Hypoxia Surveys in the Pontchartrain Basin

For
Northern Gulf Institute

By

John Lopez

Lake Pontchartrain Basin Foundation

August 11, 2017

Outline

Hydrocoast Maps

Hypoxia SE Louisiana

Potential Impacts

Dead Zones – Causation

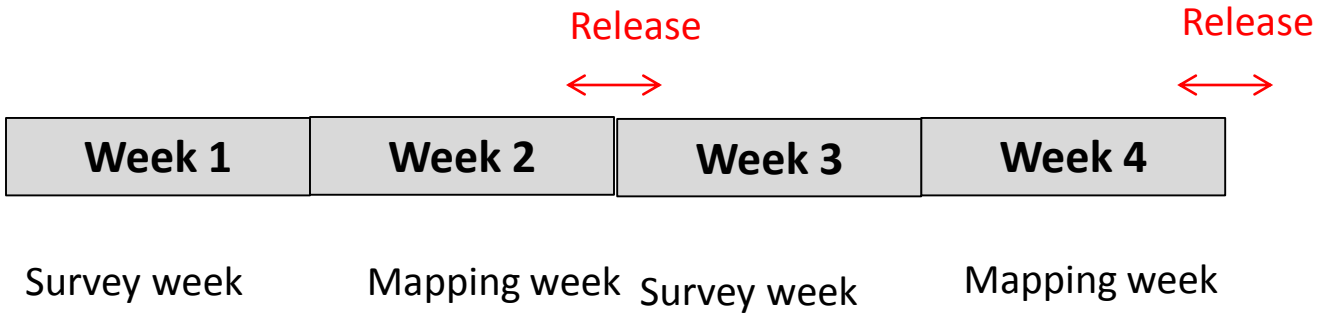
Recommendations

Hydrocoast Pontchartrain Basin

LPBF
SAVE OUR LAKE
SAVE OUR COAST
LAKE PONTCHARTRAIN BASIN FOUNDATION

Hydrocoast Map Process

Hypoxia Survey (Top, Middle, Bottom) ~ 3 times per year



Result of work flow:

“real-time” is actually a 6 to 10 day lag

“snap-shot” not instantaneous, but “average” conditions of 7 days

Hydrocoast a "Wundermap" of hydrology rather than meteorology

Developed by LPBF in 2011/2012, but continuously enhanced

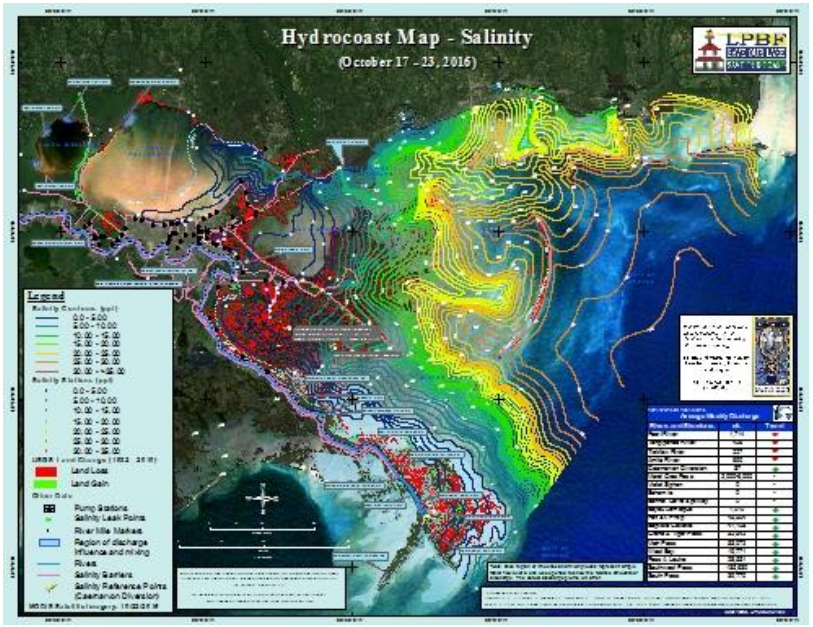
Bi-weekly mapping of critical characteristics of the coastal estuary

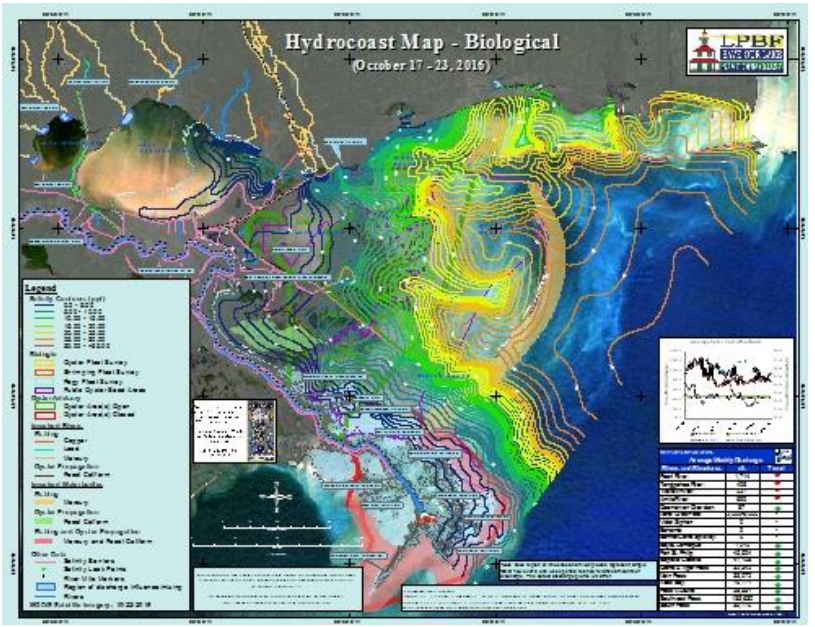
Currently five maps are released publicly bi-weekly

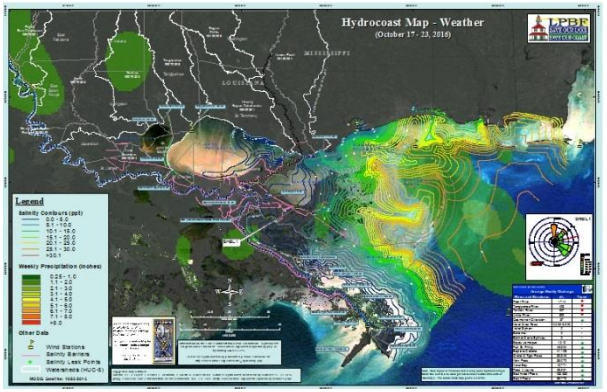
- Salinity Map with Isohalines and freshwater discharges PB & BB
- Biological Map - aerial fisheries survey and closures PB & BB
- Precipitation Map – cumulative rainfall, wind and tide PB & BB

- Habitat Map of Wetland types and soil salinity contours PB
- Water quality Map of current water quality and EPA impairments PB

Pontchartrain: -Bi-weekly Hydrocoast Map Suite







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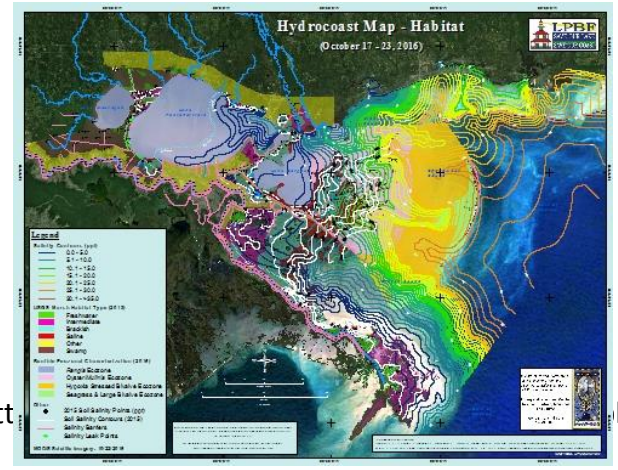

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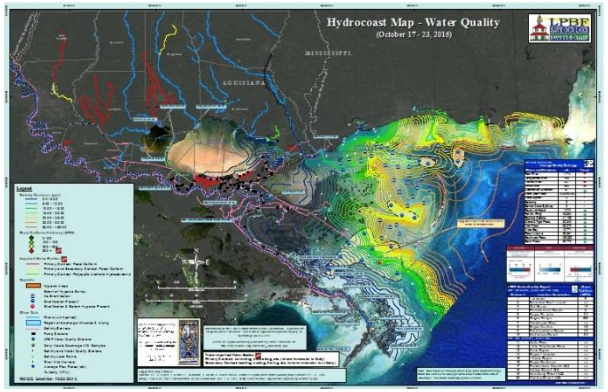


Goal : Approximately Real-time, “Snapshots” of the Estuary

Hydrocoast Map - Salinity

(January 25 - 31, 2016)

LPBF
SAVE OUR LAKE
SAVE OUR COAST

90°30'0"W 90°0'0"W 89°30'0"W 89°0'0"W 88°30'0"W 88°0'0"W

30°30'0"N 30°0'0"N 29°30'0"N

Tickfaw River: 1,040 cfs
Tangipahoa River: 1,876 cfs
Amite River: 2,188 cfs
Pearl River: 16,664 cfs
Bonnet Carre Spillway: 95,000 cfs
Violet Siphon: 0 cfs
Caernarvon Diversion: 37 cfs
Note: Low cfs values indicate a tidal influence.
Crooked Bayou Interim Gage (Seasonal)
Black Bay Interim Gage (Seasonal)
Target Salinity for January: 7.5 - 19.0 ppt
Weekly Low: 1.8, High: 7.8; Mean: 5.04 ppt
Mardi Gras Pass: 8,600 cfs
Bohemia: 33,806 cfs
Bayou Lamoque: 3,056 cfs
Fort St. Philip: 165,000 cfs
Baptiste Collette: 96,382 cfs
Grand & Tiger Pass: 102,233 cfs
Main Pass: 127,386 cfs
West Bay: 58,000 cfs
Pass A Loutre: 100,779 cfs
South Pass: 95,755 cfs
Southwest Pass: 381,894 cfs
Lake Maurepas
Lake Pontchartrain
Lake Borgne
Mississippi River
Gulf of Mexico

Legend

Salinity Contours (ppt)

- 0.0 - 5.00
- 5.00 - 10.00
- 10.00 - 15.00
- 15.00 - 20.00
- 20.00 - 25.00
- 25.00 - 30.00
- 30.00 - 35.00

Salinity Stations (ppt)

- 0.0 - 5.0

Salinity Barriers
Salinity Reference Points (Caernarvon Diversion)
MODIS Satellite Imagery: 01/29/2016

To learn more about recreating on Lake Pontchartrain and Vicinities, consider purchasing LPBF's award winning,

Fishing and Recreation Map for Lake Pontchartrain, Maurepas and Borgne

Go To SaveOurLake.org
See Gift Shop

01-25-2016 to 01-31-2016
Average Weekly Discharge

Rivers and Structures	cfs	Trend
Pearl River:	16,664	↑
Tangipahoa River:	1,876	↑
Tickfaw River:	1,040	↑
Amite River:	4,376	↑
Caernarvon Diversion:	36	↓
Mardi Gras Pass:	8,600	↓
Violet Siphon:	0	-
Bohemia:	33,806	↓
Bonnet Carre Spillway:	95,000	↑
Bayou Lamoque:	3,056	↓
Fort St. Philip:	165,000	↑
Baptiste Collette:	96,382	↓
Grand & Tiger Pass:	102,233	↓
Main Pass:	127,386	↑
West Bay:	58,000	↓
Pass A Loutre:	100,779	↑
Southwest Pass:	381,894	↑
South Pass:	95,755	↓

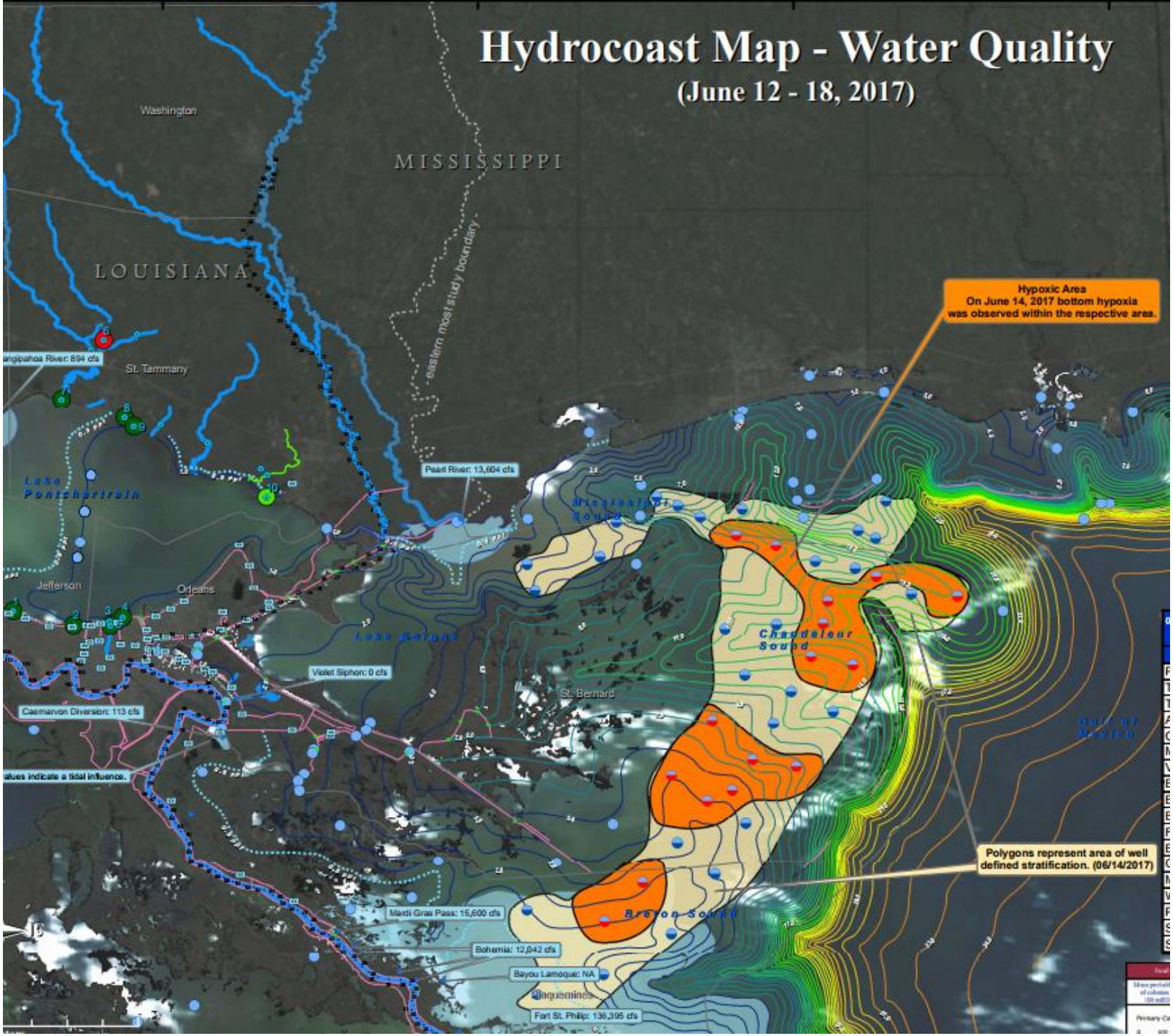
*Note: Blue region of influence and mixing icons represent simple radial flow over a one week period to show the relative amounts of discharge. The actual discharge plume will differ. *

Information on the Lake Pontchartrain Basin Foundation – Hydrocoast Program can be found at: saveourlake.org/coastal-hydromap.php, or by calling 504-836-2215

To receive Hydrocoast map products by email, subscribe at: http://saveourlake.org/subscribe_hydromap.php

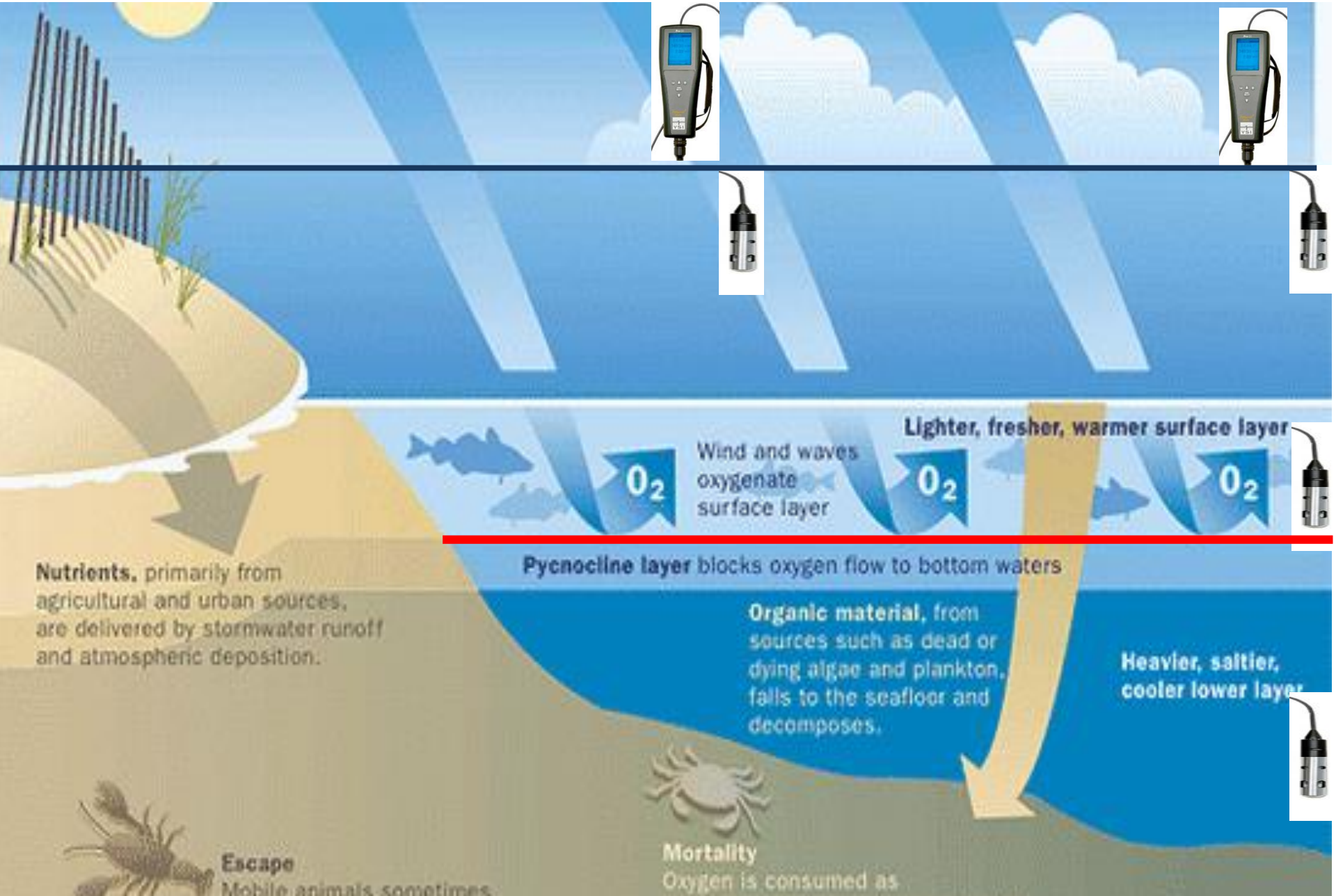
Suggested map citation:
Connor, P.F., J. Lopez, T. Henkel, E. Hillmann, A. Preau, A. Baker, D. Baker, K. Butcher, and P. Smith, Hydrocoast Salinity Map: January 25 - 31, 2016 [map], 1:1,100,000, Lake Pontchartrain Basin Foundation, N.O., La., 2015. <http://saveourlake.org/coastal-hydromap-archives.php>

NAD 1983, UTM Zone 15N


Hydrocoast Map - Water Quality
(June 12 - 18, 2017)
Washington
MISSISSIPPI
LOUISIANA
eastern most study boundary
Hypoxic Area
On June 14, 2017 bottom hypoxia was observed within the respective area.
St. Tammany
Lake Pontchartrain
Pearl River: 13,604 cfs
Jefferson
Orleans
Lake Borgne
Violet Siphon: 0 cfs
Caernarvon Diversion: 113 cfs
St. Bernard
Chandeleur Sound
Gulf of Mexico
Polygons represent area of well defined stratification. (06/14/2017)
Breton Sound
Mardi Gras Pass: 15,600 cfs
Bohemia: 12,042 cfs
Bayou Lamoque: NA
Plaquemines
Fort St. Philip: 136,395 cfs

Surface water ~ 1 ft.

Hypoxia Survey Top, Middle and Bottom



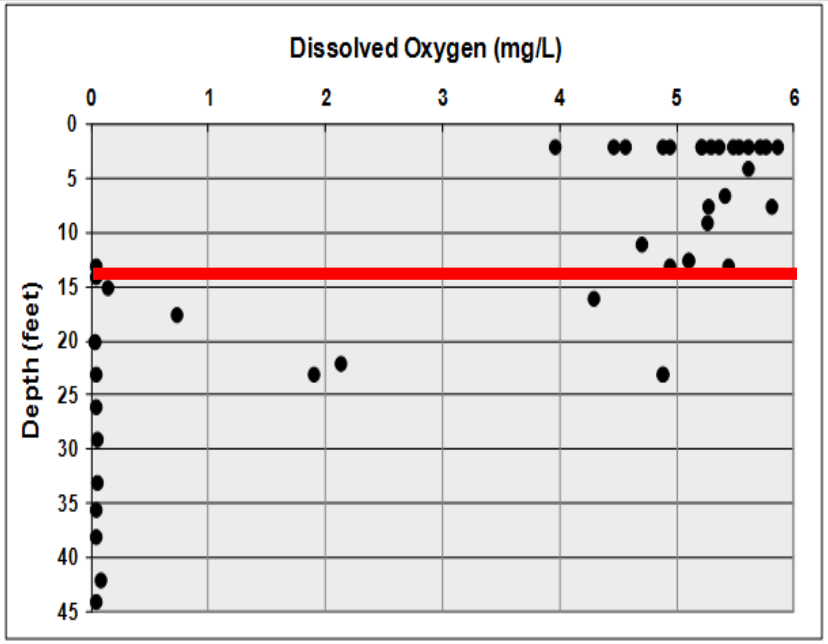
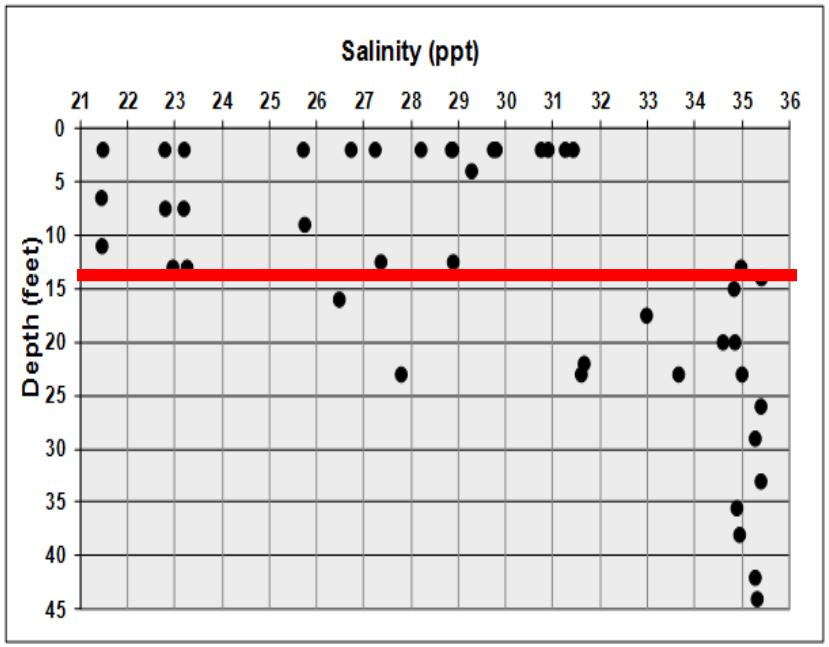


Figure 6: Graph showing dissolved oxygen with depth in 2011. Notice a decline of dissolved oxygen with depth and the rapid decline in oxygen around 10-20 feet deep.



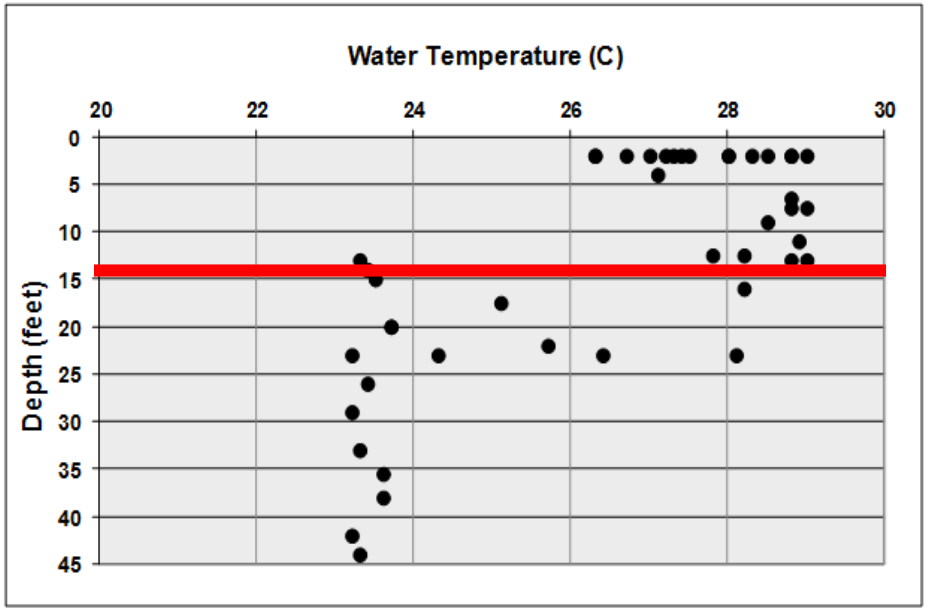
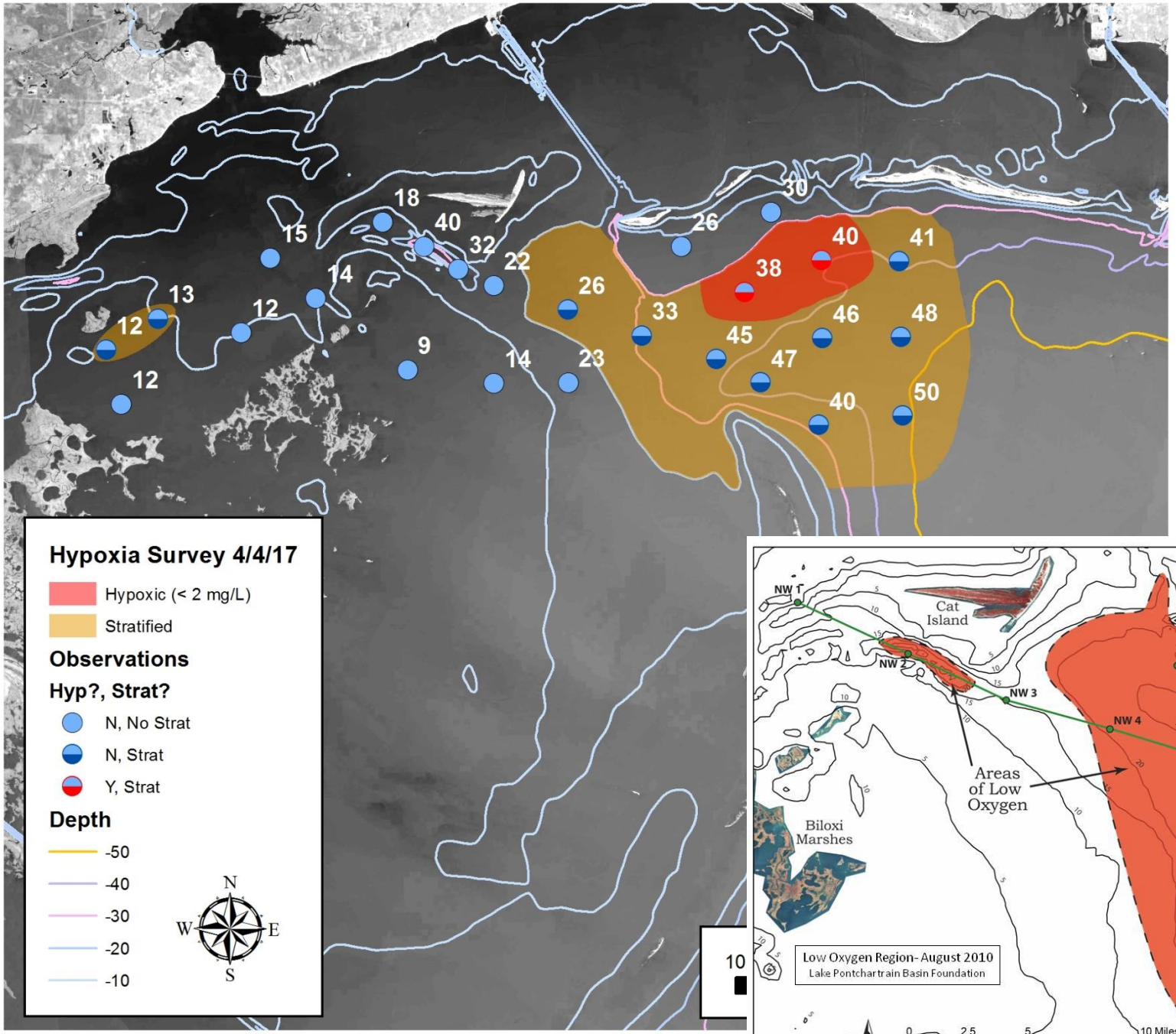


Figure 8: Graph showing change in water temperature with depth in 2011. Notice the cooler temperatures with depth with the decline in temperature occurring around 10-25 feet deep.

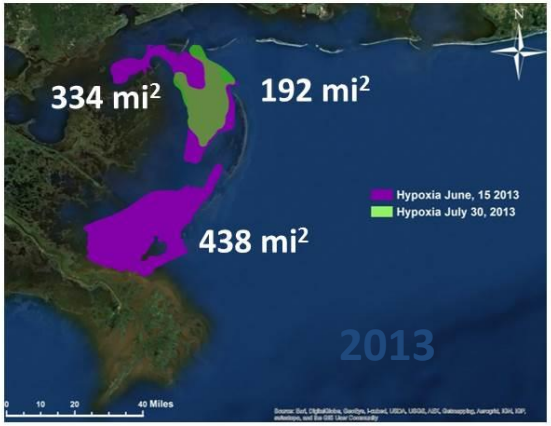
Table 1: Average difference in salinity, dissolved oxygen and temperature between the upper and lower layers o the water column in 2011.

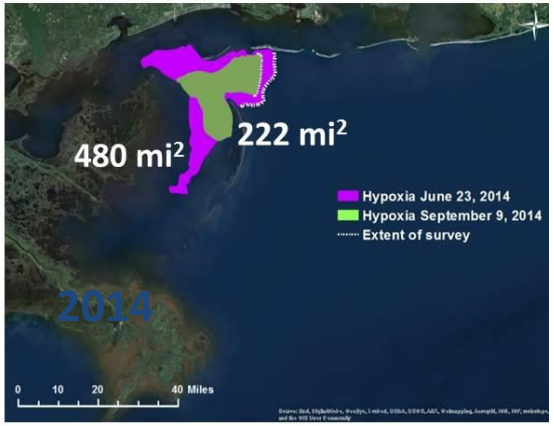
	Average Salinity (ppt)	Average DO (mg/l)	Average Temperature (C°)
Upper Layer	29.71	5.03	27.16
Lower Layer	34.99	0.08	23.46
Difference	5.28	-4.94	-3.70

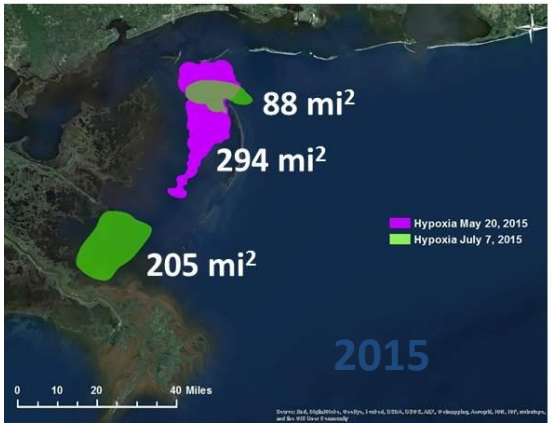

Hypoxia Survey 4/4/17
Hypoxic (< 2 mg/L)
Stratified
Observations
Hyp?, Strat?
N, No Strat
N, Strat
Y, Strat
Depth
-50
-40
-30
-20
-10
N
W
E
S
18
40
32
22
15
14
13
12
12
12
9
14
23
26
33
45
47
40
38
40
41
46
48
50
26
30

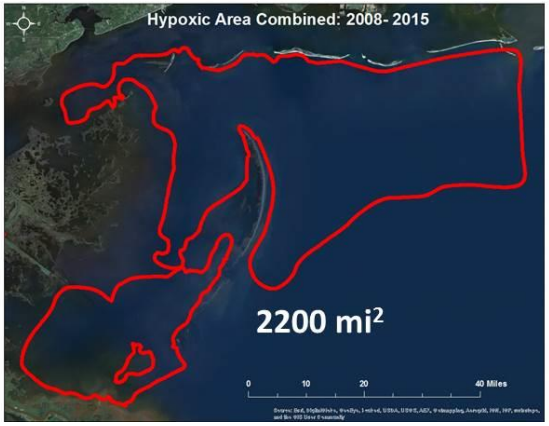
NW 1
NW 2
NW 3
NW 4
NW 5
NW 6
NE 1
NE 2
NE 3
NE 4
NE 5
NE 6
Cat Island
Ship Island
Additional Point
Areas of Low Oxygen
Biloxi Marshes
Chandeleur Island
Low Oxygen Region- August 2010
Lake Pontchartrain Basin Foundation
N
0
2.5
5
10 Miles

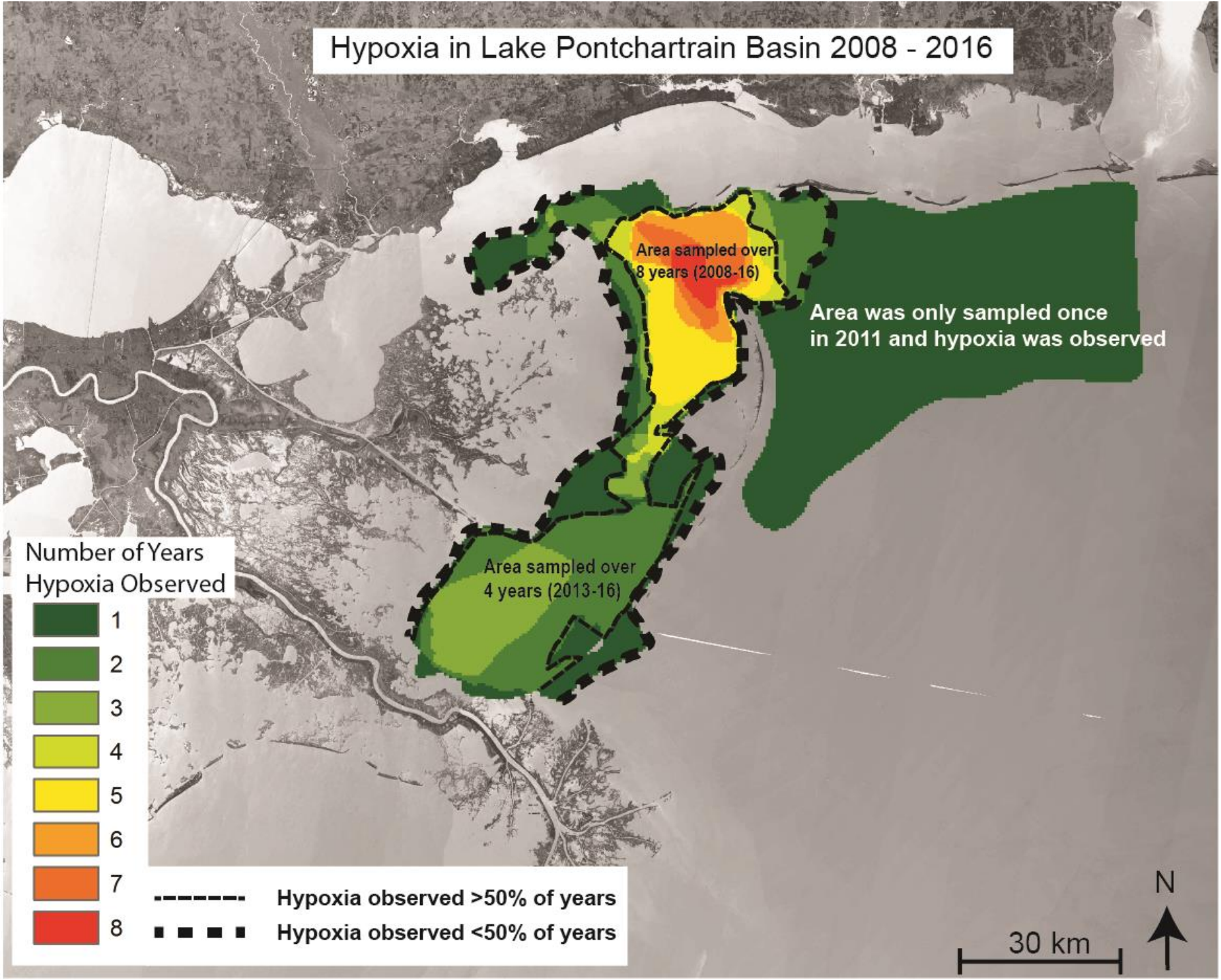
Hypoxia East of the River

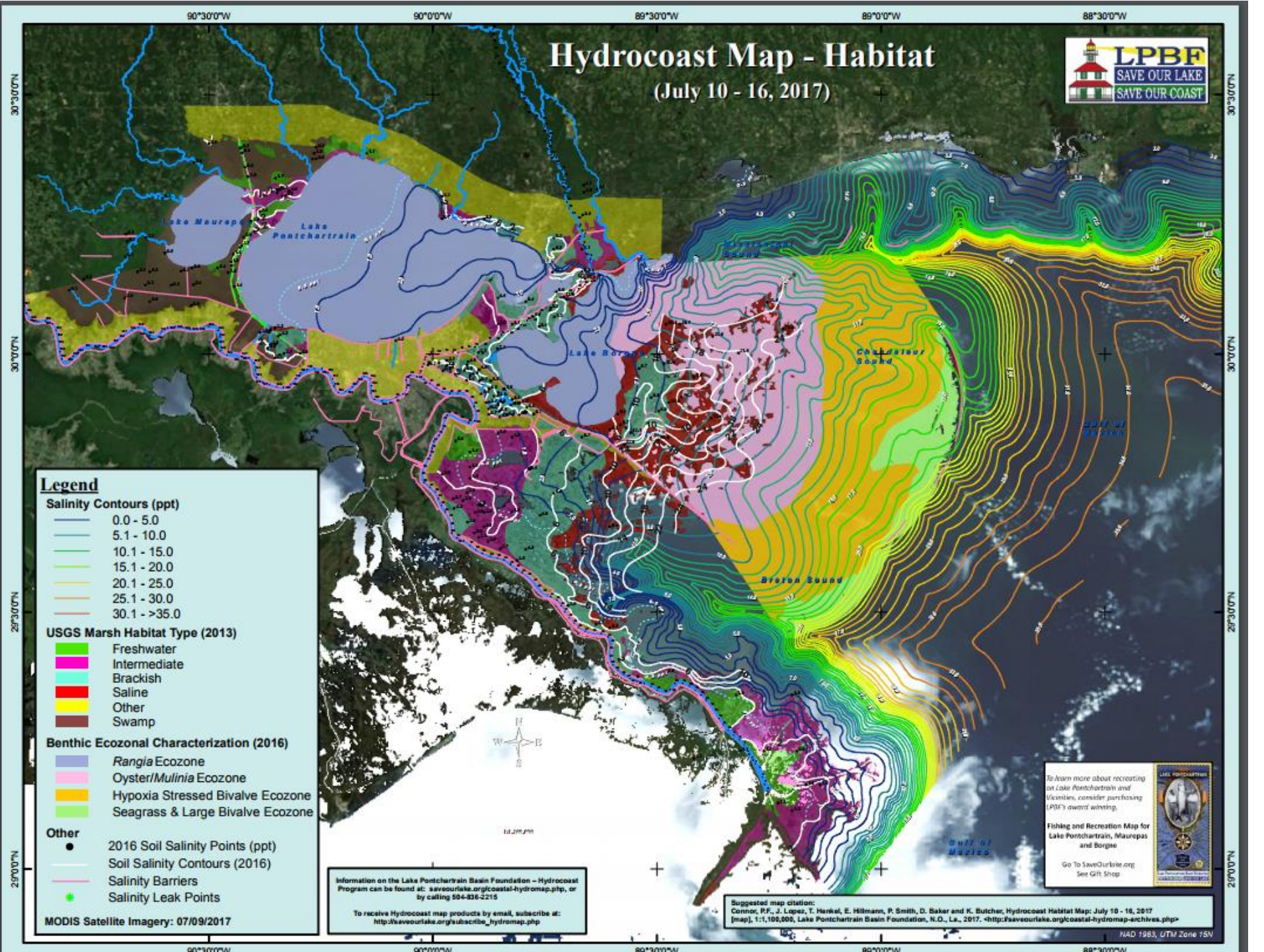









Hypoxia in Lake Pontchartrain Basin 2008 - 2016
Area sampled over 8 years (2008-16)
Area was only sampled once in 2011 and hypoxia was observed
Area sampled over 4 years (2013-16)
Number of Years Hypoxia Observed
1
2
3
4
5
6
7
8
Hypoxia observed >50% of years
Hypoxia observed <50% of years
N
30 km


Hydrocoast Map - Habitat
(July 10 - 16, 2017)
LPBF
SAVE OUR LAKE
SAVE OUR COAST
90°30'0"W
90°0'0"W
89°30'0"W
89°0'0"W
88°30'0"W
30°0'0"N
29°30'0"N
29°0'0"N
Lake Maurepas
Lake Pontchartrain
Lake Borgne
Chandeleur Sound
Breton Sound
Gulf of Mexico
Legend
Salinity Contours (ppt)
0.0 - 5.0
5.1 - 10.0
10.1 - 15.0
15.1 - 20.0
20.1 - 25.0
25.1 - 30.0
30.1 - >35.0
USGS Marsh Habitat Type (2013)
Freshwater
Intermediate
Brackish
Saline
Other
Swamp
Benthic Ecozonal Characterization (2016)
Rangia Ecozone
Oyster/Mulinia Ecozone
Hypoxia Stressed Bivalve Ecozone
Seagrass & Large Bivalve Ecozone
Other
2016 Soil Salinity Points (ppt)
Soil Salinity Contours (2016)
Salinity Barriers
Salinity Leak Points
MODIS Satellite Imagery: 07/09/2017
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To receive Hydrocoast map products by email, subscribe at: http://saveourlake.org/subscribe_hydromap.php
To learn more about recreating on Lake Pontchartrain and Vicinities, consider purchasing LPBF's award winning,
Fishing and Recreation Map for Lake Pontchartrain, Maurepas and Borgne
Go To SaveOurlake.org
See Gift Shop
Suggested map citation:
Connor, P.F., J. Lopez, T. Henkel, E. Hillmann, P. Smith, D. Baker and K. Butcher, Hydrocoast Habitat Map: July 10 - 16, 2017 [map], 1:1,100,000, Lake Pontchartrain Basin Foundation, N.O., La., 2017. <http://saveourlake.org/coastal-hydromap-archives.php>
NAD 1983, UTM Zone 15N

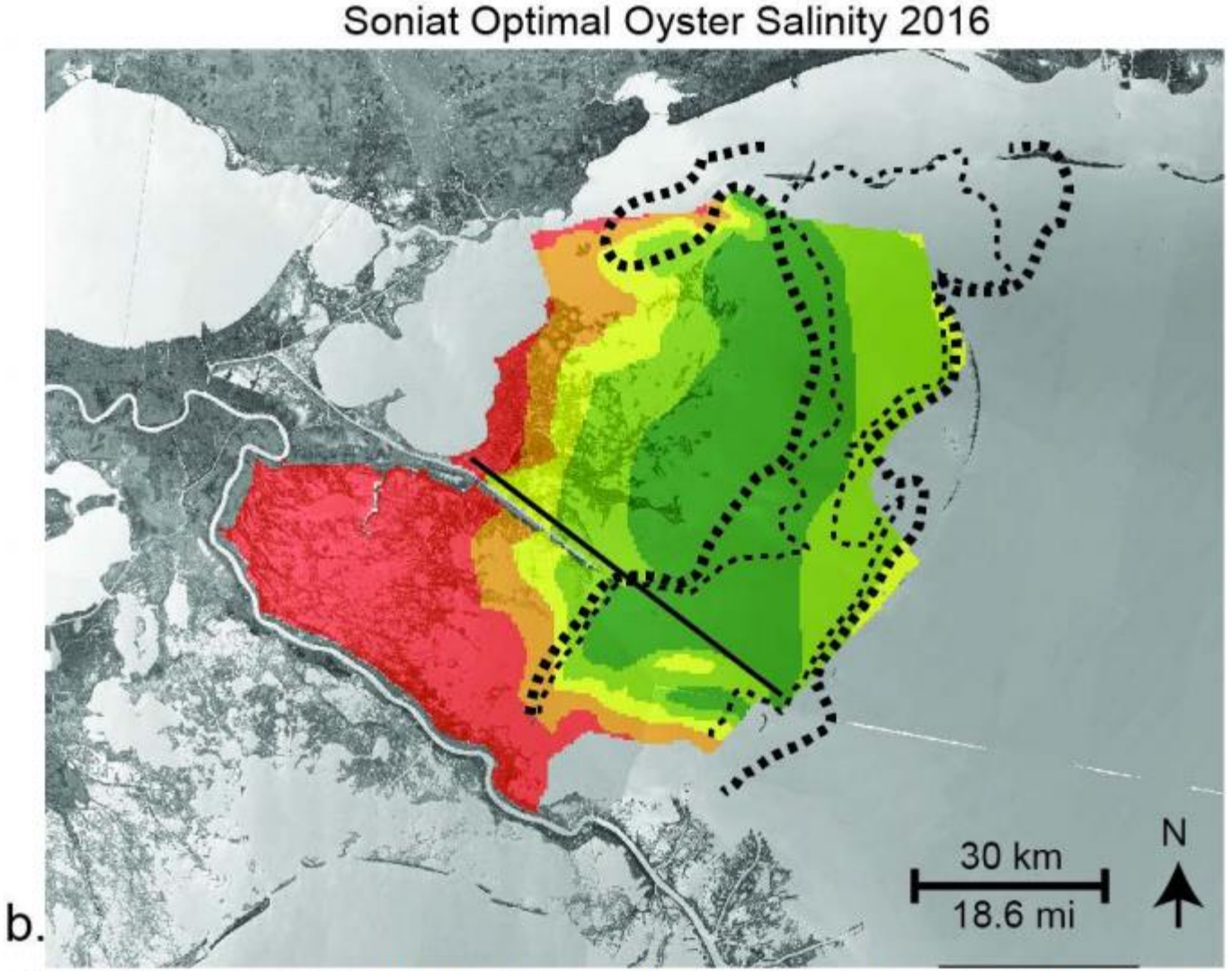

Figure 9: Close-up maps of the Biloxi Marsh and Breton Sound subbasins, highlighting the differences between salinity suitability using the (a) COOS and (b) SOOS methods. Heavy dashed line indicates extent of frequently observed hypoxic conditions (i.e. > 50% of observation years 2008-2016. Thin dashed line indicates extent of occasionally observed hypoxic conditions (i.e. 1-50 % of observation years 2008-2016). Note no observations were

Hydrocoast Map - Biological

(June 02 - 08, 2014)

LPBF SAVE OUR LAKE SAVE OUR COAST

Date: 06-02-2014

Oyster Fleet Survey

Area	Vessel Count	Productive Area (sq mi)
1	6	11.9
2	7	12.5
Totals:	13	24.3

Date: 06-02-2013

Shrimping Fleet Survey

Area	Vessel Count	Productive Area (sq mi)
1	12	13.4
2	2	0.6
3	54	49.9
4	3	3.7
5	86	107.7
6	1	2.9
7	4	3.0
8	1	2.4
9	50	53.5
10	8	16.2
11	49	42.0
12	8	15.3
13	2	0.1
Totals:	280	310.7

Dates: 06/02to 06/08, 2014

Average Weekly Discharge

Rivers and Structures	cfs	Trend
Pearl River:	12,046	↑
Tangipahoa River:	2,891	↑
Tickfaw River:	643	↑
Amite River:	5,419	↑
Caernarvon Diversion:	187	↑
Mardi Gras Pass:	2,282	↑
Violet Siphon:	285	↓
Bohemia:	0	N/A
Bonnet Carre Spillway:	0	N/A
Bayou Lamoque:	1,678	↑
Fort St. Philip:	32,236	↑
Baptiste Collette:	71,776	↑
Grand & Tiger Pass:	50,400	↑
Main Pass:	49,400	↑
West Bay:	41,900	↑
Pass A Loutre:	32,100	↓
Southwest Pass:	206,400	↑
South Pass:	85,400	↓

Legend

Salinity Contours (psu)

- 0.0 - 5.00
- 5.00 - 10.00
- 10.00 - 15.00
- 15.00 - 20.00
- 20.00 - 25.00
- 25.00 - 30.00
- 30.00 - 35.00

Salinity Stations (psu)

- 0.0 - 5.00
- 5.00 - 10.00
- 10.00 - 15.00
- 15.00 - 20.00
- 20.00 - 25.00
- 25.00 - 30.00
- 30.00 - 35.00

Biologic

- Oyster Fleet Survey
- Shrimping Fleet Survey
- Public Oyster Seed Areas

Oyster Advisory

- Oyster Area(s) Open
- Oyster Area(s) Closed
- Oyster Zone Areas

Other Data

- Salinity Barriers
- Salinity Leak Points
- River Mile Markers
- Stream Discharge
- Rivers

MODIS Satellite Imagery: 06/06/2014

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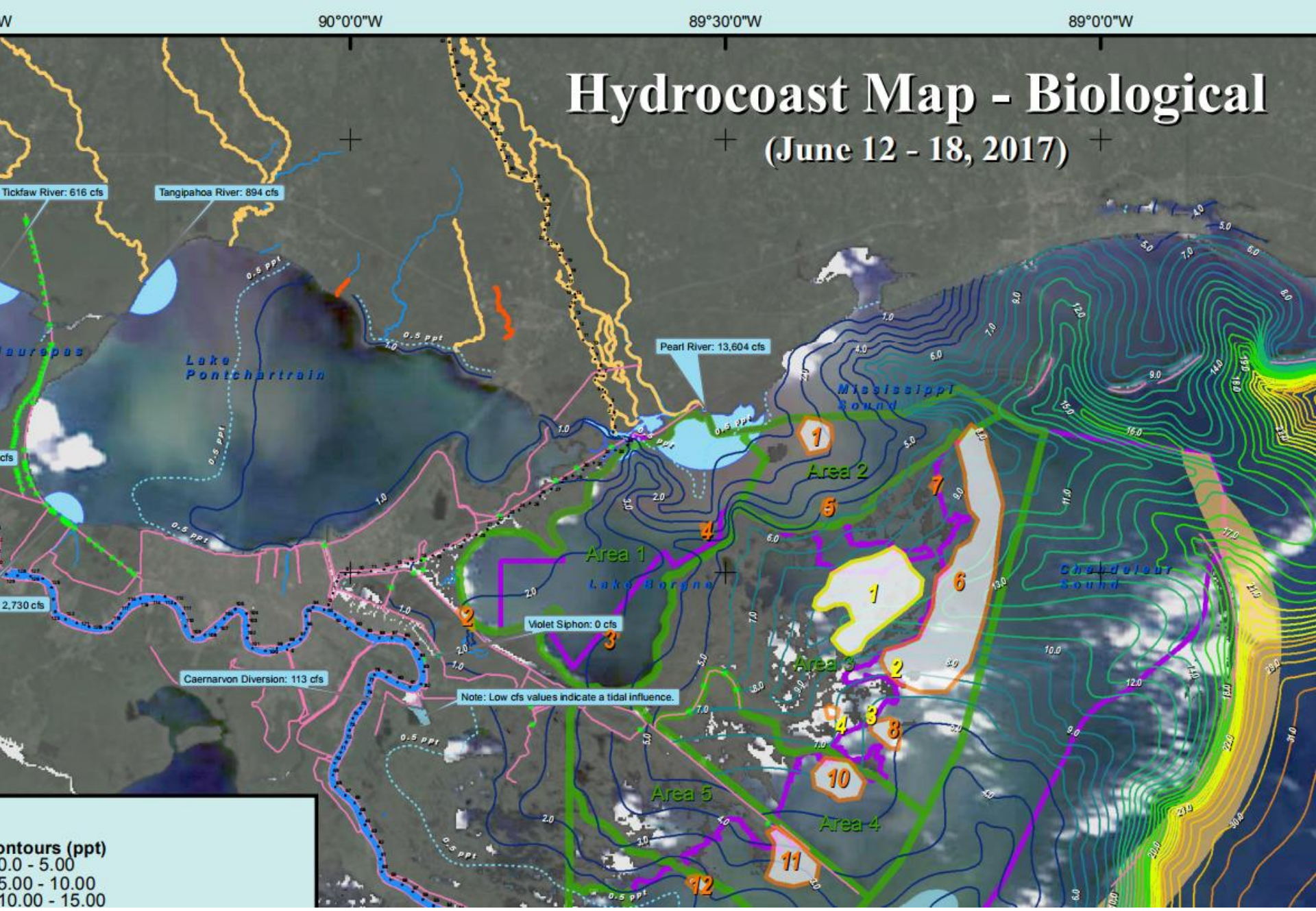
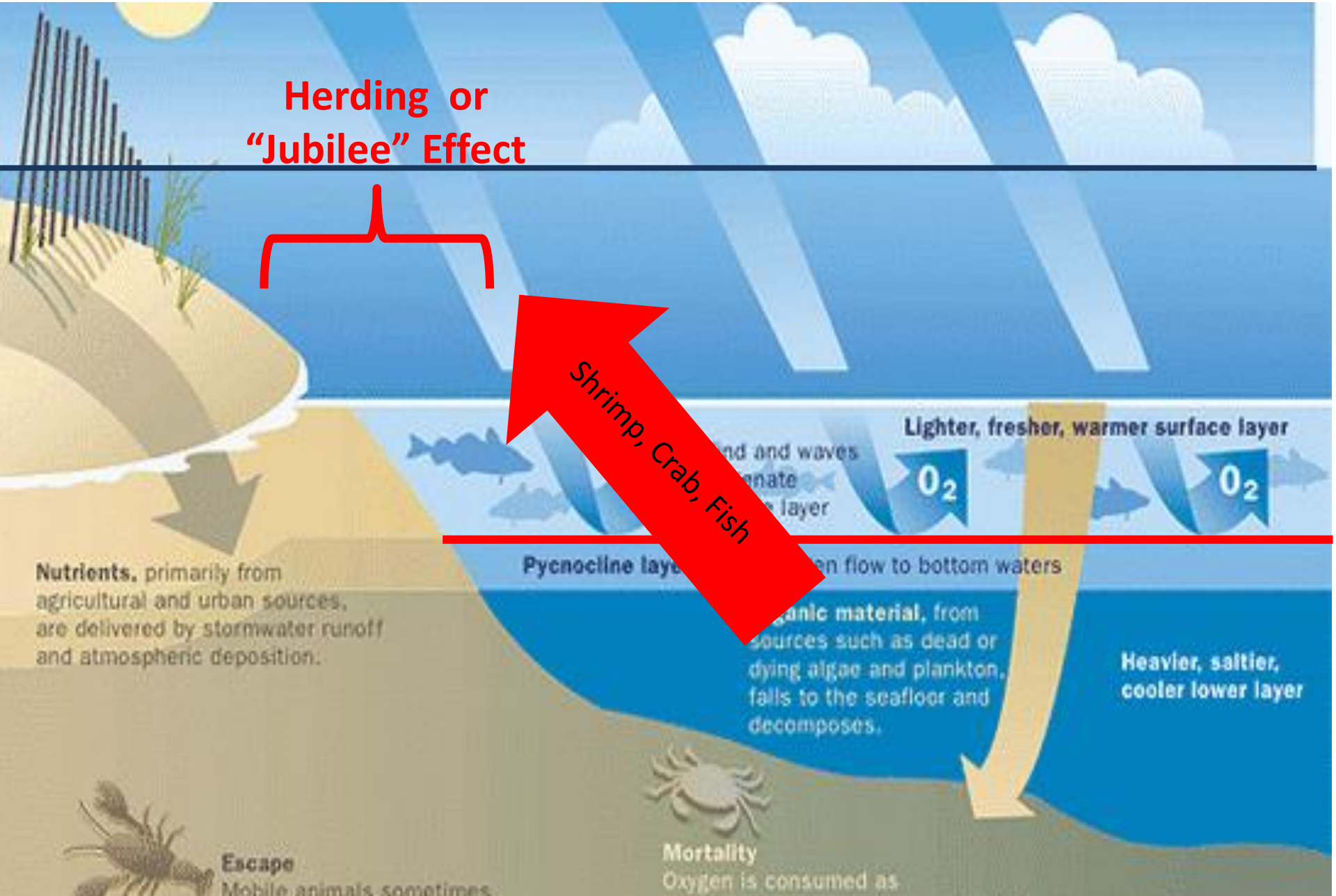
"Note: Blue discharge plumes are scaled icons representing simple radial flow over a one week period to show relative amounts of discharge. The actual discharge plume will differ. "

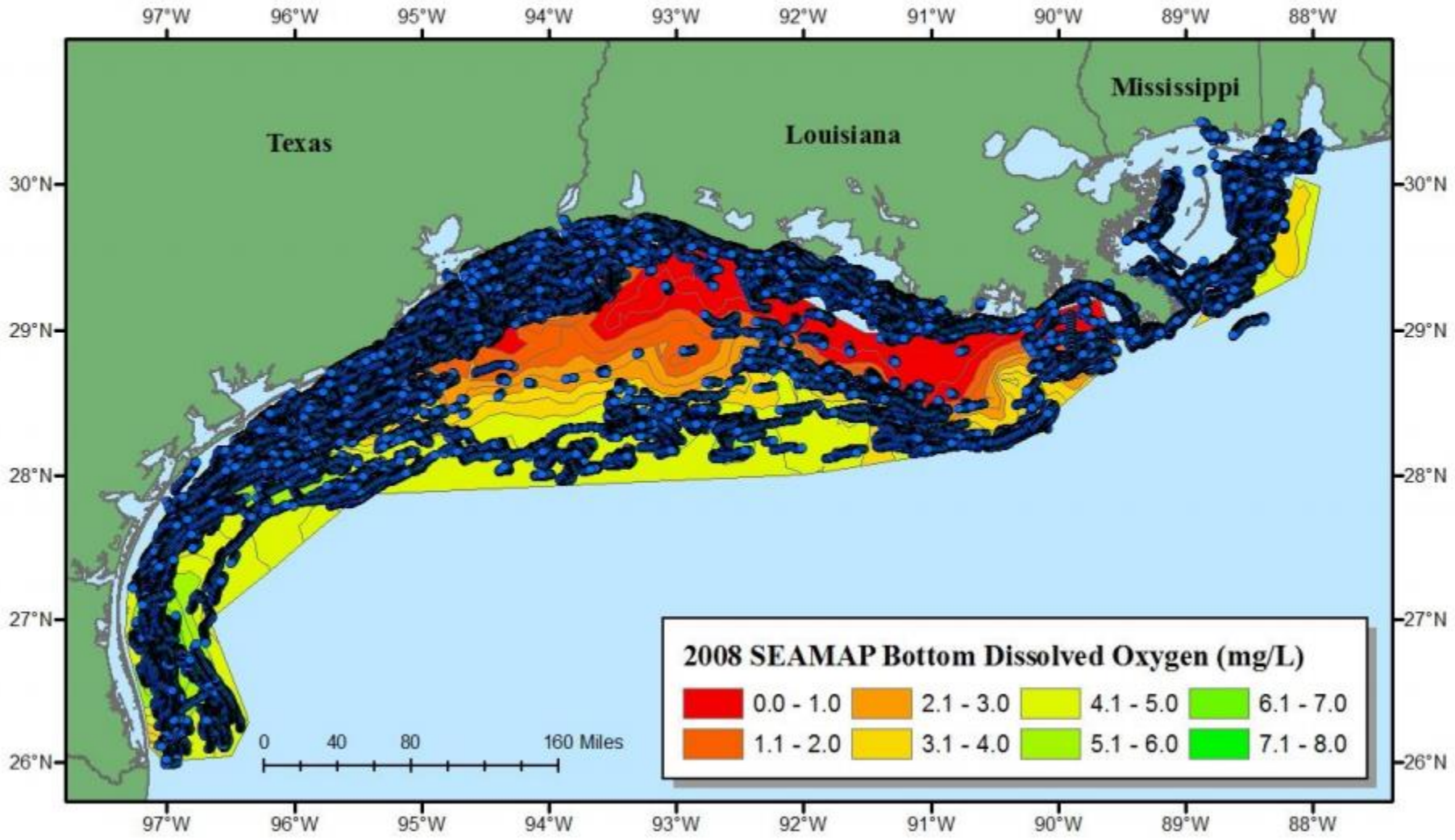
Suggested map citation:
Connor, P.F., J. Lopez, T. Henkel, A. Moshogianis, E. Hillmann, A. Baker, D. Baker, and W. Pestoff, Hydrocoast Biological Map: June 2 - 8, 2014 [map], 1:1,100,000, Lake Pontchartrain Basin Foundation, N.O., La., 2014. <http://saveourlake.org/coastal-hydromap-archives.php>


90°0'0"W
89°30'0"W
89°0'0"W
Hydrocoast Map - Biological
(June 12 - 18, 2017)
Tickfaw River: 616 cfs
Tangipahoa River: 894 cfs
Pearl River: 13,604 cfs
Lake Pontchartrain
Mississippi Sound
Chandeleur Sound
Lake Borgne
Violet Siphon: 0 cfs
Caernarvon Diversion: 113 cfs
2,730 cfs
Note: Low cfs values indicate a tidal influence.
Area 1
Area 2
Area 3
Area 4
Area 5
0.5 ppt
ontours (ppt)
0.0 - 5.00
5.00 - 10.00
10.00 - 15.00

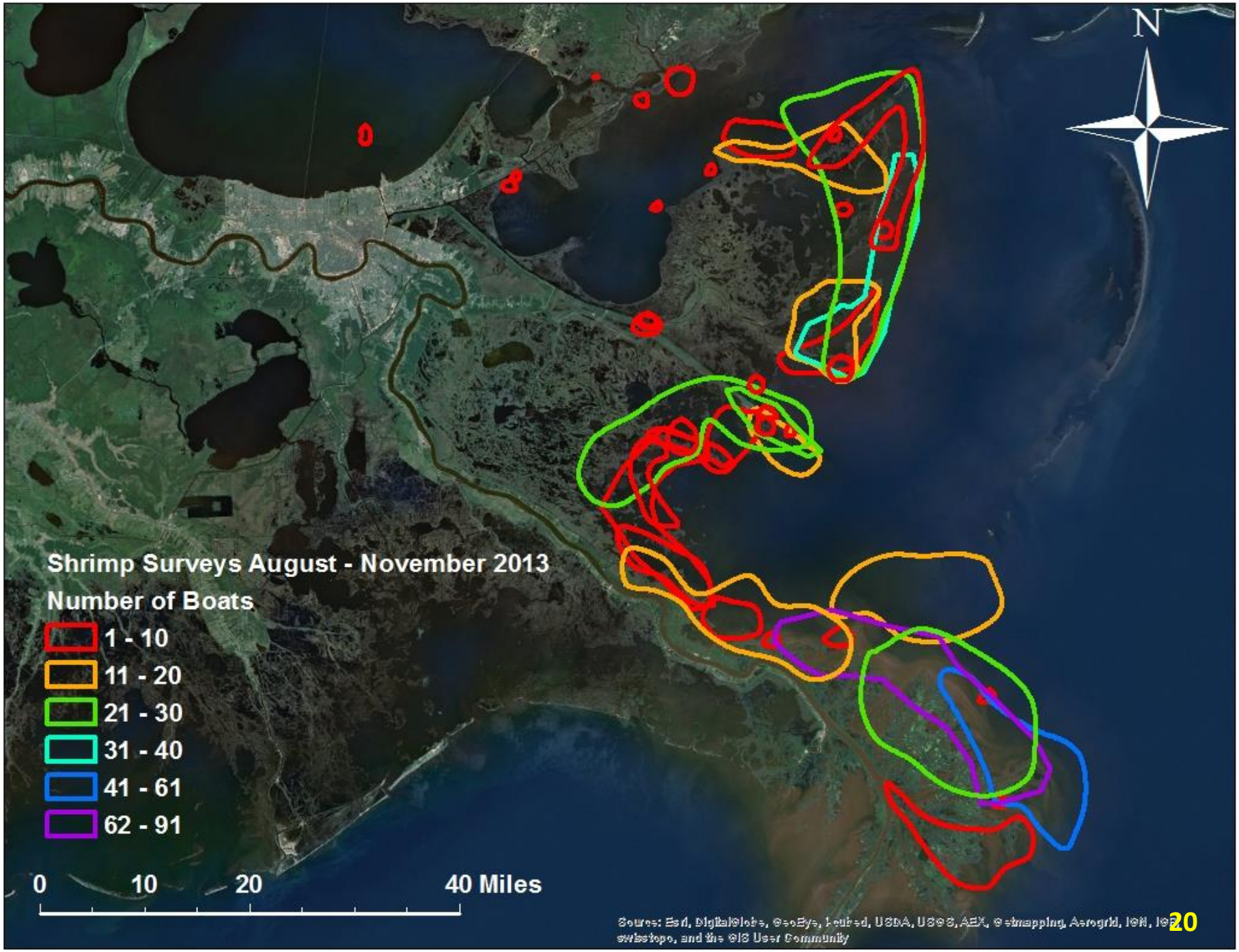
Hypoxia Area

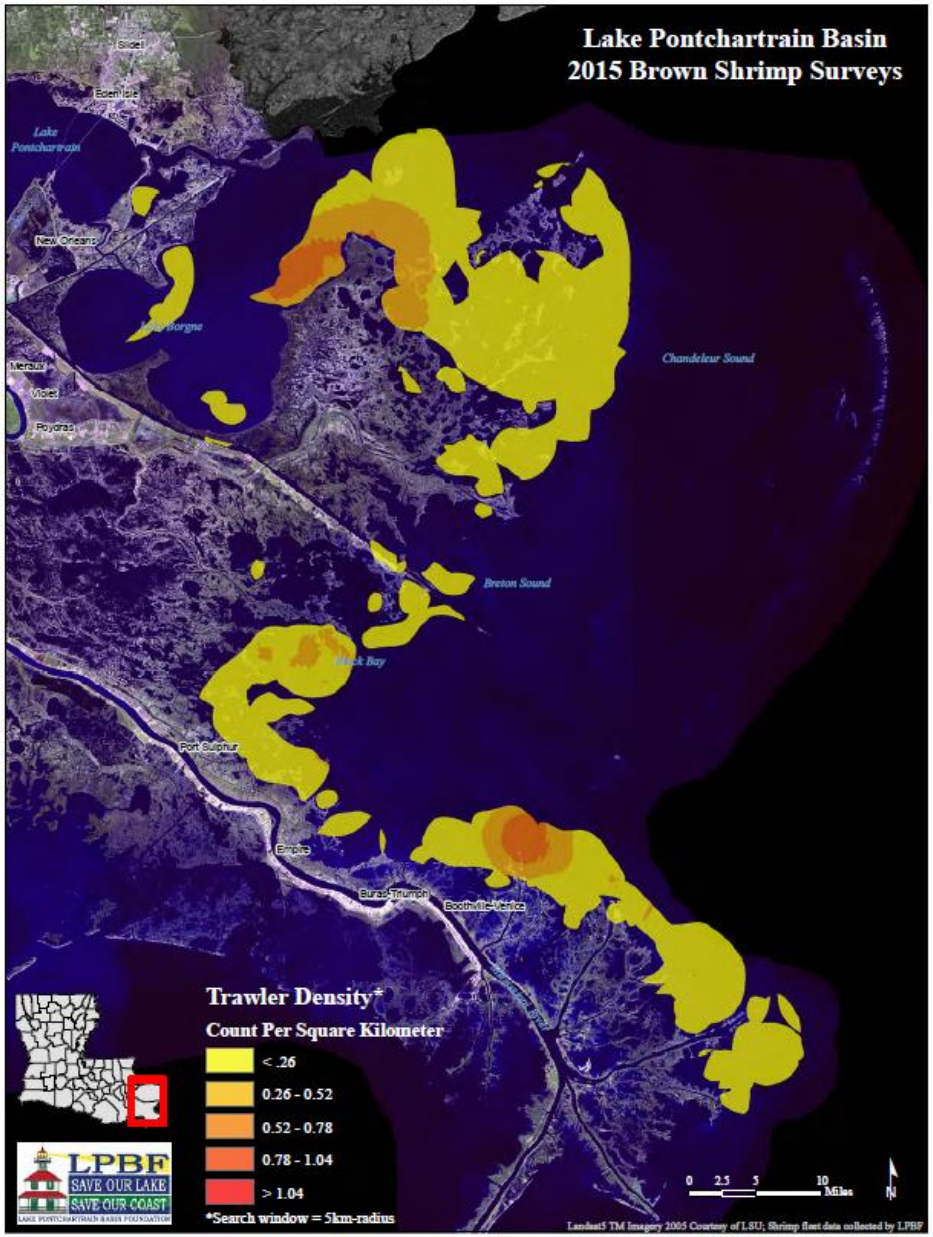


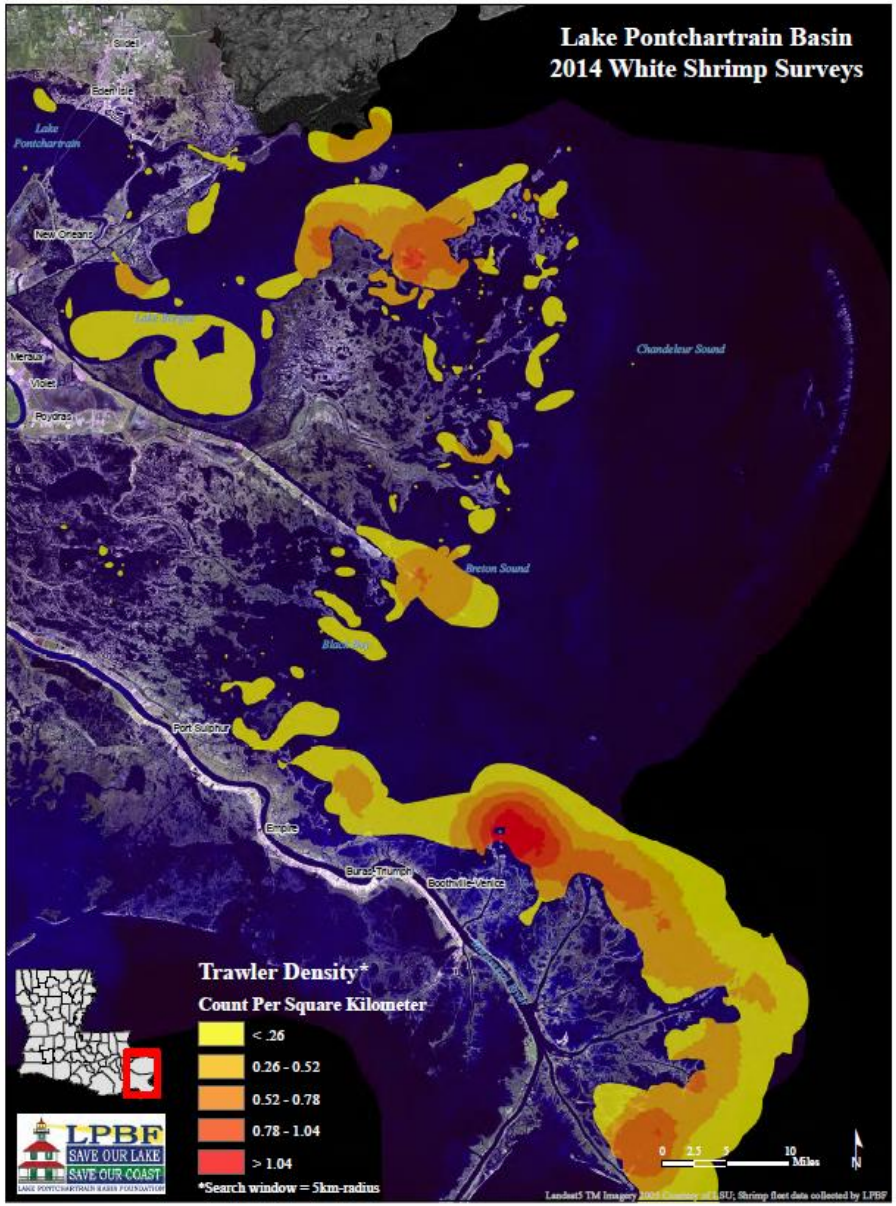
2008 SEAMAP Bottom Dissolved Oxygen and July Shrimping Effort

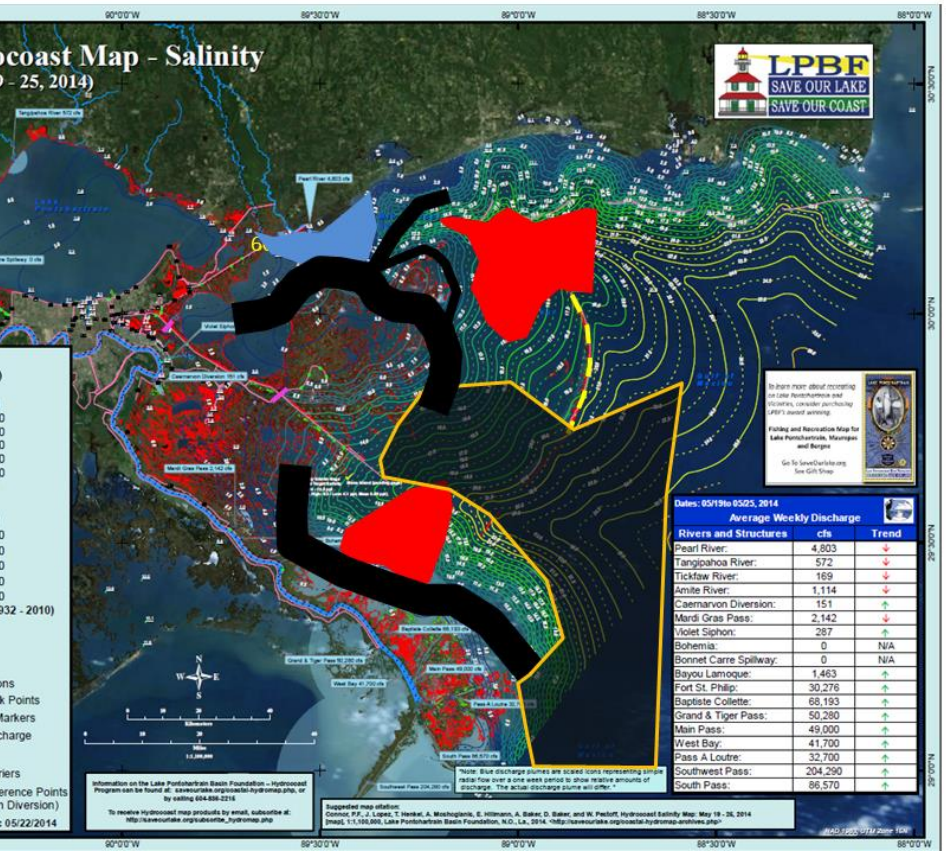


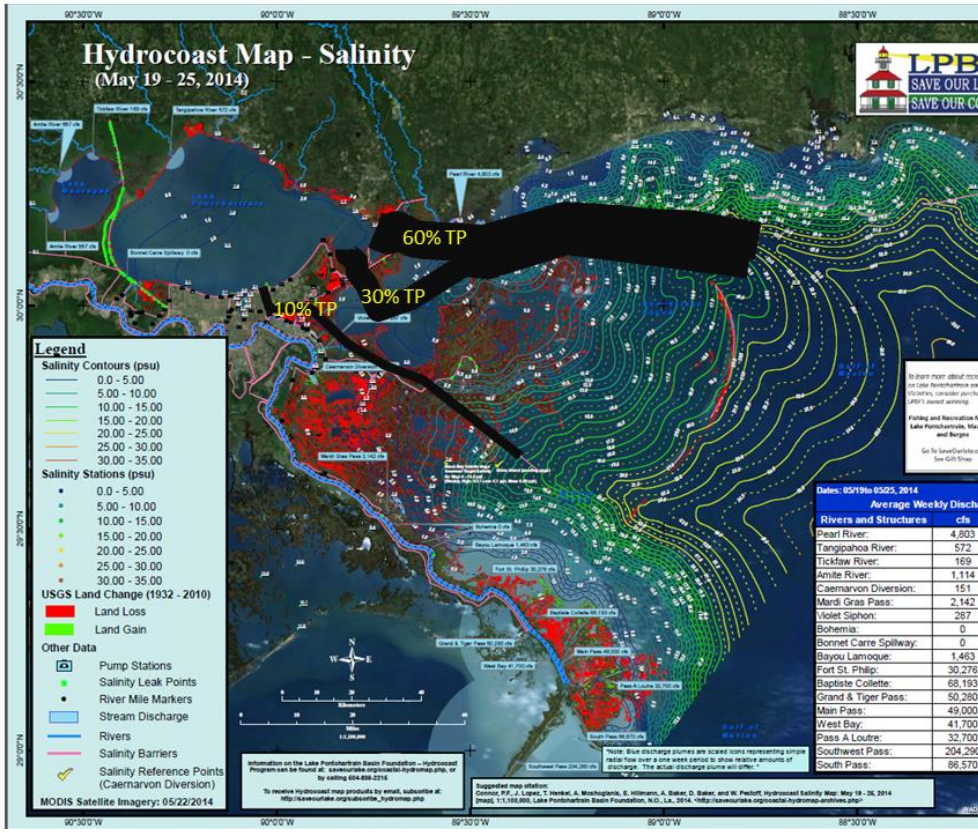
Dr. Lisa Desfosse
SEFSC Mississippi Laboratory Director
NOAA, National Marine Fisheries Service


N
Shrimp Surveys August - November 2013
Number of Boats
1 - 10
11 - 20
21 - 30
31 - 40
41 - 61
62 - 91
0
10
20
40 Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Lake Pontchartrain Basin
2015 Brown Shrimp Surveys
Slidell
Eden Isle
Lake Pontchartrain
New Orleans
Lake Borgne
Chandeleur Sound
Mandeville
Violet
Poydras
Breton Sound
Black Bay
Port Sulphur
Empire
Buras-Triumph
Boothville-Venice
Trawler Density*
Count Per Square Kilometer
< .26
0.26 - 0.52
0.52 - 0.78
0.78 - 1.04
> 1.04
*Search window = 5km-radius
0 2.5 5 10 Miles
N
LPBF
SAVE OUR LAKE
SAVE OUR COAST
Landsat5 TM Imagery 2005 Courtesy of LSU; Shrimp fleet data collected by LPBF


Lake Pontchartrain Basin
2014 White Shrimp Surveys
Slidell
Eden Isle
Lake Pontchartrain
New Orleans
Lake Borgne
Chandeleur Sound
Mandeville
Violet
Poydras
Breton Sound
Black Bay
Port Sulphur
Empire
Buras-Triumph
Boothville-Venice
Trawler Density*
Count Per Square Kilometer
< .26
0.26 - 0.52
0.52 - 0.78
0.78 - 1.04
> 1.04
*Search window = 5km-radius
0 2.5 5 10 Miles
N
LPBF
SAVE OUR LAKE
SAVE OUR COAST
Landsat5 TM Imagery 2005 Courtesy of LSU; Shrimp fleet data collected by LPBF


ocoast Map - Salinity
- 25, 2014)
LPBF
SAVE OUR LAKE
SAVE OUR COAST
Dates: 05/19to 05/25, 2014
Average Weekly Discharge
Rivers and Structures | cfs | Trend
Pearl River: 4,803
Tangipahoa River: 572
Tickfaw River: 169
Amite River: 1,114
Caernarvon Diversion: 151
Mardi Gras Pass: 2,142
Violet Siphon: 287
Bohemia: 0 N/A
Bonnet Carre Spillway: 0 N/A
Bayou Lamoque: 1,463
Fort St. Philip: 30,276
Baptiste Collette: 68,193
Grand & Tiger Pass: 50,280
Main Pass: 49,000
West Bay: 41,700
Pass A Loutre: 32,700
Southwest Pass: 204,290
South Pass: 86,570
932 - 2010)
ons
k Points
Markers
charge
riers
erence Points
n Diversion)
: 05/22/2014


Hydrocoast Map - Salinity
(May 19 - 25, 2014)
60% TP
30% TP
10% TP
Legend
Salinity Contours (psu)
0.0 - 5.00
5.00 - 10.00
10.00 - 15.00
15.00 - 20.00
20.00 - 25.00
25.00 - 30.00
30.00 - 35.00
Salinity Stations (psu)
0.0 - 5.00
5.00 - 10.00
10.00 - 15.00
15.00 - 20.00
20.00 - 25.00
25.00 - 30.00
30.00 - 35.00
USGS Land Change (1932 - 2010)
Land Loss
Land Gain
Other Data
Pump Stations
Salinity Leak Points
River Mile Markers
Stream Discharge
Rivers
Salinity Barriers
Salinity Reference Points (Caernarvon Diversion)
MODIS Satellite Imagery: 05/22/2014
Dates: 05/19to 05/25, 2014
Rivers and Structures | cfs
Pearl River: 4,803
Tangipahoa River: 572
Tickfaw River: 169
Amite River: 1,114
Caernarvon Diversion: 151
Mardi Gras Pass: 2,142
Violet Siphon: 287
Bohemia: 0
Bonnet Carre Spillway: 0
Bayou Lamoque: 1,463
Fort St. Philip: 30,276
Baptiste Collette: 68,193
Grand & Tiger Pass: 50,280
Main Pass: 49,000
West Bay: 41,700
Pass A Loutre: 32,700
Southwest Pass: 204,290
South Pass: 86,570

Characterization of Hypoxia

Topic 1 Report for the Integrated Assessment on Hypoxia in the Gulf of Mexico

Nancy N. Rabalais, R. Eugene Turner, Dubravko Justić
Quay Dortch, and William J. Wiseman, Jr.

May 1999

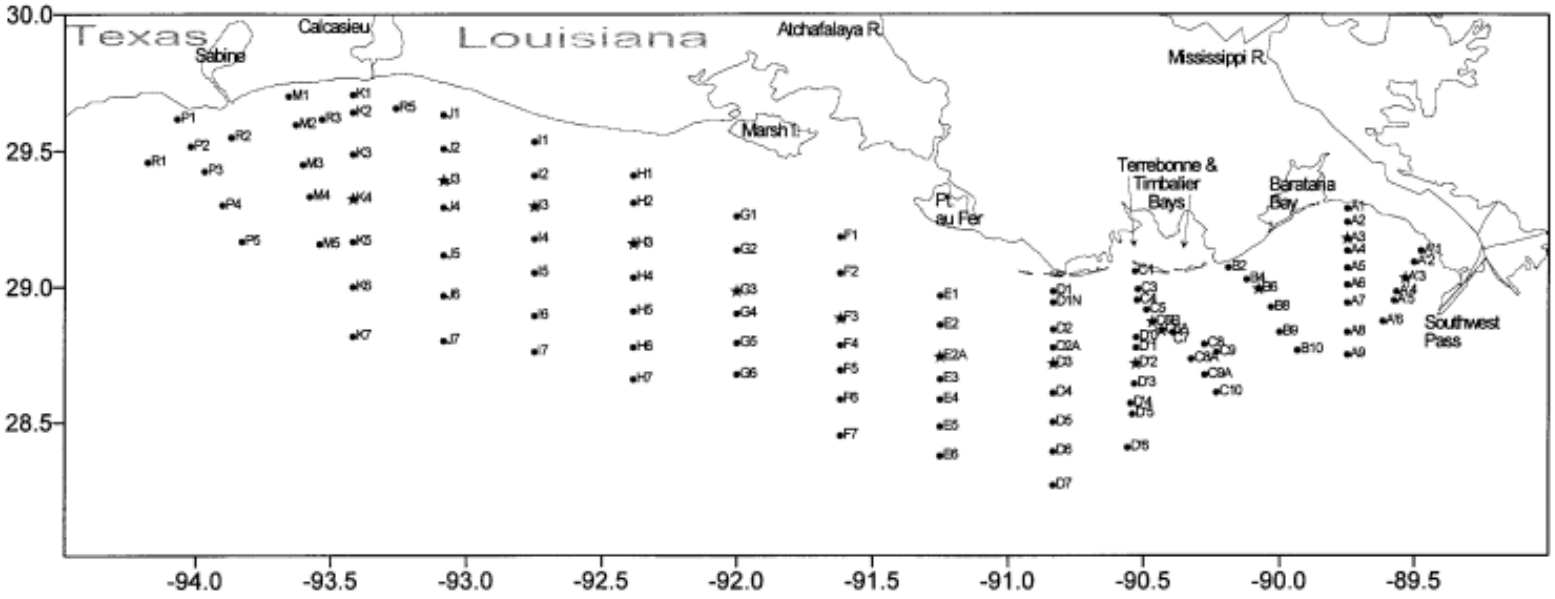
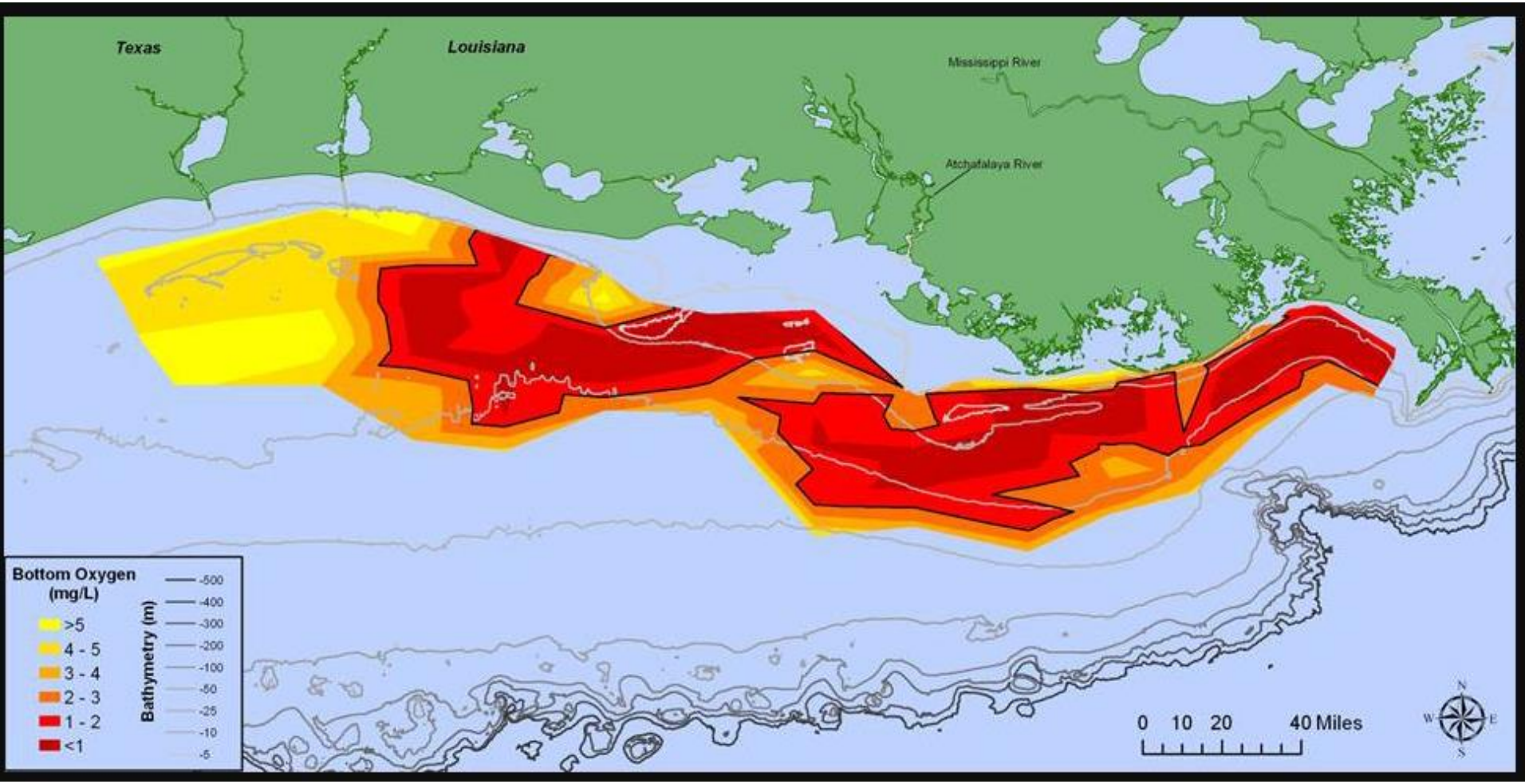
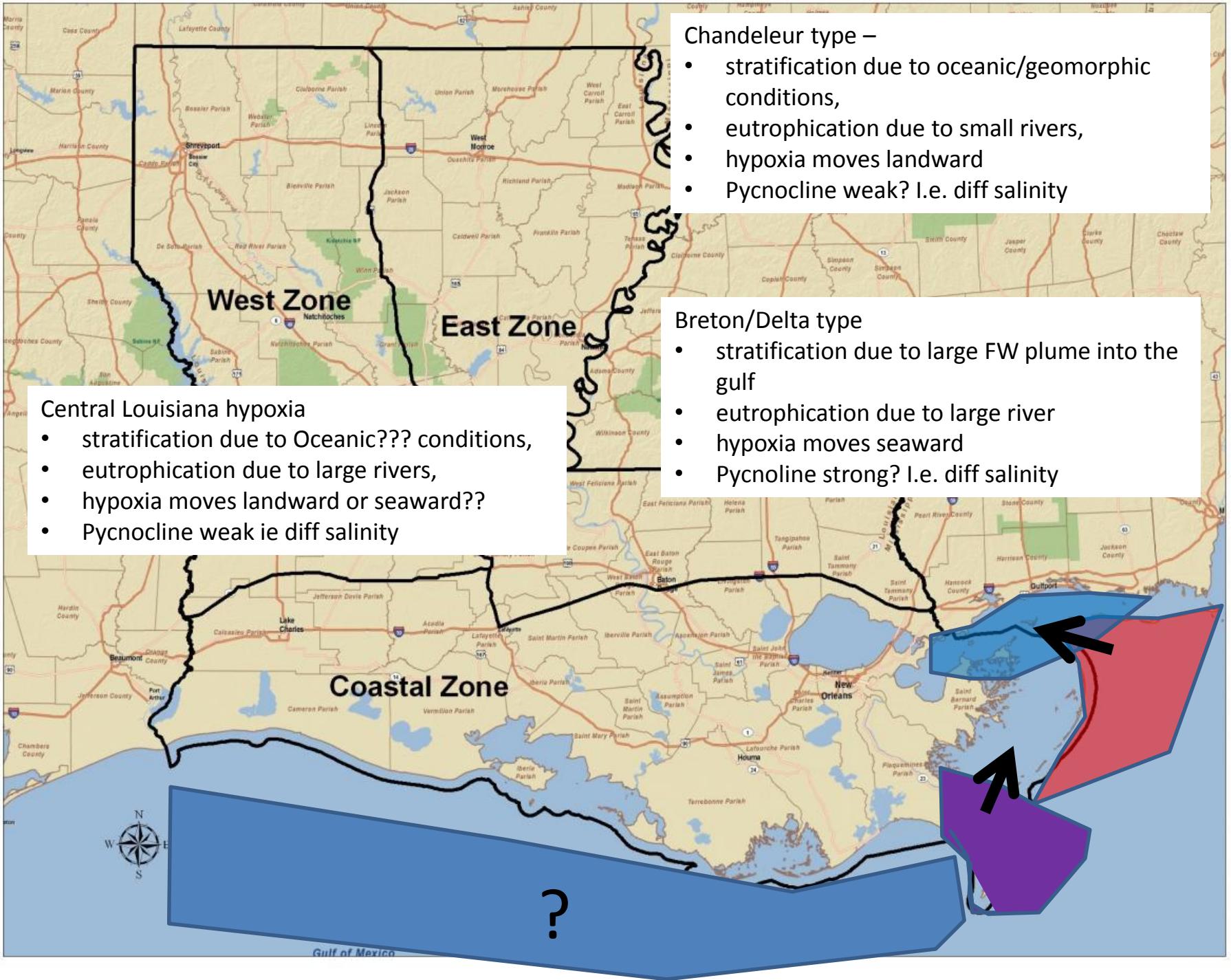
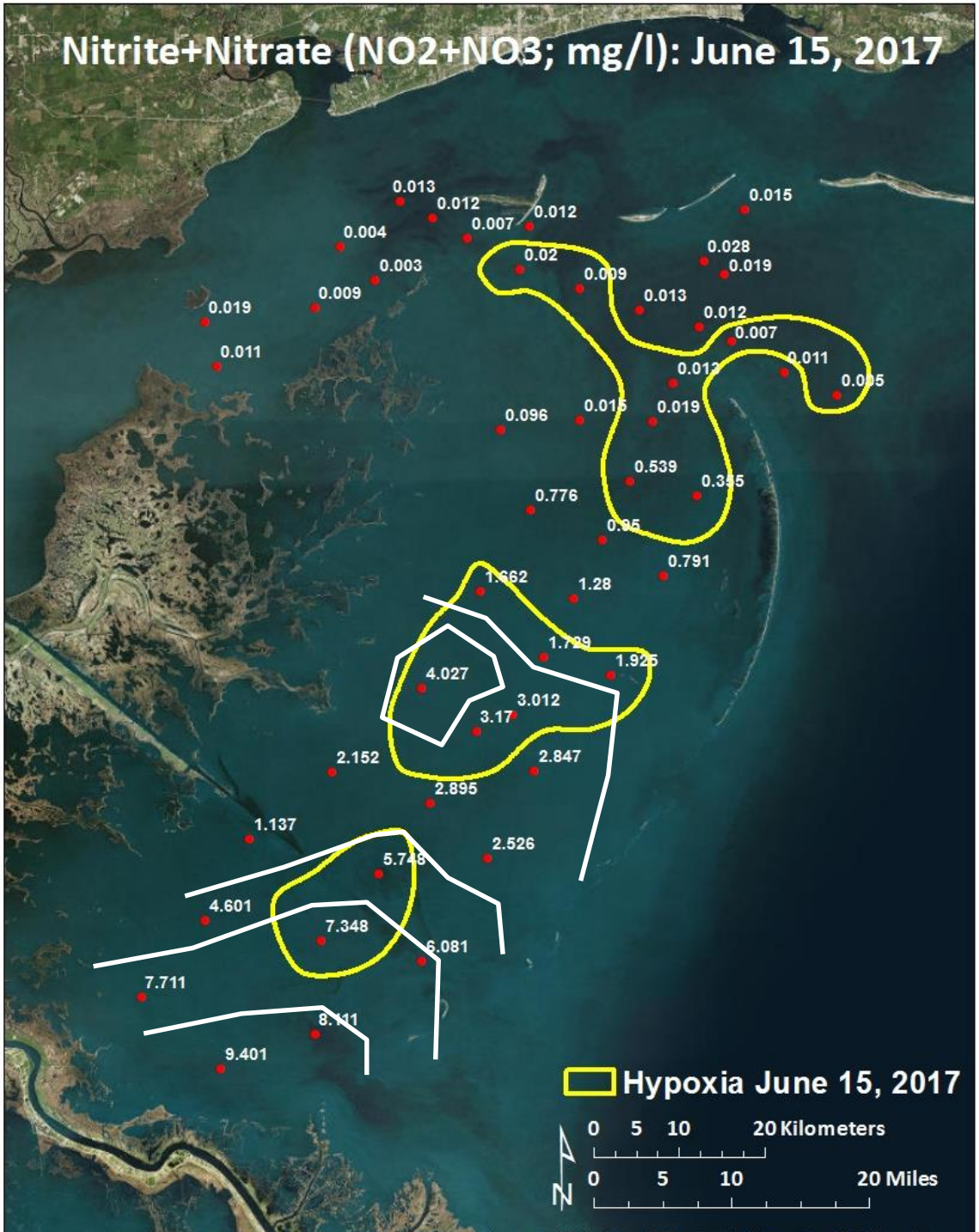


FIGURE 2.1. Distribution of stations for mid-summer shelf-wide surveys and more frequent sampling along transect C. NOTE: Stations C6A and C6B are locations of moored instruments; station C6, not shown, is between C6A and C6B. Composite data for stations C6A, C6B, and C6C comprise values for station C6*. Starred stations represent those that approximate the 20-m isobath.

Standard data collections included hydrographic profiles for temperature, salinity, dissolved oxygen, and optical properties. Water samples for chlorophyll a and phaeopigments, nutrients, salinity, suspended sediment, and phytoplankton community composition were collected from the surface, near-bottom, and variable middle depths.


Texas
Louisiana
Mississippi River
Atchafalaya River
Bottom Oxygen (mg/L)
>5
4 - 5
3 - 4
2 - 3
1 - 2
<1
Bathymetry (m)
-500
-400
-300
-200
-100
-50
-25
-10
-5
0 10 20 40 Miles
N
W
E
S


Chandeleur type –
• stratification due to oceanic/geomorphic conditions,
• eutrophication due to small rivers,
• hypoxia moves landward
• Pycnocline weak? I.e. diff salinity
West Zone
East Zone
Breton/Delta type
• stratification due to large FW plume into the gulf
• eutrophication due to large river
• hypoxia moves seaward
• Pycnoline strong? I.e. diff salinity
Central Louisiana hypoxia
• stratification due to Oceanic??? conditions,
• eutrophication due to large rivers,
• hypoxia moves landward or seaward??
• Pycnocline weak ie diff salinity
Coastal Zone
?
Gulf of Mexico


Nitrite+Nitrate (NO2+NO3; mg/l): June 15, 2017
0.013
0.012
0.007
0.012
0.004
0.003
0.009
0.019
0.011
0.02
0.009
0.015
0.028
0.019
0.013
0.012
0.007
0.011
0.005
0.096
0.539
0.776
0.791
1.662
1.28
4.027
3.012
3.17
2.152
2.847
2.895
1.137
2.526
4.601
7.348
6.081
7.711
9.401
Hypoxia June 15, 2017
0 5 10 20 Kilometers
0 5 10 20 Miles
N

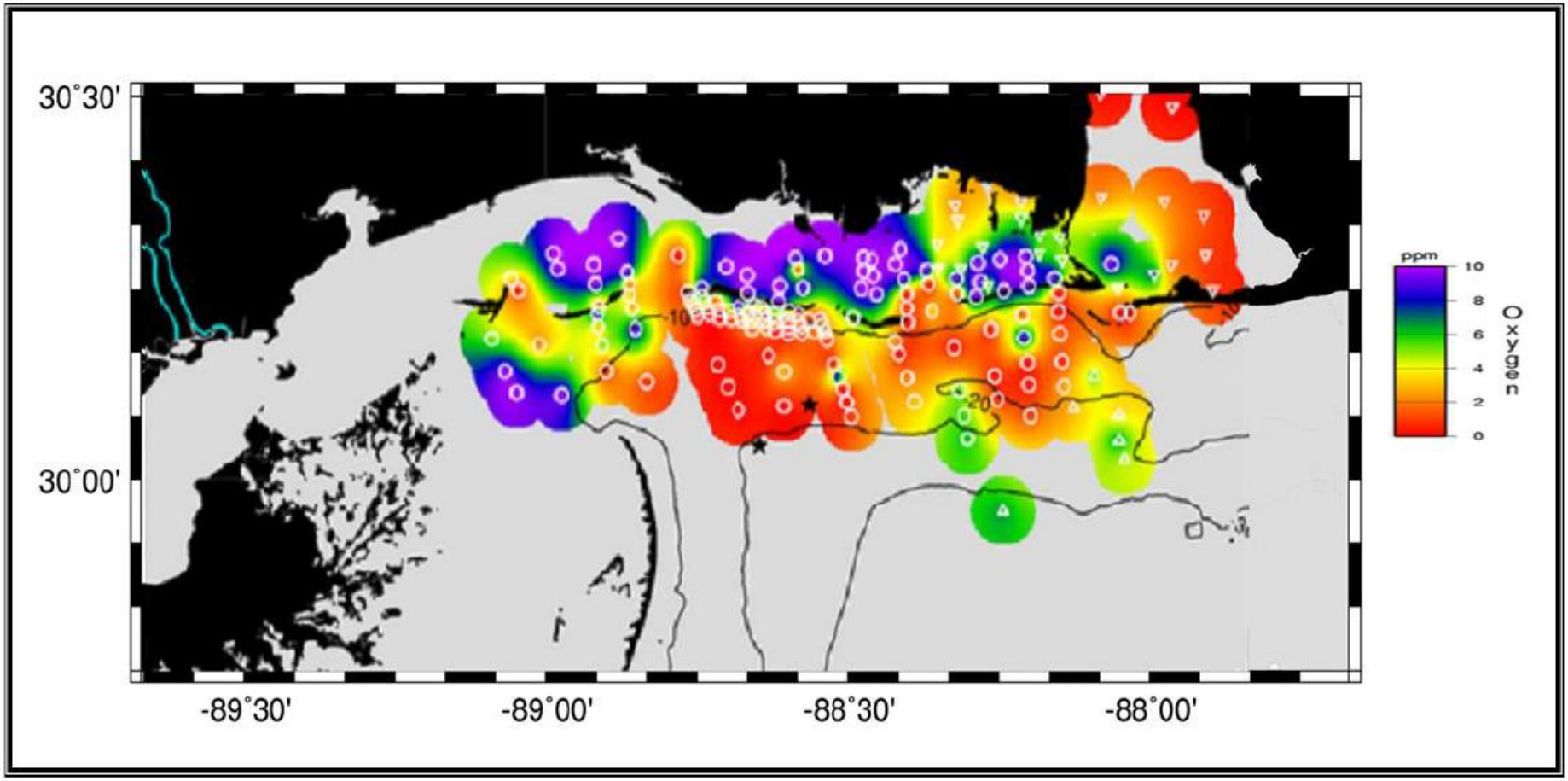
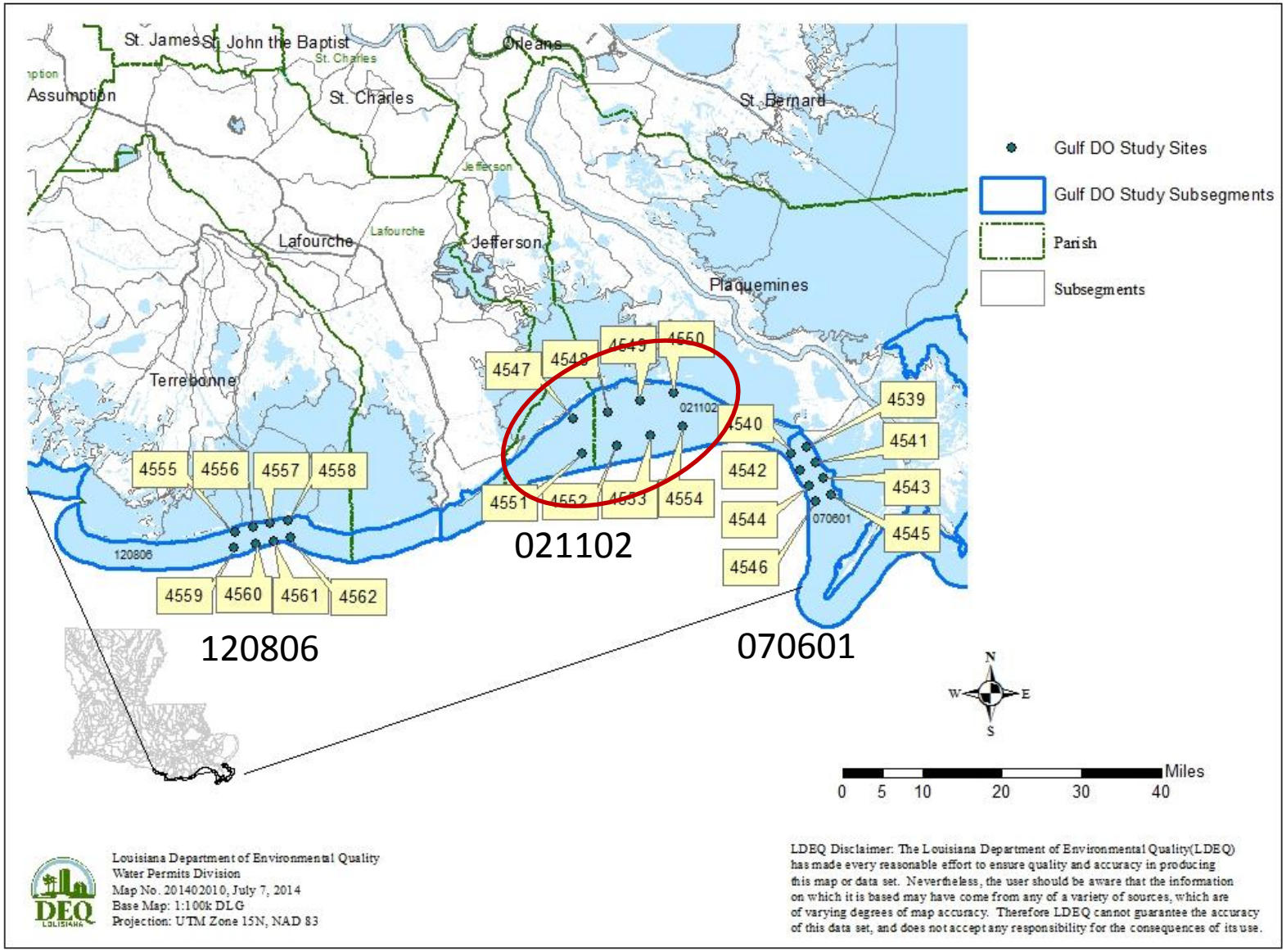


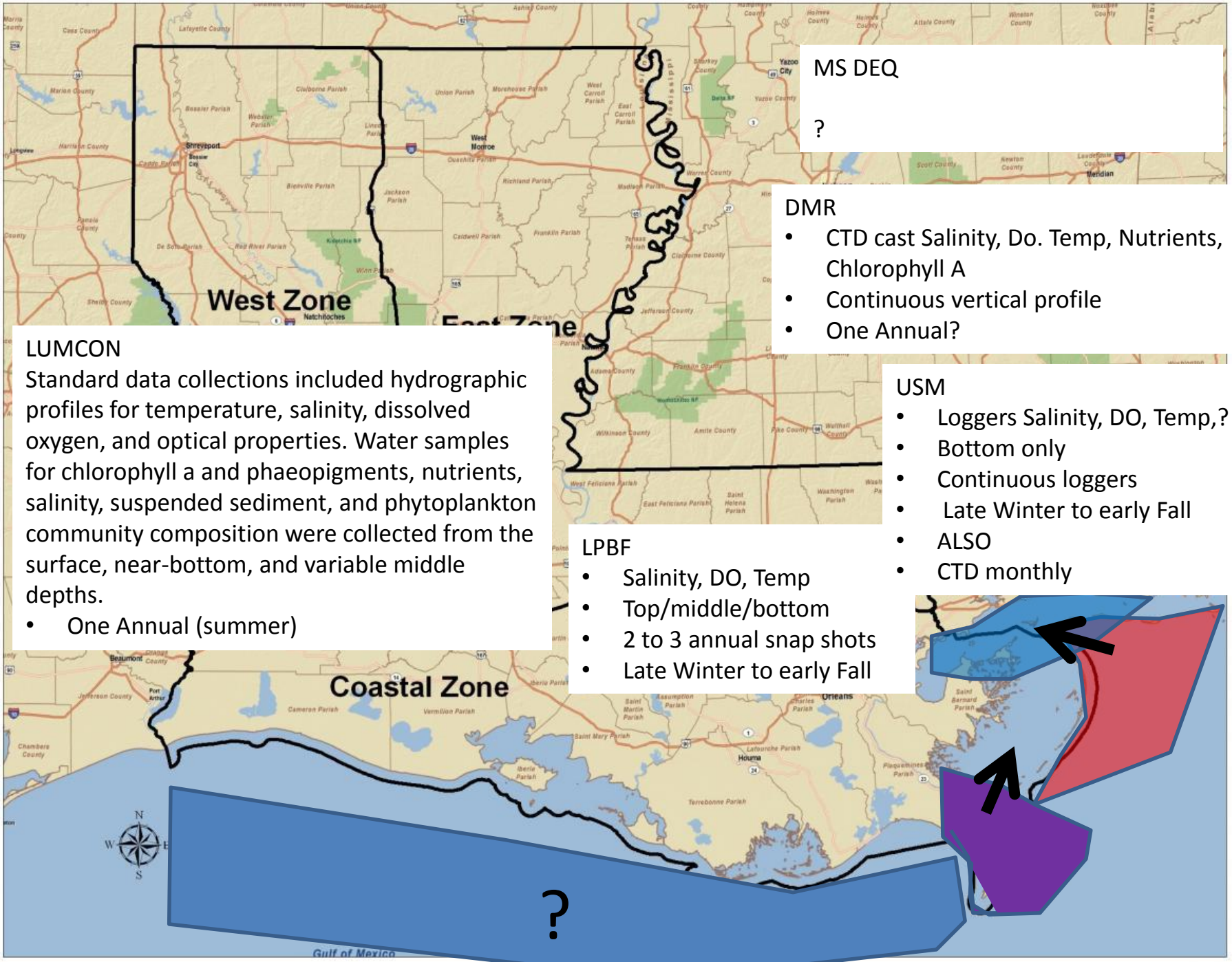
Figure 1. Bottom-water oxygen concentrations (ppm), recalculated from historical core-top data. Symbols indicate published source of core-top data. Circles are from Phleger (1954), triangles from Parker (1954), and inverted triangles from Puckett (1992), as described by Brunner et al. (2006).

Moshogianis, 2015 (USM)



DEQ LOUISIANA


Louisiana
Baton Rouge
New Orleans
Marsh Island
Mississippi Coastal
Hypoxia – USM, DMR
Cat Island
Horn Islan
Chandeleur Sound
Hypoxia - LPBF
Breton Sound
Hypoxia - LPBF
Unknown Hypoxia –
not surveyed
Approximate Dead Zone - LUMCON
Sackett Bank
Claypile Bank
son Bank



MS DEQ

?

DMR

- CTD cast Salinity, Do. Temp, Nutrients, Chlorophyll A
- Continuous vertical profile
- One Annual?

LUMCON

Standard data collections included hydrographic profiles for temperature, salinity, dissolved oxygen, and optical properties. Water samples for chlorophyll a and phaeopigments, nutrients, salinity, suspended sediment, and phytoplankton community composition were collected from the surface, near-bottom, and variable middle depths.

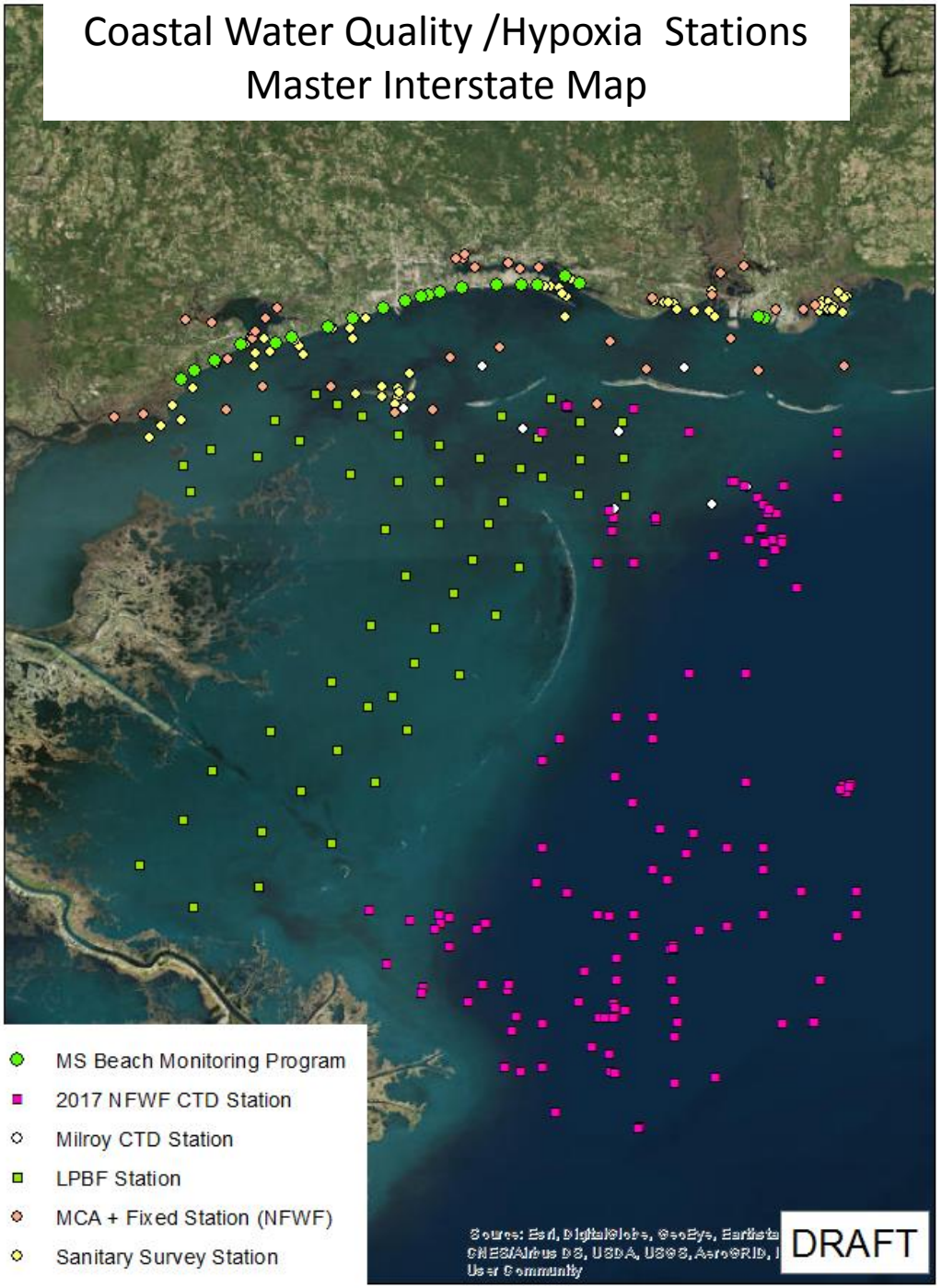
- One Annual (summer)

USM

- Loggers Salinity, DO, Temp,?
- Bottom only
- Continuous loggers
- Late Winter to early Fall
- ALSO
- CTD monthly

LPBF

- Salinity, DO, Temp
- Top/middle/bottom
- 2 to 3 annual snap shots
- Late Winter to early Fall



Ms. Dept. of Marine Resources
University of Southern Mississippi
Ms. Dept. of Environmental Quality
La Dept. Wildlife and Fisheries

Recommendations

- Increase Hypoxia monitoring temporally and spatially for the Dead Zones
- Exchange monitoring protocols and data real-time
- Fall planning meeting for the following year of monitoring