

University of South Alabama

JagWorks@USA

---

Technical Reports

Department of Earth Sciences

---

2024

## Fauna, Flora, and Land Cover Changes Over the Last Two Decades in the Mobile-Tensaw River Delta

Gabriel de Oliveria

*University of South Alabama, Mobile, AL, deoliveira@southalabama.edu*

Steven R. Schultze

*University of South Alabama, Mobile, AL, schultze@southalabama.edu*

Guilherme Mataveli

*Earth Observation and Geoinformatics Division, National Institute for Space Research (INPE), Brazil and University of East Anglia, Norwich, UK, guilherme.mataveli@inpe.br*

Follow this and additional works at: <https://jagworks.southalabama.edu/earthsci-techreports>



Part of the [Environmental Health and Protection Commons](#), [Environmental Indicators and Impact Assessment Commons](#), [Environmental Monitoring Commons](#), [Geomorphology Commons](#), [Marine Biology Commons](#), [Natural Resources and Conservation Commons](#), [Natural Resources Management and Policy Commons](#), [Sustainability Commons](#), [Terrestrial and Aquatic Ecology Commons](#), and the [Water Resource Management Commons](#)

---

### Recommended Citation

Oliveria, Gabriel de; Schultze, Steven R.; and Mataveli, Guilherme, "Fauna, Flora, and Land Cover Changes Over the Last Two Decades in the Mobile-Tensaw River Delta" (2024). *Technical Reports*. 1.

<https://jagworks.southalabama.edu/earthsci-techreports/1>

This Technical Report is brought to you for free and open access by the Department of Earth Sciences at JagWorks@USA. It has been accepted for inclusion in Technical Reports by an authorized administrator of JagWorks@USA. For more information, please contact [jherrmann@southalabama.edu](mailto:jherrmann@southalabama.edu).

# **Technical Report: Fauna, Flora, and Land Cover Changes Over the Last Two Decades in the Mobile-Tensaw River Delta**

Gabriel de Oliveira<sup>1,2</sup>, Steven R. Schultze<sup>1</sup>, Guilherme Mataveli<sup>3,4</sup>

<sup>1</sup>Department of Earth Sciences, University of South Alabama, Mobile, AL 36688, USA; [deoliveira@southalabama.edu](mailto:deoliveira@southalabama.edu), [schultze@@southalabama.edu](mailto:schultze@@southalabama.edu)

<sup>2</sup>Stokes School of Marine and Environmental Sciences, University of South Alabama, Mobile, AL 36688, USA

<sup>3</sup>Earth Observation and Geoinformatics Division, National Institute for Space Research (INPE), São José dos Campos 12227-010, SP, Brazil; [guilherme.mataveli@inpe.br](mailto:guilherme.mataveli@inpe.br)

<sup>4</sup>School of Environmental Sciences, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich NR4 7TJ, UK

## **1. Introduction**

The Mobile-Tensaw River Delta comprises one of the United States most important urban-influenced coastal systems. Besides its extraordinary animal biodiversity, the region also contains more tree species than any other region in North America (McGuire, 2021). Known as the “America’s Amazon”, the Mobile-Tensaw River Delta is currently experiencing significant regimes of disturbance (Raines, 2018). They include urban growth, droughts, extreme storm events, and even wildfires, making this region extremely susceptible to the consequences of climate change.

The Delta played a major role in the exploration and settlement of Alabama and is presently a major source of discussion related to its preservation among environmental organizations and industries/commercial/urban development companies. Rivers in the Delta region include the Tombigbee, Alabama, Mobile, Middle, Tensaw, Apalachee, Raft, Spanish, and Blakeley. Of these, the Tombigbee, Alabama, and Mobile are important transportation routes. The Mobile River is the southernmost river channel of the Tennessee-Tombigbee Waterway. Numerous small streams interconnect with delta rivers, and their courses divide, converge, and constantly change, resulting in continual erosion and redistribution of sediment deposited by former streams. The Delta also receives drainage

from adjacent uplands. Located in the southwestern Alabama, the Mobile-Tensaw River Delta comprises parts of Baldwin, Clarke, Mobile, Monroe, and Washington Counties (Smith, 2020).

The main terrestrial/aquatic ecosystems in the Delta are: bogs, bottomland hardwoods, freshwater and hardwood swamps, freshwater wetlands, maritime forests, mesic flood plains, pine savanna, riparian buffers, submerged aquatic vegetation and tidal brackish water marshes (Mobile Bay National Estuary Program; MNEP).

The region has plentiful interconnected stream systems, floodplains, swamps, bayous, lakes, and forests. It is home to an abundance of species of flora and fauna, which includes: 500 plants, 300 birds, 126 fishes, 46 mammals, 69 reptiles, and 30 amphibians (Smith, 2020). Specific aspects related to flora and fauna, as well as land cover changes in the region, will be addressed in the next sections.

## 2. Flora

The Delta comprises old-growth bottomland hardwood forests as well as cypress-tupelo swamps. Either needle-leaved evergreen forests (slash pine and long leaf pine) or broadleaved deciduous trees (e.g. tupelos, sweet bay, red maple, tulip poplar and ashes, *Fraxinus pennsylvatica* and *F. profunda*) comprise the majority of a dense canopy. Dominant species vary with the frequency and duration of flooding (Miller-Way et al., 1996).

The Mobile-Tensaw River Delta hosts several types of plants. Some of the rare plants known to occur in this area is the green-fly orchid (*Epidendrum conopseum*), which is the only epiphytic orchid known to occur in the state. Epiphytes use the host plant as a place to grow while obtaining nutrients. It has been found growing in the swamps of the Delta and uses a diversity of hardwood tree hosts, including live oaks, southern magnolias, swamp tupelo, and bald cypress.

The southern rein orchid, *Platanthera flava*, is another orchid found in the Delta. The southern rein orchid is found over most of the United States east of the Mississippi River drainage except south Florida. Tiny-leaved buckthorn, *Sageretia minutiflora*, one of the rarest shrubs in the United States, is also known to occur in the Delta. Its specific habitat is found on and around the calcareous shell mounds in the Mobile-Tensaw River Delta, as well as on Little Dauphin Island and Dauphin Island. The rare sarvis holly, *Ilex amelanchier*, has been reported from only 3 counties in Alabama, Mobile, Washington and Baldwin. It occurs in woodlands astride creeks, river floodplain forests and cypress-gum swamps. It is found in the sub-canopy under red maple, tupelo gum and cypress. Sarvis holly is a difficult plant to locate when not in fruit, especially after losing its leaves. It is one of the rarest hollies in the state.

Loblolly bay, *Gordonia lasianthus*, is found only in Baldwin, Covington, Geneva, and Mobile counties in Alabama. Loblolly bay is found in swamps, bogs, hammocks and bays along the southern coastal plain, from southern Virginia, west to Louisiana, and south to Lake Okeechobee in peninsular Florida. The loblolly bay is botanically related to the tea plant of

Asia. This tree is a beautiful evergreen, growing up to 70 feet in height (Alabama Wildlife Federation; AWF).

### **3. Fauna**

As outstanding as the Delta's plant composition is its abundance and diversity of animals (Miller-Way et al., 1996). Over 300 species have been recorded from the Delta, including more than 100 that nest there. The bottomland forest of the upper Delta is prime habitat for warblers, vireos, turkeys, and owls. The lower portion is important to shorebirds and wintering waterfowl.

Approximately 40 mammal species occur in or around the Delta. The Delta has the large swamp rabbit or "canecutter," the cottontail, and the diminutive marsh rabbit. Otters and bobcats are also common. Reptiles and amphibians have a haven in and around the Delta, with about 70 percent of Alabama's species represented. At least 18 turtles, 40 snakes, 10 lizards, 1 alligator, 20 salamanders, and 20 frogs are there. Box turtles and gopher tortoises can be found on the high ground of the Delta's margins. Two, the Alabama red-bellied turtle and the southern black-knobbed sawback, are found nowhere else. Few places in the world can boast the turtle diversity of the Delta.

The Delta also supports a phenomenal diversity of at least 126 fish species. Nearly a third of the state's freshwater fish are represented by the 97 species found there. Largemouth bass, bluegill, and crappie are popular with fishermen, but also present are obscure species with names like taillight shiner, Dixie chub, tadpole madtom, and cypress darter. Twenty-nine saltwater species, including mullet, flounder, bull shark, and striped bass are found in the region as well (Alabama Wildlife Federation; AWF).

### **4. Land Cover Changes**

The Delta has been an important agricultural location as well as a source of fish, timber, lumber, pulpwood, sand, clay, gravel, oil, and gas. Primary uses of the Delta today are recreation and education, including boating, fishing, hunting, wildlife observation, and study of wetland ecology. However, it is important to consider the surrounding areas of the Delta in order to understand the future impacts of human-induced activities on this extremely important ecosystem.

Figures 1 and 2 illustrate the land cover maps for the Mobile-Tensaw River Delta in 2001 and 2019, respectively. These maps were retrieved based on the information published by the National Land Cover Database (NLCD) (Dewitz et al., 2021), using Landsat images with a spatial resolution of 30 meters. These maps provide a remarkable information about land cover changes in the Delta in the last two decades. Based on these maps and Table 1, we can observe that the Mobile-Tensaw River Delta is dominated by open waters (~25%), followed by evergreen forests (~22%), and woody wetlands (~20%). Urban areas (i.e. developed, open space; developed, low intensity; developed, medium intensity; developed, high intensity) occupy ~14% of the area. Hay/pasture and cultivated crops cover ~8% of the

region, with a dominance of cultivated crops (~5%). The total areas for shrubs/scrubs, herbaceous, and emergent herbaceous wetlands are very similar, on the order of ~3% each. Other types of forests, such as deciduous and mixed forests represent ~2%. The remaining of the region is represented barren lands, which covers less than 1% of the total area.

The Mobile-Tensaw River Delta is located within a large metropolitan area, where there is a higher pressure from urban development, especially on its central western and central eastern sides, where the cities of Mobile, Spanish Fort, Daphne and Fairhope are located. On the southeastern and southwestern corners, there is a higher pressure related to cattle production and annual crops, such as cotton and corn. Over these areas, the amount of forests and/or other natural ecosystems such as shrubs/scrub is very limited. The most preserved areas of the Mobile-Tensaw River Delta are located in the northeast and northwestern corners, as it can be observed larger presence of woody wetlands, emergent herbaceous vegetation, and deciduous, evergreen, and mixed forests.

Figure 3 illustrates the changes that occurred in the Delta in the past two decades (2001-2019). The urban areas increased ~14%, from 563.3 km<sup>2</sup> in 2001 to 642.7 km<sup>2</sup> in 2019, or 79.4 km<sup>2</sup>. A total of 34.9 km<sup>2</sup> of the 79.4 km<sup>2</sup> of urban expansion occurred over areas that used to be deciduous, evergreen or mixed forests. A total of 22.9 km<sup>2</sup> occurred over areas that used to be occupied by hay/pasture, and cultivated crops. The remaining (21.6 km<sup>2</sup>) occurred over open water, barren lands, shrub/scrub, herbaceous, woody wetlands, and emergent herbaceous wetlands (see “urban change” in Figure 3). The deciduous, evergreen and mixed forests reduced from 1,167.0 km<sup>2</sup> in 2001 to 1,082.4 km<sup>2</sup> in 2019, which corresponds to a decrease of 84.6 km<sup>2</sup>, or ~7%. Timber and logging are the main contributors to this reduction observed in pristine forests (Figure 4). We also observed that after these areas are logged, the majority is converted to hay/pasture.

Interestingly, shrubs/scrubs and herbaceous vegetation increased 48 km<sup>2</sup>, varying from 237.8 km<sup>2</sup> (2001) to 285.8 km<sup>2</sup> (2019), or ~20%. The expansion of shrubs/scrubs and herbaceous vegetation occurred heterogeneously over the region, with the majority occurring over areas that used to be occupied by forests (deciduous, evergreen, and mixed). This is a very interesting result because shows a possible slow transition between tall canopy trees towards more a savanna type vegetation in the Delta, which may be related to human-induced disturbances and climate change, as a transition to a drier and warmer climate in the region. Hays/pasture areas decreased 36.3 km<sup>2</sup>, whilst cultivated crops increased about 1.5 km<sup>2</sup>. This result shows a trend of reduction of areas of annual crops, such as cotton, corn, etc., towards cattle production in the Delta in the past two decades.

There is also a very interesting trend occurring in the Delta regarding the transitions between woody wetlands and emergent herbaceous wetlands. Woody wetlands reduced from 970.9 km<sup>2</sup> to 939.6 km<sup>2</sup>, or 31.3 km<sup>2</sup> (~3%), while there was a large increase of emergent herbaceous wetlands, from 100.2 km<sup>2</sup> in 2001 to 128.9 km<sup>2</sup> in 2019. This corresponds to a considerable rise of 28.7 km<sup>2</sup> or 28.6%. The expansion of emergent herbaceous wetlands mainly occurred over areas that used to be occupied by woody wetlands, especially in the central and north-central parts (see “wetland within class change” in Figure 3). These changes are very interesting and yet to be understood. Many factors may

be playing a role in changing ecosystems from woody wetlands towards emergent herbaceous vegetation with shorter canopies and reduced biomass, such as the changes in the availability of nutrients, salinity, warmer water temperatures, among others. The other remaining classes, open waters and barren lands reduced  $\sim 4.1 \text{ km}^2$  and  $1.4 \text{ km}^2$  between 2001 and 2019.

These land cover changes, especially the ones related to the drastic reduction of deciduous, evergreen, and mixed forests ( $\sim 84.6 \text{ km}^2$ , or  $\sim 7\%$ ) and woody wetlands ( $31.3 \text{ km}^2$  or  $\sim 3\%$ ) causes impacts to the natural ecosystems in the region, such as stream pollution, deterioration in fish populations, increase of invasive alien plant and animal species, among others. There is an even higher concern in the lower part of the Delta, as can be seen in detail in Figure 5, given the continued commercial and industrial development of the U.S. HWY 98 causeway and I-10, which will keep contributing for a deterioration and reduction of ecosystem services and ecological functioning in the Lower Delta. Urgent actions are needed to protect the North America's most biodiverse river system in order to maintain its sustainability and natural resources for the future generations.

## References

Alabama Wildlife Federation (AWF). "Plants", <https://www.alabamawildlife.org/plants/>. Accessed 25 May 2022.

Alabama Wildlife Federation (AWF). "Wildlife", <https://www.alabamawildlife.org/wildlife/>. Accessed 25 May 2022.

Dewitz, J., and U.S. Geological Survey, 2021, National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021): U.S. Geological Survey data release, <https://doi.org/10.5066/P9KZCM54>.

McGuire, R. "All About the Mobile & Tensaw River Basins", *Alabama Water Watch*, 12 August 2021, <https://wp.auburn.edu/aww/all-about-the-mobile-tensaw-river-basins/>. Accessed 25 May 2022.

Miller-Way, T.; Dardeau, M.; Crozier, G. 1996. Weeks Bay National Estuarine Research Reserve: an estuarine profile and bibliography. *Dauphin Island Sea Lab Technical Report*, pp. 96-01.

Raines, B. 2018. *Saving America's Amazon: The threat to our nation's most biodiverse river system* (ISBN: 978-1-58838-338-9) (200 p.). Atlanta, USA: Newsouth.

Smith, E. "Mobile-Tensaw Delta", *Encyclopedia of Alabama*, 4 June 2020, <http://encyclopediaofalabama.org/article/h-1201>. Accessed 25 May 2022.

Mobile Bay National Estuary Program (MNEP). "Mobile Tensaw River Delta", *Alabama Gulf Ecological Management Site (GEMS)*, <https://www.mobilebaynep.com/assets/pdf/GEMS-MobileTensawRiverDelta-FINALREV.pdf>. Accessed 25 May 2022.

# Land Cover Map - Mobile-Tensaw River Delta (2001)

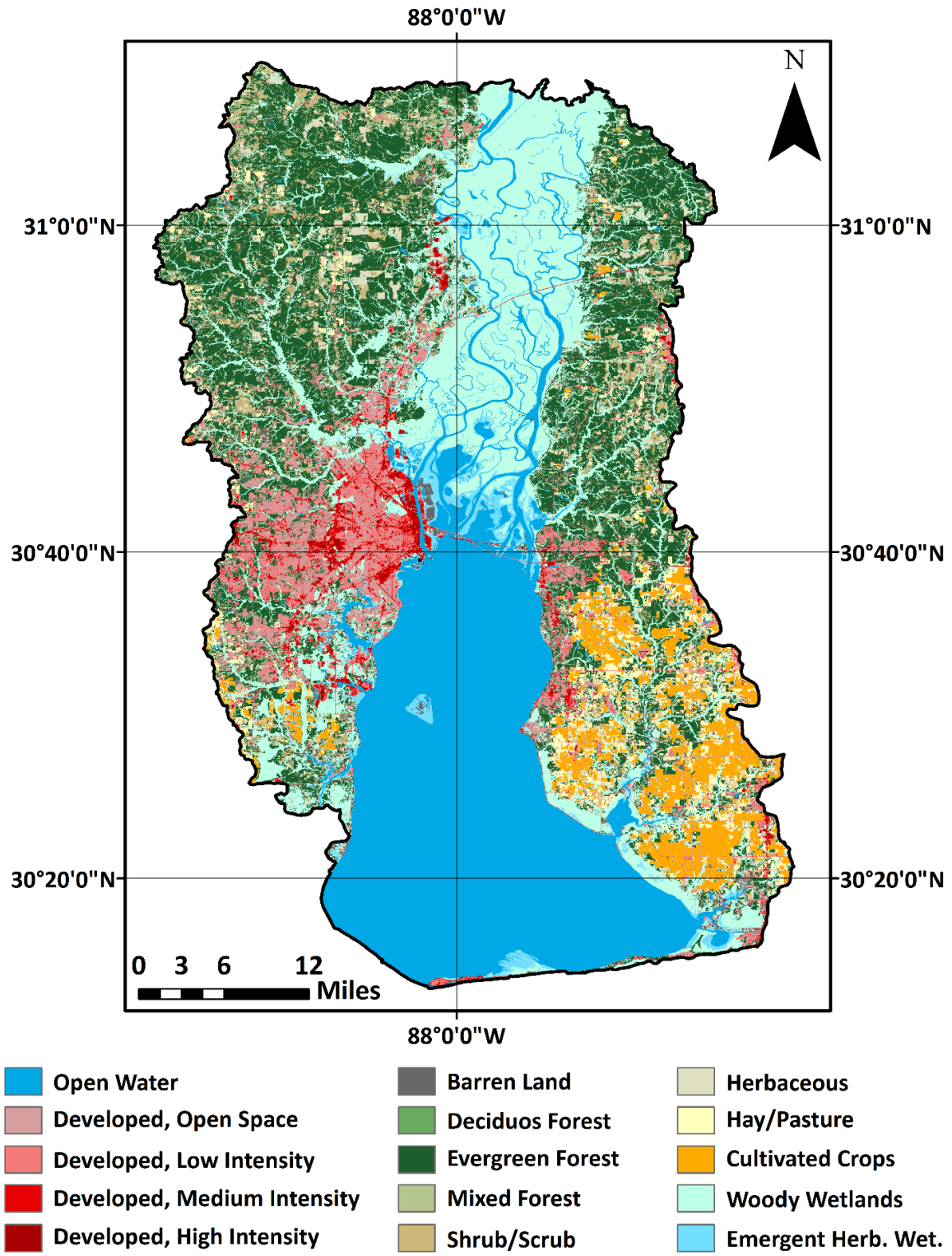


Figure 1. Land-cover map of the Mobile-Tensaw River Delta for 2001.



# Land Cover Map - Mobile-Tensaw River Delta (2019)

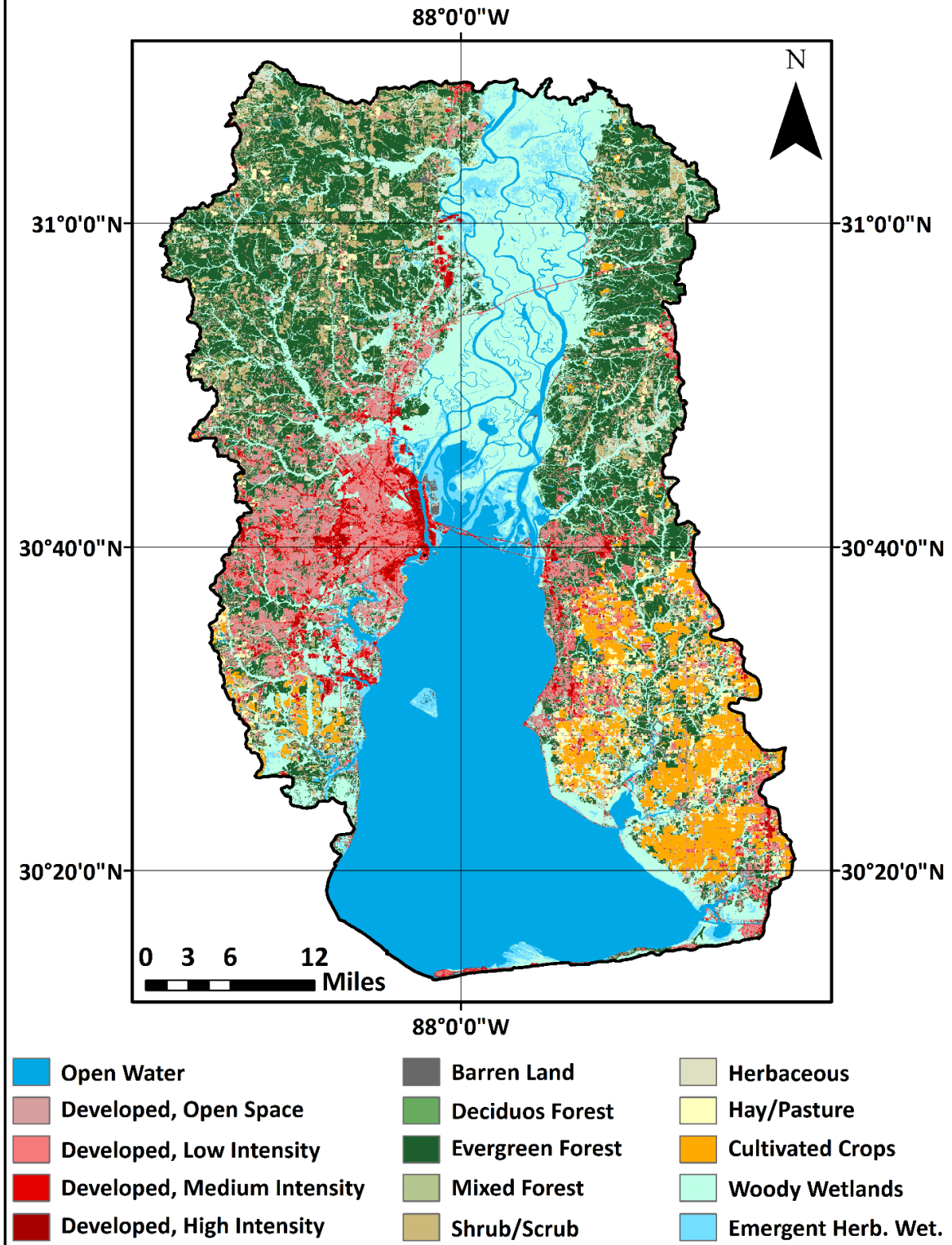


Figure 2. Land-cover map of the Mobile-Tensaw River Delta for 2019.

# Change Index - Mobile-Tensaw River Delta (2001-2019)

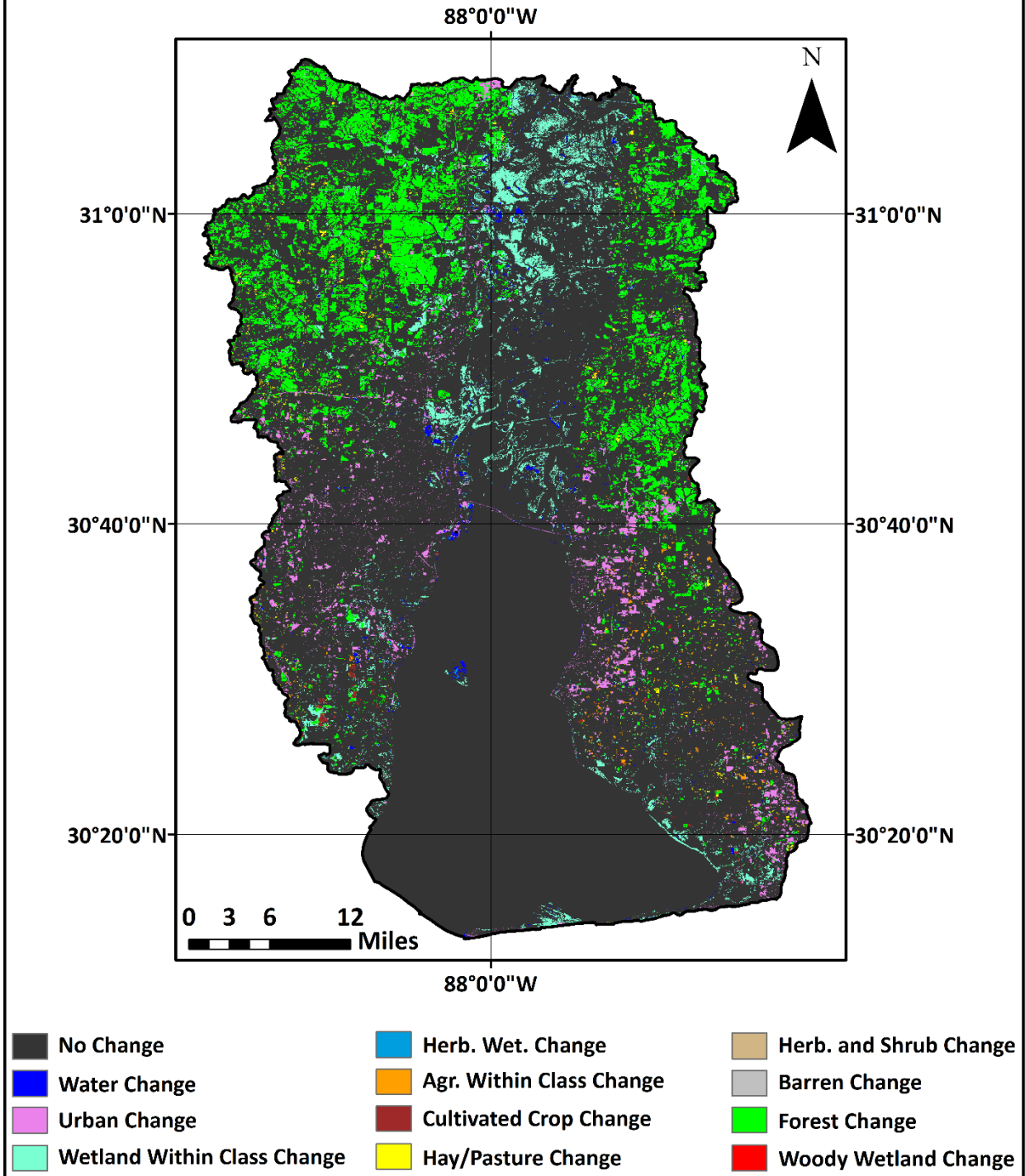
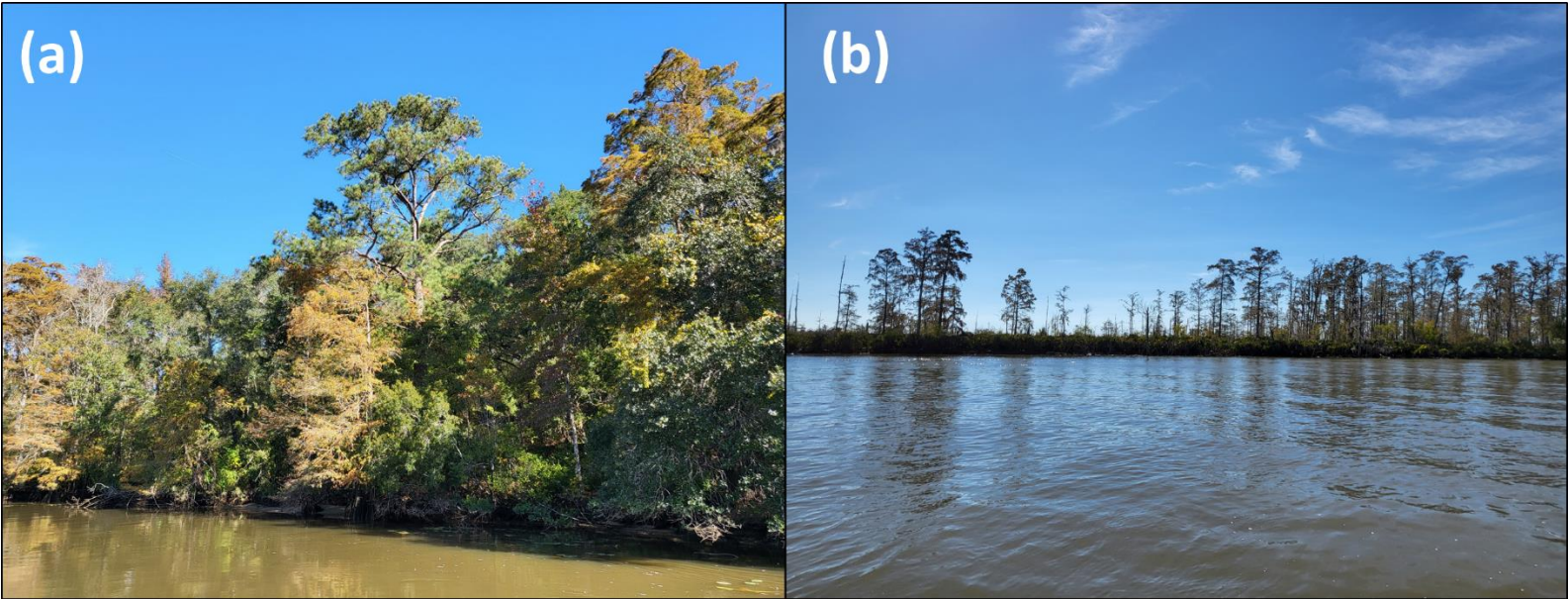


Figure 3. Change index map of the Mobile-Tensaw River Delta for 2001-2019.



**Figure 4. Photos illustrating pristine evergreen forests (a) and a recently logged area (b) in the Upper Mobile-Tensaw River Delta. Photos taken in September 2021.**

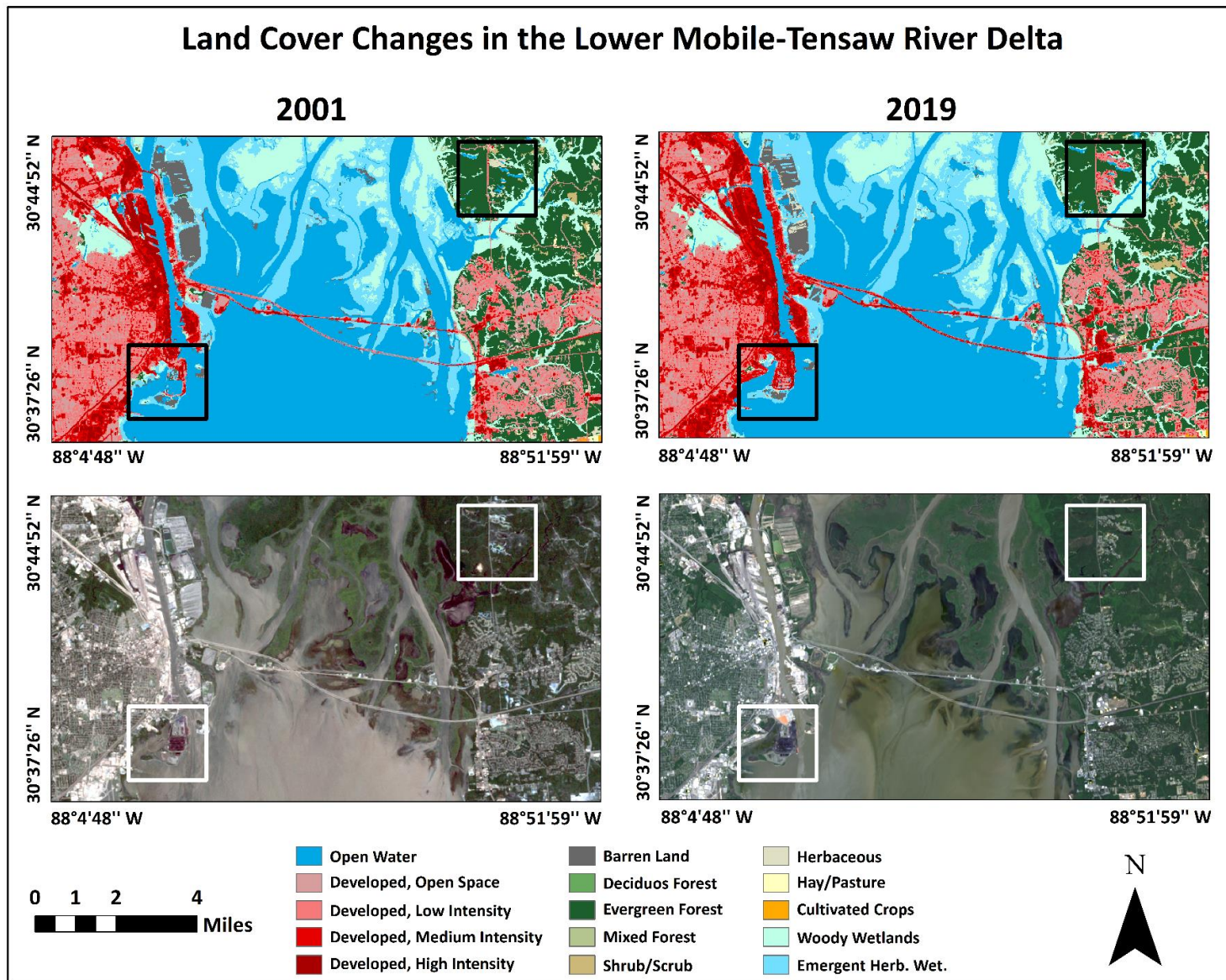


Figure 5. Detailed areas with extensive land cover changes in the Lower Mobile-Tensaw River Delta between 2001-2019.

**Table 1. Quantification of the land cover types in the Mobile-Tensaw River Delta and absolute (km<sup>2</sup>) and relative (%) differences observed in the interval between 2001-2019.**

Land Cover Type	2001		2019		Difference (km <sup>2</sup> )	Difference (%)
	Area (km <sup>2</sup> )	%	Area (km <sup>2</sup> )	%		
Open Water	1,165.3	25.2	1,161.2	25.1	-4.1	-0.4
Developed, Open Space	297.7	6.4	306.1	6.6	8.4	2.8
Developed, Low Intensity	164.9	3.6	189.5	4.1	24.6	14.9
Developed, Medium Intensity	73.0	1.6	108.6	2.3	35.6	48.8
Developed, High Intensity	27.7	0.6	38.5	0.8	10.8	39.0
Barren Land	22.4	0.5	21.0	0.5	-1.4	-6.3
Deciduous Forest	4.0	0.1	3.8	0.1	-0.2	-5.0
Evergreen Forest	1,068.8	23.1	1,006.8	21.8	-62.0	-5.8
Mixed Forest	94.2	2.0	71.8	1.6	-22.4	-23.8
Shrub/Scrub	127.1	2.7	156.0	3.4	28.9	22.7
Herbaceous	110.7	2.4	129.8	2.8	19.1	17.3
Hay/Pasture	189.5	4.1	153.2	3.3	-36.3	-19.2
Cultivated Crops	209.5	4.5	211.0	4.6	1.5	0.7
Woody Wetlands	970.9	21.0	939.6	20.3	-31.3	-3.2
Emergent Herbaceous Wetlands	100.2	2.2	128.9	2.8	28.7	28.6
<b>TOTAL</b>	<b>4,626</b>	<b>100</b>	<b>4,626</b>	<b>100</b>	<b>--</b>	<b>--</b>

EXTRA MAP (SAME AS FIGURES 1 AND 2, BUT COMBINED)

