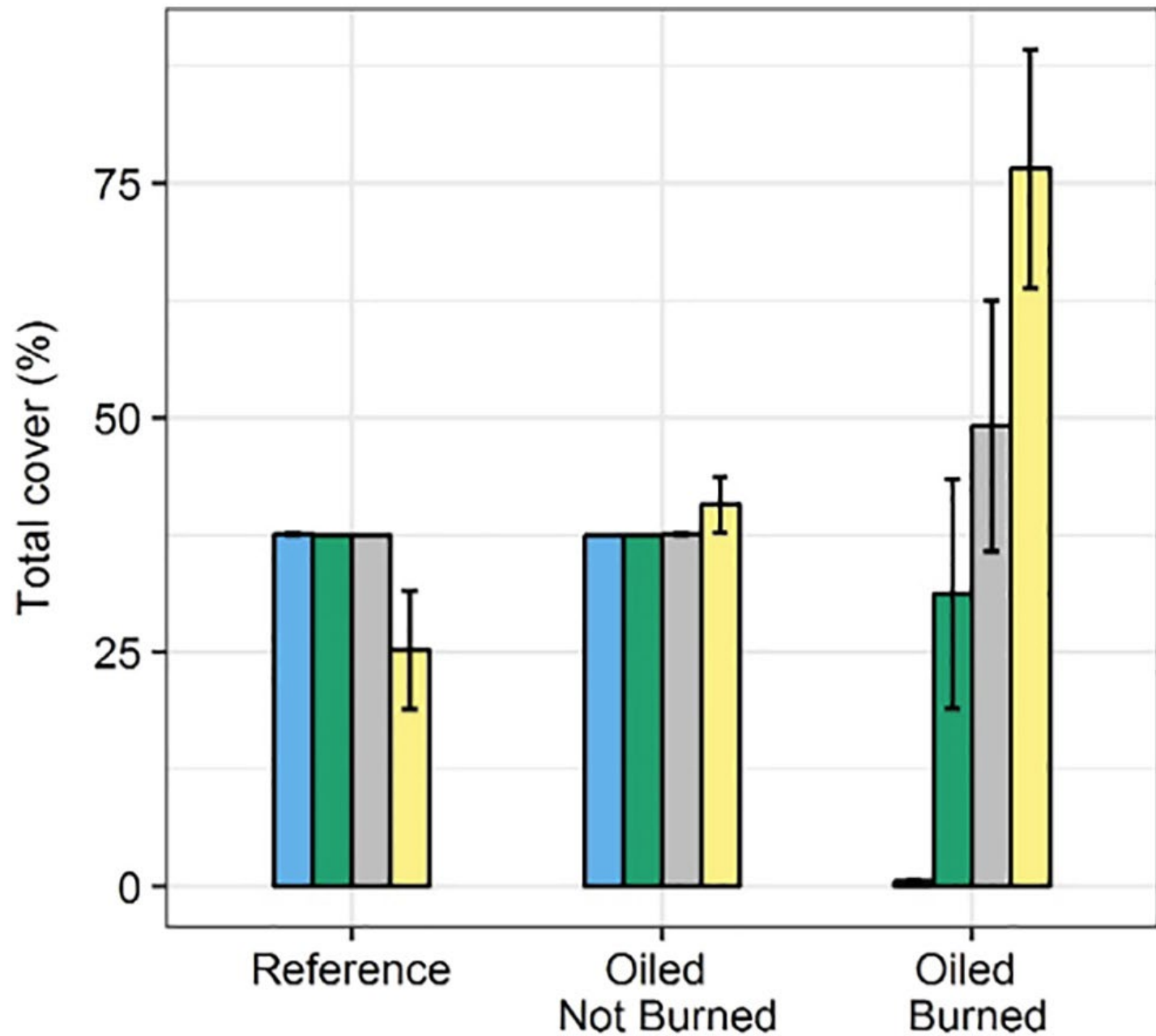
Photo credit: NOAA



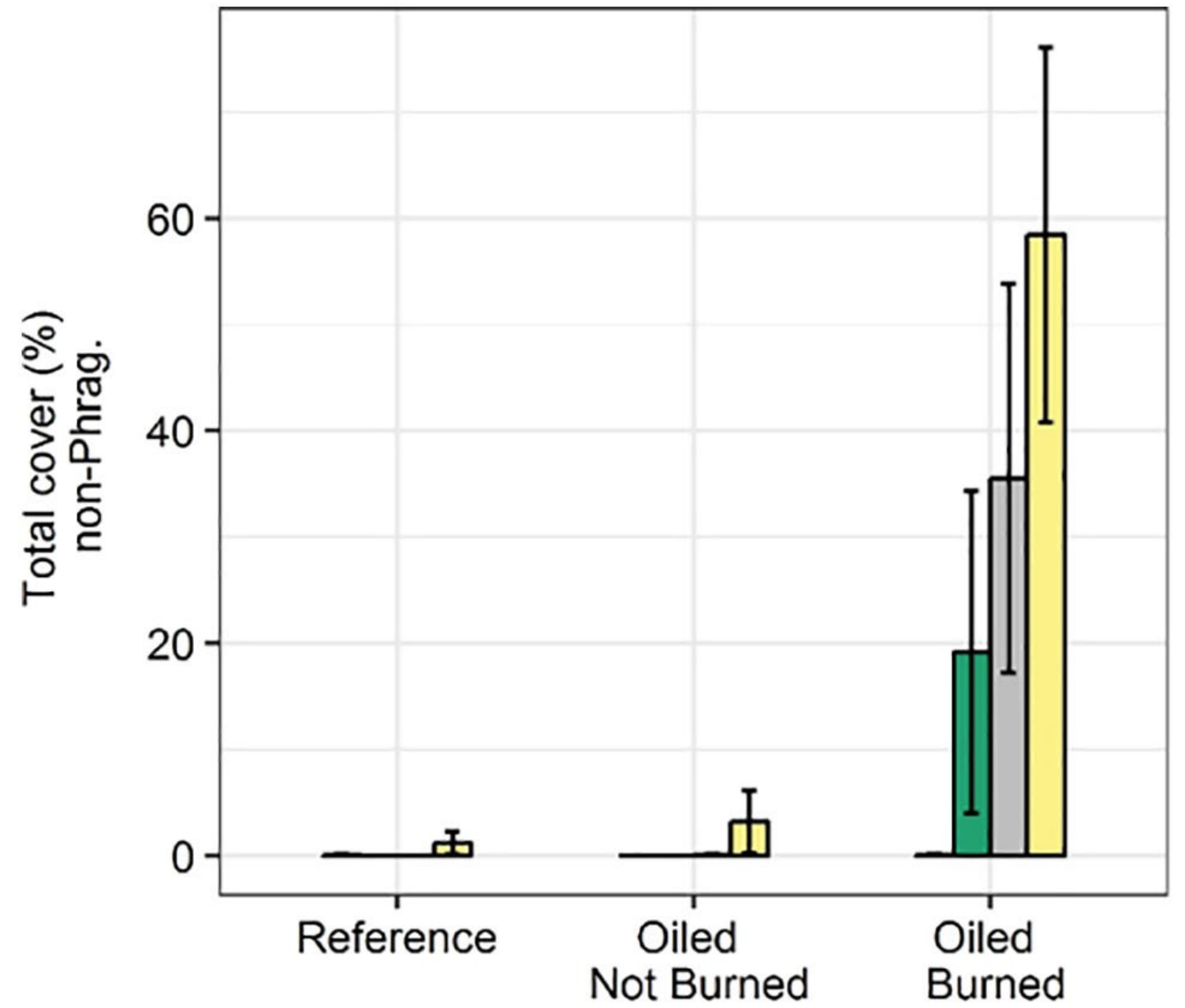


The burn ended at the edge of the heavily oiled marsh

Photo credit: NOAA



■ June 2014 ■ Sept. 2014 ■ Sept. 2015 ■ Sept. 2016



■ June 2014 ■ Sept. 2014 ■ Sept. 2015 ■ Sept. 2016

Burn May 2014

Octave Header Lessons Learned

- Removed gross oil and reduced residual oil on the vegetation
- Sediment oil levels were initially elevated in the oiled and burned sites, but were similar to reference sites after 3 months
- Vegetation cover recovered in 2 years
- Differences in plant species composition could be viewed positively, but will not persist





XTO, Pointe a La Hache

Date of Spill: 22 November 2017

ISB Conditions: 30 bbl SLC

Oiled area = 3 acres

Burned area = 2 acres on 1 Dec 2017

Habitat: Interior intermediate marsh, *S. alterniflora*, bulrush

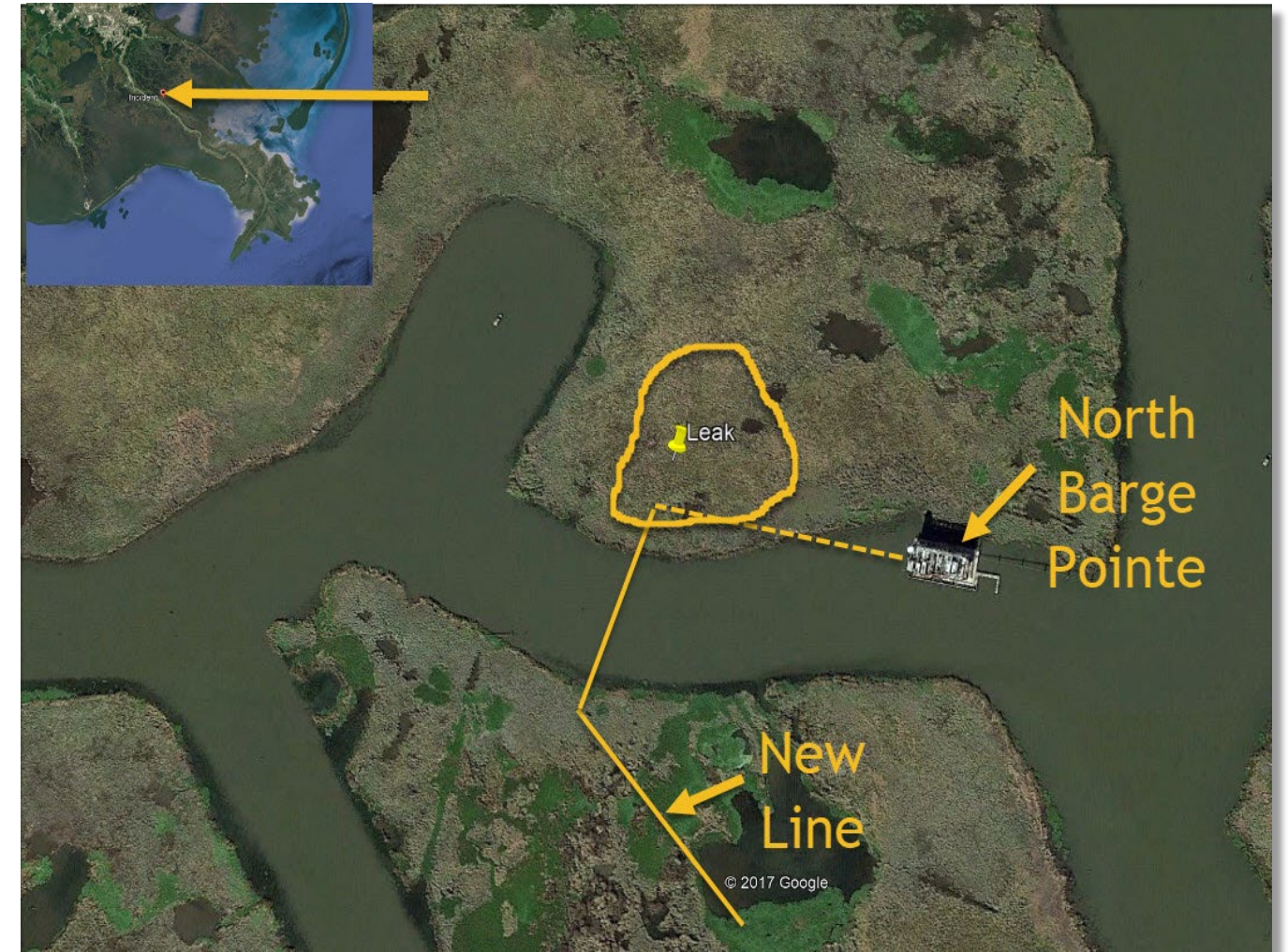


Photo credit: USCG



11.26.2017 22:31

Photo credit: LOSCO

1 Dec 2017
(10 days after release)



29DEC2017



Photo credit: OMIES₂₇



20 Feb 2018



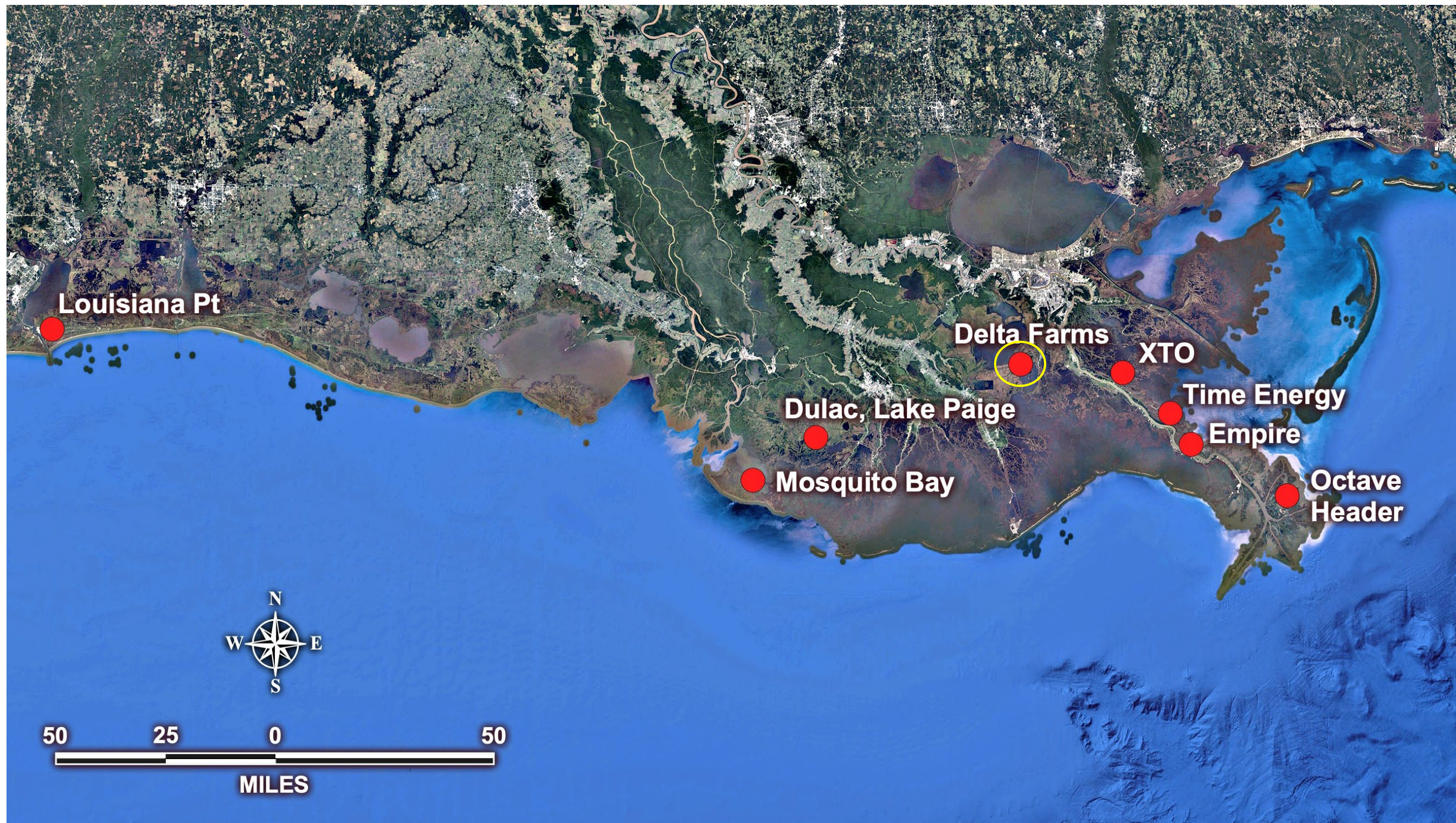
22 June 2018



XTO, Pointe a La Hache: Lessons Learned

- Unburned oil and burn residue persisted at release site
- Vegetative recovery in 1 growing season in most areas
- No vegetative recovery at release site (heavily oiled soils) and in heavily trampled areas prior to burn





Delta Farms

Date of Spill: 2 December 2017

ISB Conditions: 50 bbl SLC, 0.5 acres oiled/3.3 burned on 11 December

Habitat: Floating intermediate marsh, *Scirpus*, *Sagittaria*, *Elocharis*, *S. patens*



Photo credit: Forefront
Emergency Management

Pre-Burn
11 Dec 2017

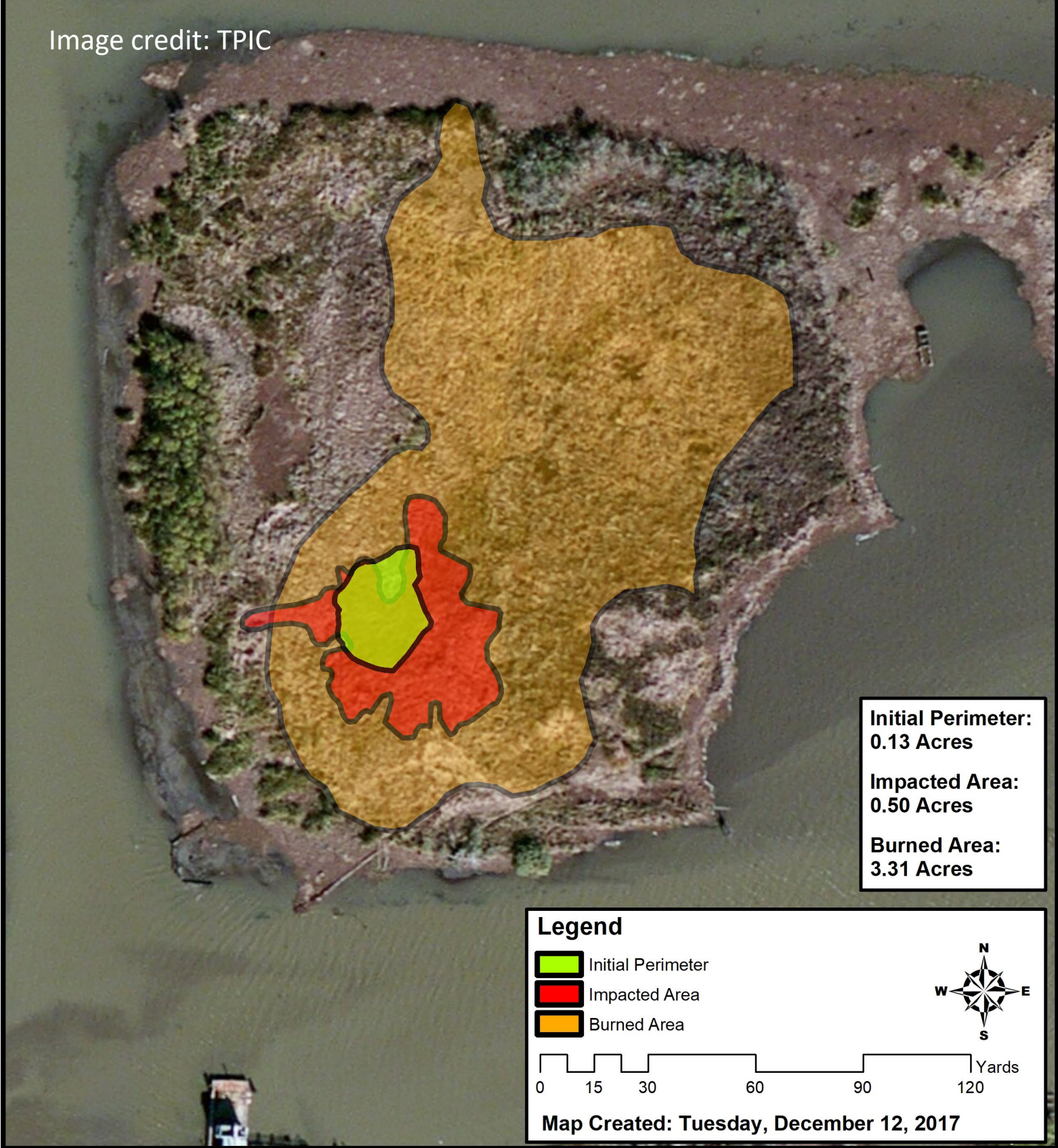


Photo credit: Forefront Emergency Management



Post-Burn
Same day

Image credit: TPIC

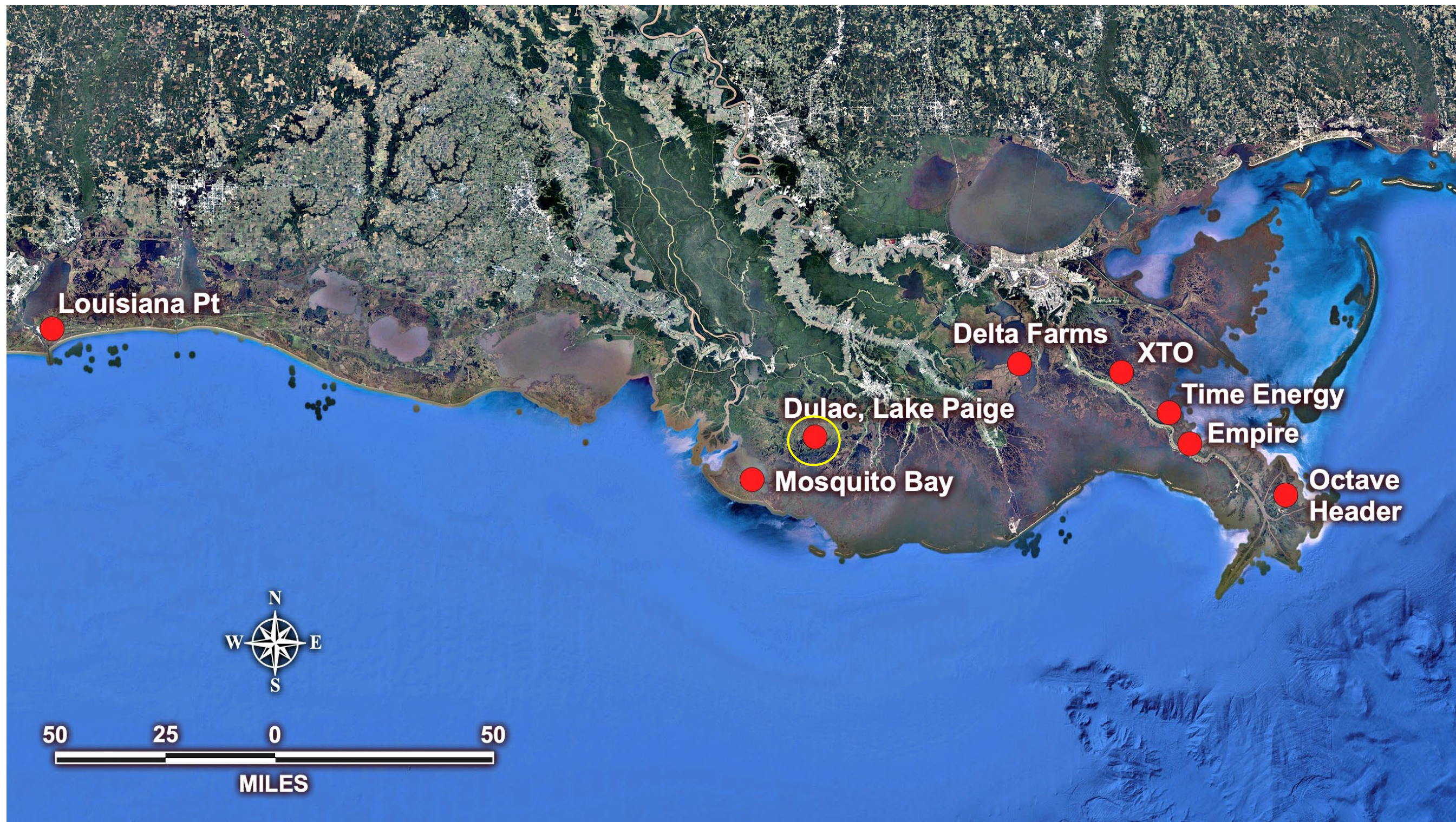


Sept 2018



Delta Farms: Lessons Learned

- Burning did not effectively remove all the oil, particularly liquid oil trapped under the floating marsh and in vegetation mat at the release point
- Follow-up operations: Periodic hand raking of heavily oiled marsh surface to break up, remove, and enhance weathering of remaining surface oil and oiled vegetation mats at the release site
- Vegetative regrowth approaching reference site by 3 years except for at the release site
- Burning was not totally effective but not detrimental



Dulac

Date of Spill: 15 November 2018

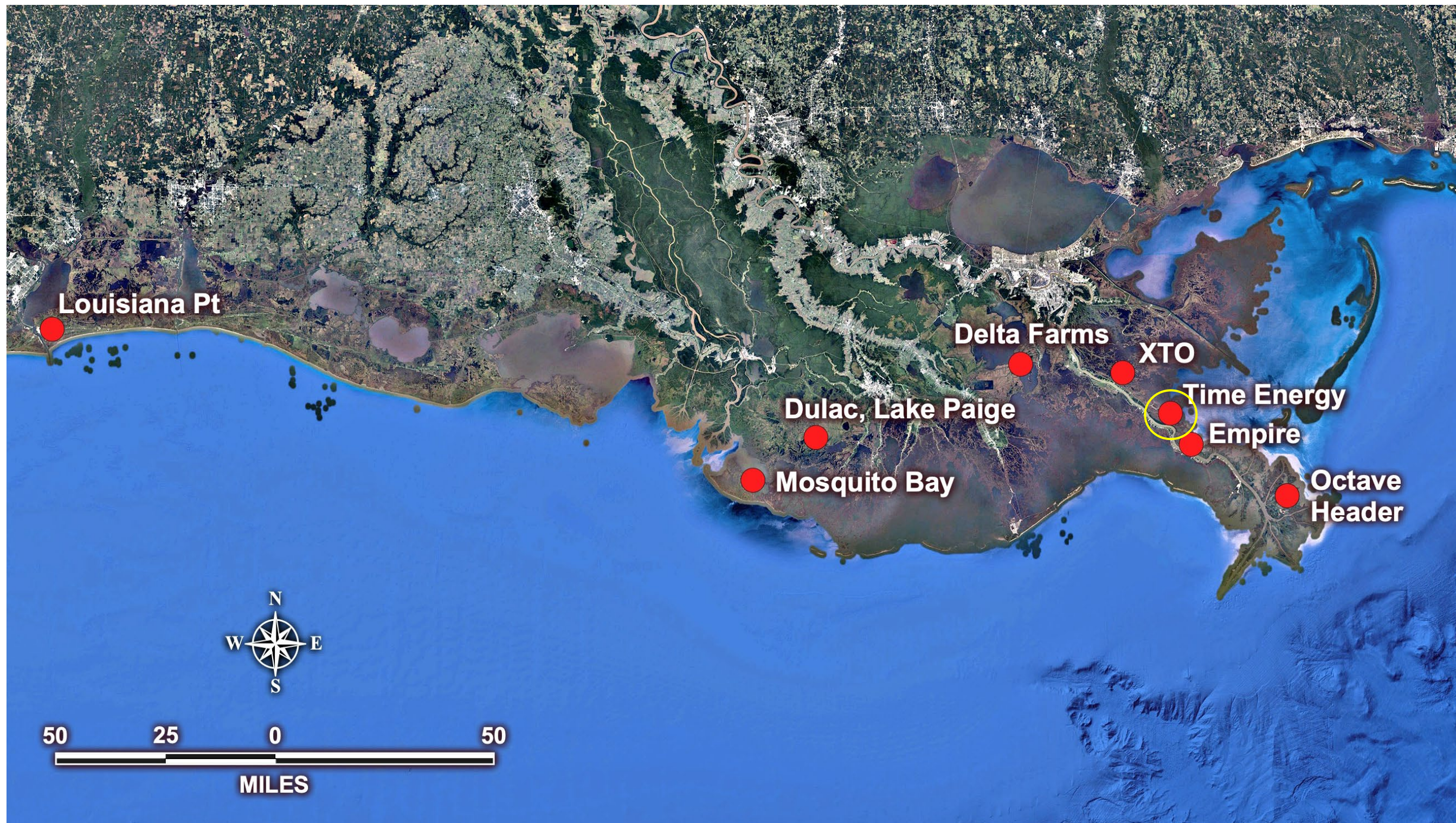
ISB Conditions: 40 bbl condensate, 0.3 acres oiled/burned 19 Nov 2018

Habitat: Flotant marsh



Photo credits: TPIC





Time Energy, Cox Bay

Date of Spill: 15 August 2019; burned 21 Aug 2019

ISB Conditions: 2 sites with SLC: 19 bbl and <1 bbl + produced water

Habitat: Intermediate marsh



Photo credit: USCG



Photo credit: NOAA

Time Energy: Video



Video credit:
Forefront
Emergency
Management

Time Energy: Lessons Learned

- Site 1 (recent spill, oil only): minor residues, site raked to break up residues
- Site 2 (legacy produced water site): heavily oiled sediments remained after the burn and were a source of oil refloating to the surface



Site 2, 26 September 2019

Photo Credit: NOAA

Lessons Learned from Louisiana Marsh ISBs

- The burned area can be >> oiled area, so the potential for a larger burn area should be explicitly considered for sites:
 - That have not been burned recently (thus have abundant natural fuel present)
 - Where fire breaks cannot be completely cleared
 - Without a lot of free-standing water
 - With dry or dead vegetation

Note all ISBs were in interior, not fringing marshes.

Lessons Learned from Louisiana Marsh ISBs

- A water layer is *preferred* but not required under all conditions
- Saturated soils are required
- ISB can be used weeks post-spill to remove oil; but it will not prevent vegetation mortality from prior oil exposure
- There can be burn residue (less for condensates) – may require post-burn removal/raking
- Oils that penetrate into the substrates or are released below the marsh surface will persist after burning
- Select ISB option early, to prevent damage from foot traffic, etc.

Lessons Learned from Louisiana Marsh ISBs

- Vegetative recovery usually occurs within 1-2 growing seasons
- Burning can result in initial change in plant species
- Very appropriate for small spills in marsh interior where access for manual removal can cause extensive damage

Inland ISB Case History: Ruffy Brook, MN

- >50 bbl Canadian crude oil, July 2000. 3 acres burned in same day of spill. Tarry residue was picked up in sheets
- Freshwater ponded marsh (willows, cattails, rushes, lots of open water). Water depth 1-3 feet



Burn area = oiled area
Ample water level

Inland ISB Case History: Ruffy Brook, MN



Pre-burn oil July 2000



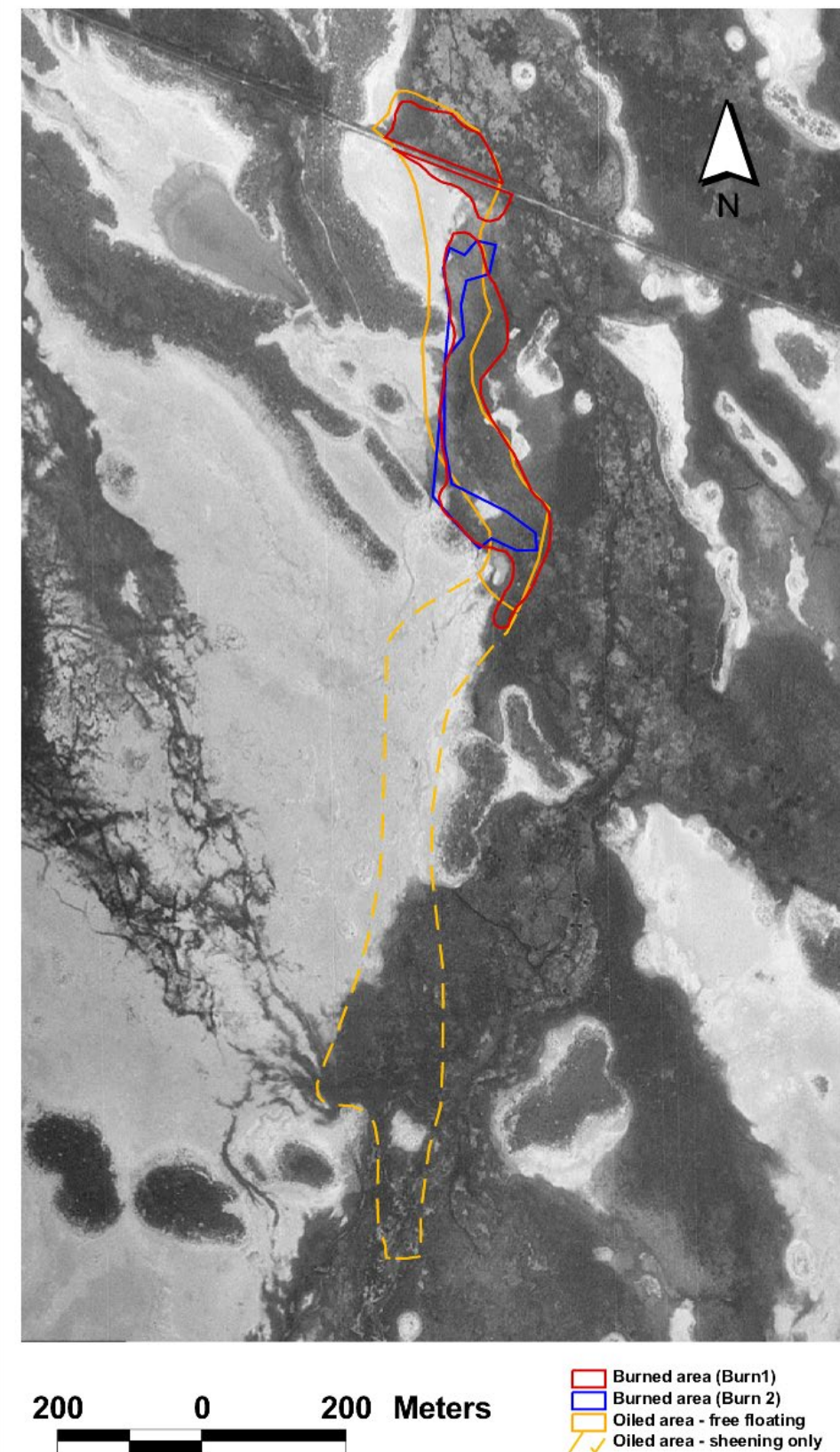
Burn residue was quickly recovered



1 year later, grassy vegetation recovered; willow trees died

Chevron P/L, UT

- 100 bbl diesel, Jan 2000
- Wetlands bordered by alkali or mud flats, snow/ice with multiple freeze/thaws before 1st burn
- 15.3 ac. Free oil; 22.9 ac. Sheen
- 12.7 ac. Burned 10 March 2000 (6 weeks later)
- 3.4 ac. Burned 27 April 2001



Inland ISB Case History: Chevron P/L, UT

Ponded wetland pre-burn, 3/2000



One-year later, 7/2001



Post-thaw 2nd burn 4/2000



- Snow and ice can both help (keep from spreading) and hinder (cover oiled areas)
- Evaluate need for additional burns at thaw
- Actual burned area was 1.3 x intended area
- Burning was effective in removing surface oil but not oil penetrated into sediments
- Burning cannot reduce prior toxic effects
- Would have been more effective if burned earlier

Why Consider Wetland ISBs

- Rapid removal of up to 100% of oil on the wetland or water surface (not just on the vegetation)
 - To reduce exposure to marsh fauna
 - To keep oil from spreading to other sensitive areas
 - To avoid trampling of soils/mixing oil into soils during manual removal
- Minimal logistics/waste generation for difficult-to-access areas

Why ISB May Not be Appropriate

- Air quality and public health concerns
- High risk of an uncontrolled burn
 - Strong winds
 - Ineffective fire break/fire control
- Oil won't burn
 - Oil is emulsified and won't sustain ignition
 - Oil has penetrated the soils, with minimal surface oil
- Oil type/conditions can leave a large amount of burn residue
- Potential to impact protected species in the wetland

Optimal Conditions for ISB in Wetlands

- The spill site is remote or sparsely populated
- The winds are less than 12 miles per hour, and preferably lower
- Light to medium oil
- The oil is relatively fresh and has not formed a stable emulsion
- Vegetation is mostly herbaceous (grasses)
- The vegetation is dormant
- At wetland sites, soil is covered by a layer of water
- The burned vegetation will not be flooded post-burn

Acknowledgments: LA ISBs



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