



# **SYNTHESIS OF BREEDING BIRD USE OF CHANDELEUR ISLANDS, LOUISIANA**

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*Cover image courtesy of: Colibri Ecological Consulting, LLC*

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## PREFACE

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The Water Institute (the Institute) has developed this report for the Louisiana Coastal Protection and Restoration Authority. The Institute team is made up of collaborative, multi-disciplinary staff that have the necessary background and expertise to support this effort, including avian science, coastal geomorphology and ecology, and barrier island restoration.

The purpose of this technical memorandum is to synthesize colonial waterbird nesting data on Chandeleur Islands from 2010-2013, 2015, 2018, and 2021–2022. This information is intended to inform and support the Coastal Protection and Restoration Authority Engineering and Design Team activities and stakeholder coordination for PO-0199, Chandeleur Islands Restoration. The data summarized in this report was acquired from aerial surveys and associated dotting analysis by Colibri Ecological Consulting (Capitolo et al., 2023; Colibri Ecological Consulting & R. G. Ford Consulting Company, 2015), and describes the abundance, species diversity, and colony locations of nesting colonial waterbirds on North and South Chandeleur Islands, New Harbor Island, Gosier Islands, and Freemason Island.



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## LIST OF BIRD SPECIES CODES

Species Code	Species Name
AMOY	American Oystercatcher
ANHI	Anhinga
BBWD	Black-bellied Whistling Duck
BCNH	Black-crowned Night Heron
BLSK	Black Skimmer
BRPE	Brown Pelican
CAEG	Cattle Egret
CATE	Caspian Tern
FOTE	Forster's Tern
GBHE	Great Blue Heron
GBTE	Gull-billed Tern
GREG	Great Egret
LAGU	Laughing Gull
LETE	Least Tern
MAFR	Magnificent Frigatebird
MODU	Mottled Duck
REEG	Reddish Egret
ROSA	Royal or Sandwich Tern
ROSP	Roseate Spoonbill
ROYT	Royal Tern
RUTU	Ruddy Turnstone
SATE	Sandwich Tern
SDHE	Small Dark Heron/Egret (i.e., Tricolored Heron, Little Blue Heron, or Reddish Egret)
SNEG	Snowy Egret
TRHE	Tricolored Heron
ULGU	Unknown Large Gull
UNGU	Unknown Gull
UNNH	Unidentified Night Heron
UNSB	Unknown Shorebird
UNTE	Unknown Tern sp.
UNWA	Unknown Waterbird (likely in proportion of spp. present in colony)
USTE	Forster's and/or Gull-billed Tern (Unknown Small Tern)
WFIB	White-faced Ibis
WHEG	Great/Snowy Egret (and sometimes Cattle Egret too; WH = White)
WIPH	Wilson's Phalarope
WIPL	Wilson's Plover
YCNH	Yellow-crowned Night Heron



## 1.0 INTRODUCTION

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The Coastal Protection and Restoration Authority has contracted Coastal Engineering Consultants, Inc. to provide engineering and design services for the Chandeleur Island Restoration Project (PO-199). This is a barrier island and habitat restoration project located in southeastern Louisiana. The PO-199 Project will dredge sediment from an offshore borrow site and use it on and adjacent to the Chandeleur Islands to provide and enhance habitat for colonial nesting waterbirds, nesting sea turtles, migratory birds, submerged aquatic marine seagrass meadows, and to extend the time that the Chandeleur Islands remain subaerial.

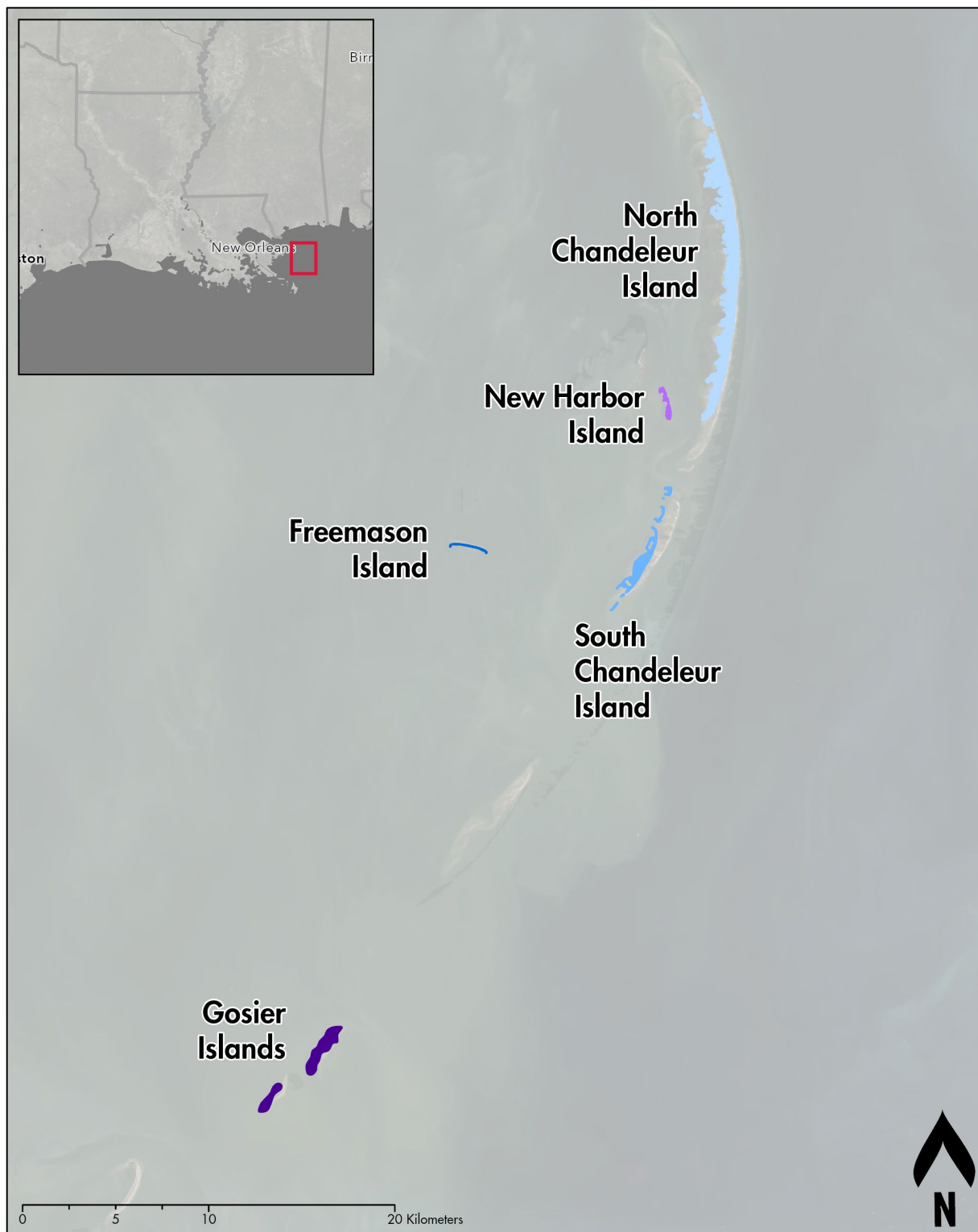
The goals of this project are to:

- Restore and conserve bird-nesting and foraging habitat;
- Restore and enhance submerged aquatic vegetation;
- Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat;
- Create, restore, and enhance barrier and coastal islands and headlands.

The engineering and design phase of this project is funded through the Deepwater Horizon (DWH) oil spill Natural Resource Damage Assessment (NRDA) settlement administered by the Regionwide Trustee Implementation Group (RW TIG), under the RW TIGs's Restoration Plan 1 (DWH NRDA Trustees, 2021). To inform and support these restoration efforts, this report synthesizes colonial waterbird nesting data on North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands from 2010–2013, 2015, 2018, and 2021–2022.

Together with Breton Island to the south, North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands comprise the Breton National Wildlife Refuge (NWR), which is located in the northern Gulf of Mexico, to the east of New Orleans and mainland Louisiana across Chandeleur Sound (Figure 1). Collectively, these islands total around 3,500 acres and provide valuable nesting habitat for many species of birds. North and South Chandeleur islands are the largest of these islands and have the most nesting activity, primarily by Royal Terns (ROYT), Sandwich Terns (SATE), and Black Skimmers (BLSK). New Harbor Island is vegetated with shrubs and mangroves that are used for nesting by large numbers of Brown Pelicans (BRPE). Gosier and Freemason islands have the least nesting activity due to sparse vegetation and flooding, although these islands are frequently used by birds for loafing.





Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics

*Figure 1. Geographic locations of North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands.*



## 1.1 METHODOLOGY

Bird observations and nesting data were acquired during the breeding season (May–June 2010–2013, 2015, 2018, and 2021–2022) via aerial photography and quantified by Colibri Ecological Consulting, LLC. Photographs were taken with full frame cameras with telephoto lenses that had a focal length range of 16–300 millimeters. The images were captured from a fixed-wing aircraft which was flown between an altitude of 700 to 1000 feet above ground level. Flight paths and photo angles were determined upon approach toward target colonies and depended upon colony extent, bird species present, wind strength, vegetation, and sun positioning.

To quantify the birds within the photographs, suitable images were manually marked using a counting software that tallied total counts for each species. These data were then entered into a Microsoft Access database which can be queried for total numbers of nests and birds at designated colonies. A detailed description of methodologies for surveys and associated bird quantification/analysis are available within Colibri Ecological Consulting & R. G. Ford Consulting Company, (2015). In 2022, these aerial photography and quantification methodologies were adapted to increase the resolution of the photographs and allow for data quantification/post-processing using a Geographic Information System (GIS). The raw dataset used to inform this report, including species, number of nests, and colony coordinates, is available in Appendix A: Raw Data.

The manual marking process was conducted by experts in bird identification. However, aerial imagery being used as the primary data acquisition methodology has inherent limitations in the detectability of certain birds. Notably, due to their size, smaller birds including Least Tern (LETE) and Wilson's Plover (WIPL) were limited in their detections, and only American Oystercatcher (AMOY) were regularly observed among solitary nesting shorebird species (Capitolo et al., 2023). Non-detection may also occur for birds such as Reddish Egret (REEG), Tricolored Heron (TRHE), and Black-crowned Night Heron (BCNH) that nest lower in canopies and are sometimes concealed by vegetation (Rodgers et al., 2005). As such, it should be noted that the information presented herein is not a comprehensive assessment of all the birds that are using Chandeleur Islands, rather an overview of the birds identified using a select methodology. For a more thorough assessment of bird use on Chandeleur Islands, it is recommended that this information be used in addition to on-the-ground point counts and surveys.



## 2.0 SUMMARY OF TRENDS

A total of 40 bird species were observed and quantified using aerial imagery during 2010–2013, 2015, 2018, and 2021–2022 on North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands. Of these 40 species, 20 species were identified as nesting (Table 1). Nesting species primarily included Royal Terns (ROYT), Sandwich Terns (SATE), Laughing Gulls (LAGU), Black Skimmers (BLSK), and Brown Pelicans (BRPE). For density maps of these species in each year, see Appendix B.

*Table 1. Bird species and nests observed North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands across 2010, 2011, 2012, 2013, 2015, 2017, 2021, and 2022.*

Birds Observed	Number of sampling years observed	Number of sampling years observed nesting
Laughing Gull (LAGU)	8	8
Unknown Tern sp. (UNTE)	2	0
Snowy Egret (SNEG)	1	1
Brown Pelican (BRPE)	8	8
Black Skimmer (BLSK)	8	8
Unknown Large Gull (ULGU)	1	0
American Oystercatcher (AMOY)	3	1
Caspian Tern (CATE)	8	8
Royal Tern (ROYT)	8	8
Sandwich Tern (SATE)	8	8
Great Egret (GREG)	8	8
Magnificent Frigatebird (MAFR)	6	0
Small Dark Heron/Egret (SDHE)	1	1
Tricolored Heron (TRHE)	7	5
Royal or Sandwich Tern (ROSA)	3	3
Gull-billed Tern (GBTE)	7	7
Least Tern (LETE)	5	5
Unknown Gull (UNGU)	1	0
Unknown Shorebird (UNSB)	2	0
Black-crowned Night Heron (BCNH)	2	1
Unknown Small Tern (USTE)	1	0
Cattle Egret (CAEG)	2	0
Reddish Egret (REEG)	4	3
Anhinga (ANHI)	1	0
Black-bellied Whistling Duck (BBWD)	1	0
Great Blue Heron (GBHE)	1	0
Least Bittern (LEBI)	1	0
Mottled Duck (MODU)	1	0
White-faced Ibis (WFIB)	1	0



Birds Observed	Number of sampling years observed	Number of sampling years observed nesting
Great/Snowy Egret (WHEG)	2	1
Yellow-crowned Night Heron (YCNH)	2	1
Unidentified Night Heron (UNNH)	1	0
Forster's Tern (FOTE)	3	3
Wilson's Phalarope (WIPH)	1	0
Unknown Waterbird (UNWA)	1	0
Ruddy Turnstone (RUTU)	1	0
Wilson's Plover (WIPL)	1	0
Roseate Spoonbill (ROSP)	1	0

The total number of nesting birds observed throughout North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands varied during each survey year (Figure 2). The low number of nests observed in 2010 (N=2170) compared to the other years coincides with the DWH oil spill and the resulting cleanup activities (Colibri Ecological Consulting & R. G. Ford Consulting Company, 2015).

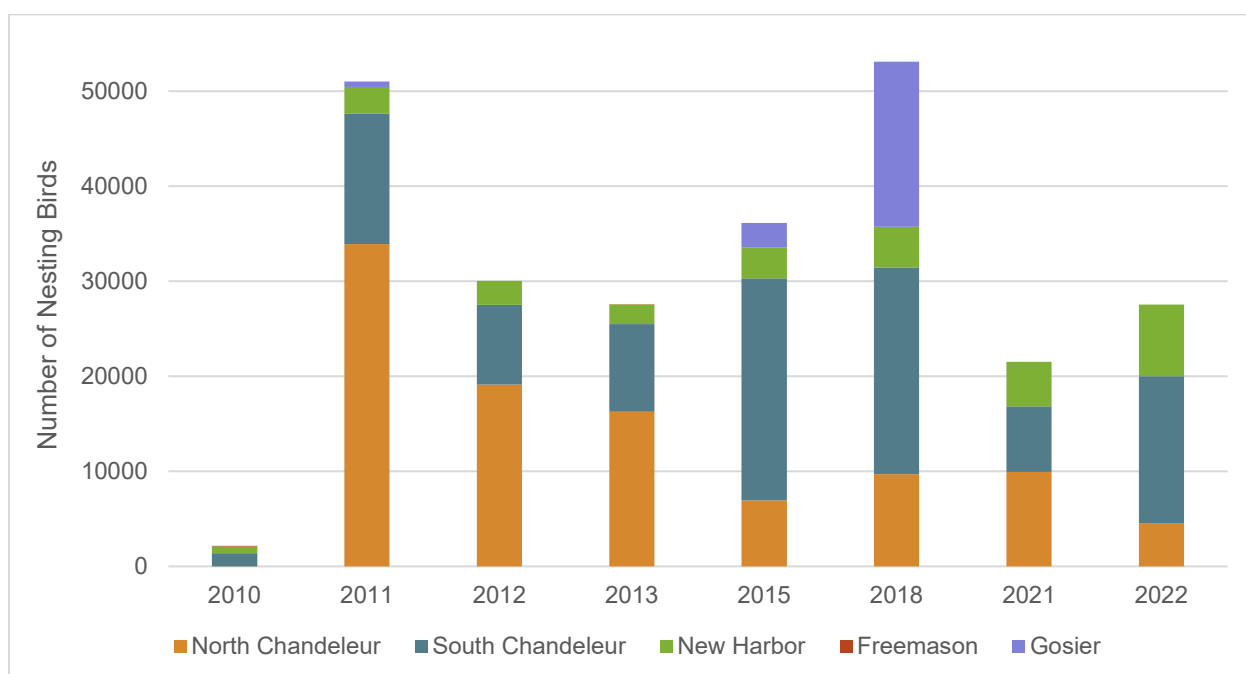


Figure 2. The distribution of nesting birds observed across 2010, 2011, 2012, 2013, 2015, 2018, 2021, and 2022, on North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands

Birds have nested every survey year on North Chandeleur, South Chandeleur, and New Harbor, but were only observed nesting on Freemason Island in 2010 and 2013, and on Gosier Islands in 2011, 2015, and 2018 (Table 2). North and South Chandeleur islands have had a mean nest count of 12,560 (+/- 3,734) and 12,524 (+/- 2,662) nests per year respectively and New Harbor Island had a mean of 3482 (+/- 728) nests per year. Freemason Island had very few nesting birds and was highly variable year to year (15 +/-



11 nests per year), while Gosier Island had much higher numbers in some years, but was also highly variable (2,562 +/- 2,137 nests per year; Table 2).

Overall, SATE and ROYT were the most abundant nesters (N=206,565) followed by BRPE (N=25,766).

*Table 2. The total number of nesting birds on North and South Chandeleur, New Harbor, Freemason and Gosier islands as well as mean and standard error (SE) across 2010, 2011, 2013, 2015, 2018, 2021, and 2022*

Year	North Chandeleur	South Chandeleur	New Harbor	Freemason	Gosier	Total
2010	21	1,383	676	90	0	2,170
2011	33,903	13,713	2,845	0	562	51,023
2012	19,133	8,389	2,527	0	0	30,049
2013	16,283	9,215	2,046	30	0	27,574
2015	6,932	23,375	3,270	0	2,574	36,151
2018	9,715	21,753	4,279	0	17,358	53,105
2021	9,941	6,896	4,693	0	0	21,530
2022	4,551	15,464	7,519	0	0	27,534
<b>Mean</b>	<b>12,560</b>	<b>12,524</b>	<b>3,482</b>	<b>15</b>	<b>2,562</b>	<b>31,142</b>
<b>SE</b>	<b>3,734</b>	<b>2,662</b>	<b>728</b>	<b>11</b>	<b>2,137</b>	<b>5,765</b>

Although not identified in this dataset, there is evidence of a unique hybrid taxon, the Chandeleur Gull, that was discovered nesting on South Chandeleur Island in 1989 (Dittmann & Cardiff, 2005). The Chandeleur Gull has a population <50 and is restricted to the Chandeleur Islands (Remsen et al., 2019).

## 2.1 NORTH CHANDELEUR ISLAND

North Chandeleur Island is the largest island within Breton NWR and was used for nesting by ground-nesting birds. The greatest number of nests observed on North Chandeleur Island were ROYT, SATE, LAGU, and BLSK (Table 3, Figure 3). The largest number of nesting birds (N=33,903) were observed in 2011 (see Table 2). LAGU were the only species observed nesting in 2010, whereas ROYT, SATE and BLSK were observed nesting in all subsequent survey years. SATE were the most abundant nesting species with the largest individual colony of 17,426 nests and the largest annual total of 25,001 nests observed in 2011. The largest number of BLSK nests (N=977) were observed in 2022. LETE colonies ranged from 22–33 nests and were observed in all years except 2013 and 2018. Forster’s Terns (FOTE) were only observed nesting in 2021 (N=18) and 2022 (N=3), and a single AMOY nest<sup>1</sup> was observed in 2018.

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<sup>1</sup> As noted in Methodology (Section 1.1) and in Capitolo et al. (2023), although American Oystercatchers were regularly detected during the surveys, the aerial survey methodology does not often detect solitary nesting shorebirds.



Table 3. Total number of nesting birds by species observed at North Chandeleur Island

Species	2010	2011	2012	2013	2015	2018	2021	2022
AMOY	0	0	0	0	0	1	0	0
BLSK	0	301	357	326	535	927	820	977
CATE	0	82	51	35	65	105	181	226
FOTE	0	0	0	0	0	0	18	3
GBTE	0	19	25	21	29	75	65	43
LAGU	21	228	78	231	41	4	1,056	1,128
LETE	0	33	0	0	29	0	22	28
ROSA	0	441	8,284	0	0	0	0	2
ROYT	0	7,798	5,742	3,871	1,666	1,460	2,404	1,021
SATE	0	25,001	4,596	11,799	4,567	7,143	5,375	1,123



Figure 3. Off-nadir aerial imagery (taken 700 to 1000 feet above ground level) of ROYT and SATE nesting on North Chandeleur Island in 2011 (Credit: Colibri Ecological Consulting, LLC). For locations of nesting colonies in 2011, see 1.1.1.1.1(i)Appendix B.

## 2.2 SOUTH CHANDELEUR ISLAND

South Chandeleur Island was used for nesting by ground-nesting birds such as ROYT, SATE, LAGU, and BLSK (Table 4, Figure 4). The largest number of nesting birds (N=1,383 nests) were observed on South Chandeleur Island in 2010, and 2015 supported the largest number of nests across all survey years



(N=23,375; see Table 2). Unlike North Chandeleur Island, South Chandeleur Island also supported nesting BRPE in 2011 (N=72) and 2022 (N=1). LETE were only observed nesting in 2012. BLSK, Caspian Terns (CATE), ROYT, and SATE were observed nesting during all survey years.

Table 4. Total number of nesting birds by species observed at South Chandeleur Island

Species	2010	2011	2012	2013	2015	2018	2021	2022
BLSK	89	171	139	264	273	376	472	168
BRPE	0	72	0	0	0	0	0	1
CATE	16	132	278	66	13	209	148	184
FOTE	0	0	0	0	0	0	59	3
GBTE	0	10	9	3	11	20	13	8
LAGU	15	388	0	51	47	28	783	90
LETE	0	0	37	0	0	0	0	0
ROSA	0	0	0	0	0	0	0	4
ROYT	400	2923	2750	1021	4706	7536	3567	4806
SATE	863	10017	5176	7810	18325	13584	1854	10200



Figure 4. Off-nadir aerial imagery (taken 700 to 1000 feet above ground level) of ROYT and SATE nesting on South Chandeleur Island in 2015 (Credit: by Colibri Ecological Consulting, LLC). For locations of nesting colonies in 2015, see Appendix B.



## 2.3 NEW HARBOR ISLAND

New Harbor Island was primarily used for nesting by shrub-nesting birds such as BRPE, Great Egrets (GREG), LAGU, and TRHE (Table 5). With the exception of TRHE, these species were observed during all survey years. The largest number of nesting birds (N=7,519) was observed in 2022 (see Table 2). New Harbor Island is inhabited by dense shrubs and mangroves that are commonly used for nesting by BRPE (Figure 5). BRPE were the most abundant nesters on the island, with the largest colony observed in 2022 (N=7,479). The second most-abundant nesting species was LAGU and the largest LAGU colony was observed in 2011 (N=396). Some species, such as night-herons, FOTE, and Snowy Egrets (SNEG) were only observed nesting during a single year. REEG nested on the island in 2012 (N=1), 2015 (N=6), and 2022 (N=3)<sup>2</sup>.

Table 5. Total number of nesting birds by species observed at New Harbor.

Species	2010	2011	2012	2013	2015	2018	2021	2022
BCNH	0	3	0	0	0	0	0	0
BLSK	0	0	0	7	0	4	0	0
BRPE	662	2039	2233	1756	2676	4114	4684	7479
FOTE	0	0	0	0	0	6	0	0
GREG	3	6	8	4	3	4	4	6
LAGU	3	743	270	279	583	151	5	29
REEG	0	0	1	0	6	0	0	3
SDHE	1	0	0	0	0	0	0	0
TRHE	7	52	6	0	2	0	0	2
WHEG	0	0	9	0	0	0	0	0
YCNH	0	1	0	0	0	0	0	0
SNEG	0	1	0	0	0	0	0	0

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<sup>2</sup> See Methodology (Section 1.1) for caveat about shrub-nesting bird detectability using aerial survey methodology.





Figure 5. Off-nadir aerial imagery (taken 700 to 1000 feet above ground level) of BRPE nesting on New Harbor Island in 2022 (Credit: Colibri Ecological Consulting, LLC). For locations of nesting colonies in 2022, see Appendix B.

## 2.4 FREEMASON ISLAND

On Freemason Island, nesting was observed in 2010 and 2013 by BLSK (Table 6; Figure 6). The largest BLSK colony was observed in 2010 (N=90) and no BLSK or other birds have been observed nesting on the island since 2013 (see Table 2). Freemason Island is small (approximately 32 acres per 2021 overflight imagery) compared to the other islands and is likely no longer suitable for bird nesting due to elevation and related inundation. Smaller islands such as Freemason Island are more prone to overwash events and do not have adequate vegetation requirements that many birds require for successful nesting (Owen & Pierce, 2013; Raynor et al., 2012). Although Freemason Island is not used for nesting, birds such as BRPE have been observed using the island for loafing.

Table 6. Total number of nesting birds by species observed at Freemason Island

Species	2010	2011	2012	2013	2015	2018	2021	2022
BLSK	90	0	0	30	0	0	0	0



*Figure 6. Off-nadir aerial imagery (taken 700 to 1000 feet above ground level) of BLSK nesting on Freemason Island in 2010 (Credit: Colibri Ecological Consulting, LLC). For locations of nesting colonies in 2010, see Appendix B.*

## **2.5 GOSIER ISLANDS**

There was no nesting observed on Gosier Islands in 2010, 2012, 2013, or 2021, and the islands were mostly submerged in 2022 at the time of the surveys (Table 7). Birds have been observed nesting on Gosier Islands in 2011, 2015, and 2018, with the largest number of nests in 2018 (N=17,358; see Table 2; Figure 7). The most common nesting birds observed on Gosier Islands were ground-nesting birds including ROYT, SATE, LAGU, and BLSK (Table 7). BRPE, FOTE, and LAGU were only observed nesting in 2018. The largest colonies were observed in 2018, totaling 6,469 ROYT and 9,684 SATE.



Table 7. Total number of nesting birds by species observed at Gosier Islands across 2010, 2011, 2012, 2013, 2015, 2018, 2021, and 2022.

Species	2010	2011	2012	2013	2015	2018	2021	2022
BLSK	0	219	0	0	121	120	0	0
BRPE	0	0	0	0	0	50	0	0
CATE	0	72	0	0	106	8	0	0
FOTE	0	0	0	0	0	38	0	0
GBTE	0	16	0	0	25	5	0	0
LAGU	0	0	0	0	0	984	0	0
ROYT	0	2	0	0	1054	6469	0	0
SATE	0	253	0	0	1268	9684	0	0



Figure 7. Off-nadir aerial imagery (taken 700 to 1000 feet above ground level) of ROYT, SATE, and LAGU nesting on Gosier Islands (north) in 2018 (Credit: Colibri Ecological Consulting, LLC). For locations of nesting colonies in 2018, see Appendix B.



### 3.0 CONTRIBUTION TO TOTAL NESTING BIRDS IN COASTAL LOUISIANA

Louisiana provides critical nesting habitat for an abundance of waterbird species (Michot et al., 2003; Remsen et al., 2019). North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands contribute to overall breeding populations in Louisiana and the northern Gulf of Mexico. With the exception of 2010 (when the DWH oil spill occurred), 10–20% of all nesting colonial waterbirds surveyed via aerial overflights by Colibri Ecological Consulting in Louisiana<sup>3</sup> nested on these islands each survey year (Figure 8).

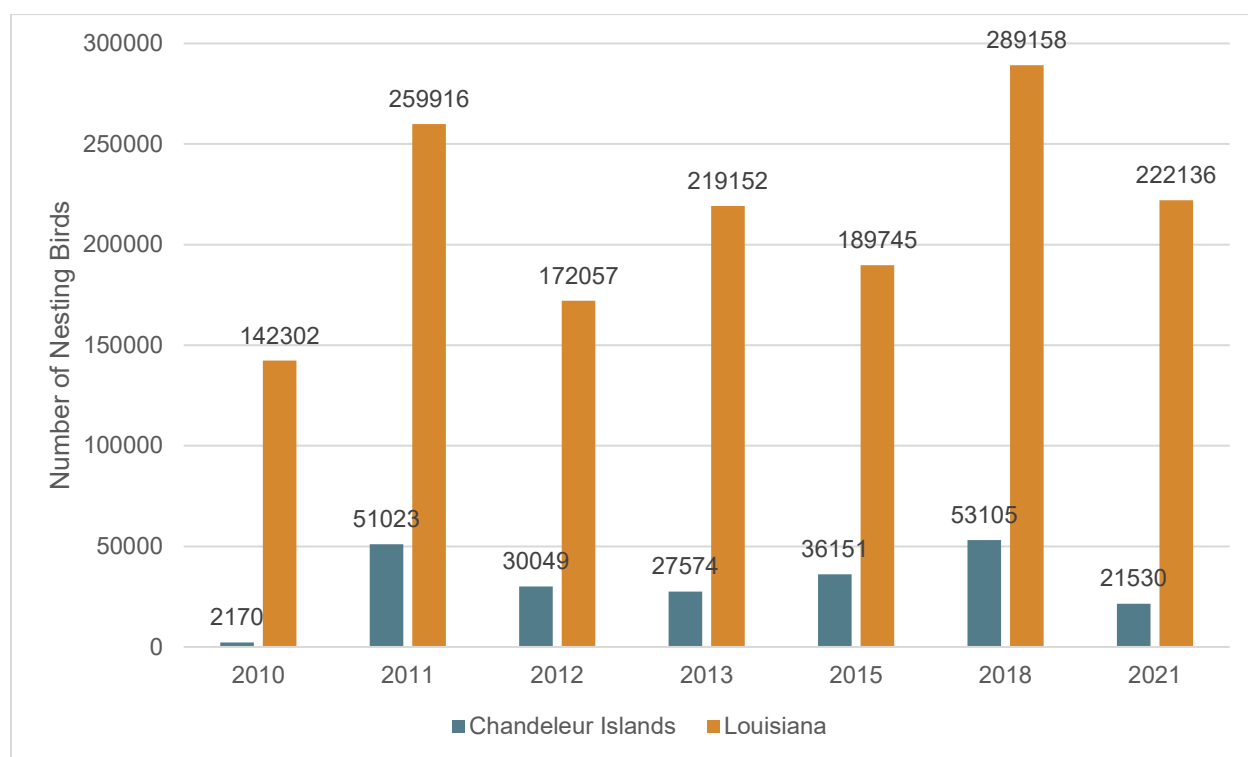


Figure 8. The total number of nesting birds observed via aerial overflights by Colibri Ecological Consulting on North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands (“Chandeleur Islands”, in blue) compared to all survey sites in Louisiana (“Louisiana”, in orange). Note that 2022 is not included in this figure because only a partial Louisiana survey was done that year.

Breeding population abundance in Louisiana for BRPE, ROYT, SATE, BLSK, and LAGU using the estimated total number of breeding individuals surveyed across all Louisiana colonies<sup>3</sup> were compared to estimated mean yearly breeding populations; this comparison is shown in Table 8. The results illustrate an approximation of how many of Louisiana’s breeding individuals nest on the Chandeleur Islands. On

<sup>3</sup>Deepwater Horizon Regionwide Trustee Implementation Group. 2023. Avian Data Monitoring Portal. <https://avianmonitoring.com>



average, over half (73%) of the total breeding population of SATE and an estimated 26% and 41% of Louisiana’s BRPE and ROYT, respectively, nest on these islands. These species as well as LAGU experienced some of the largest recorded mortality rates during the DWH oil spill (Haney et al., 2014).

*Table 8. The percentage of the total estimated Louisiana breeding populations of BRPE, ROYT, SATE, BLSK, and LAGU nesting on North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands (“Chandeleur Islands”).*

Species	Total Louisiana Breeding Population <sup>1</sup>	Chandeleur Islands Est. Yearly Average <sup>2</sup>	Est. % of Coastal Louisiana Population
BRPE	27,509	7,172	26%
ROYT	42,136	17,450	41%
SATE	56,247	41,514	73%
BLSK	6,317	1,994	32%
LAGU	63,596	2,056	3%

<sup>1</sup>Estimated yearly average from all survey years except 2010, calculated by averaging the total number of nests observed **across all surveyed Louisiana colonies** and multiplying by 2 (to account for 1 breeding pair/nest)

<sup>2</sup>Estimated yearly average from all survey years except 2010, calculated by averaging the total of number of nests observed **across all surveyed Chandeleur Islands colonies** and multiplying by 2 (to account for 1 breeding pair/nest)

As noted previously, aerial surveying methodology is not comprehensive and the estimated total Louisiana breeding population in Table 8 does not account for any breeding individuals that may be nesting outside of the airplane survey paths. Additional total Louisiana breeding population estimates are provided by Remsen et al. (2019) and are listed below in Table 9 as a comparison to the values from the aerial surveys.

Species	Total Louisiana Breeding Population, per Remsen et al. (2019)	Total Louisiana Breeding Population, per aerial surveys
BRPE	35,000	27,509
ROYT	50,000	42,136
SATE	75,000	56,247
BLSK	10,000	6,317
LAGU	100,000	63,596

Across northern Gulf of Mexico states, Louisiana ranks first in supporting the following species that have been observed nesting on the islands: SATE, ROYT, BRPE, BLSK, FOTE, and TRHE (Remsen et al., 2019). Nesting tricolored herons have been observed on New Harbor Island, likely due to the availability of shrub vegetation, whereas nesting SATE, ROYT, BRPE, BLSK, and FOTE have all been observed on South Chandeleur, New Harbor, and Gosier islands. These islands are used by ground-nesting bird species that require adequate vegetation cover and sediment composition, refuge from predators, and foraging opportunities. Globally, Louisiana contributes to 70% and 20% of SATE and ROYT populations (respectively), and to 23% of the global Brown Pelican population (Remsen et al., 2019). The protection and restoration of these islands, therefore, may have an influence on both the Gulf of Mexico and global populations of these species.



## CONCLUSION

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Barrier islands and associated marsh islands such as North Chandeleur, South Chandeleur, New Harbor, Gosier, and Freemason islands are suitable for nesting birds due to their unique habitat features and isolation from the mainland. In the 1980s and 1990s, the Chandeleur Islands were thought to support some of the largest breeding bird colonies in the world (Spendelow & Patton, 1988). The data presented herein illustrate that the five islands in the Chandeleur Islands region do in fact host a diversity and abundance of nesting bird species. As noted previously, the aerial survey methodology has limitations with regards to the types of birds that it can detect, however in total, over 249,000 bird nests across the eight survey years were quantified in the study region. For some species, including SATE and ROYT, these islands provide nesting habitat for >30% of their total breeding populations in Louisiana.

These data can be further refined with ongoing and improved aerial surveys and additional information provided from on-the-ground or other survey methods. However, there is evidence even with this singular methodological approach to indicate that the Chandeleur Islands are important in supporting Louisiana's breeding waterbirds. Variability in nest numbers and species across years indicate also that nesting habitat suitability on these islands can change from year to year. Nesting variability is frequently observed on barrier islands due to the dynamic nature of the islands and associated habitat changes (Windhoffer et al., 2017). Bird nest use varies as island features including size, vegetation composition, elevation, and sediment change or diminish over time. Certain islands are not used for nesting due to inadequate vegetation characteristics and disturbances such as flooding or large numbers of loafing birds. The protection/creation of barrier island habitats that are suitable for nesting during restoration activities will provide valuable co-benefits to many species of nesting birds.



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## APPENDIX A. RAW DATA

These tables provide the raw data collected from the overflight imagery analysis for 2010, 2011, 2012, 2013, 2015, 2018, 2021, and 2022. They include names of colonies, associated coordinates, species, and number of nests observed. Note that any birds listed with 0 nests were observed at the colony.

Table A-1. Raw data for 2010

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	LAGU	0
Chandeleur North A	29.96953	-88.82772	UNTE	0
Chandeleur North B	29.94982	-88.82380	LAGU	0
Chandeleur North B	29.94982	-88.82380	SNEG	0
Chandeleur North C	29.92969	-88.82180	LAGU	21
Chandeleur North D	29.90169	-88.82485	BRPE	0
Chandeleur North D	29.90169	-88.82485	LAGU	0
Chandeleur North D	29.90169	-88.82485	UNTE	0
Chandeleur North E	29.88840	-88.82646	BLSK	0
Chandeleur North E	29.88840	-88.82646	BRPE	0
Chandeleur North E	29.88840	-88.82646	LAGU	0
Chandeleur North E	29.88840	-88.82646	ULGU	0
Chandeleur North E	29.88840	-88.82646	UNTE	0
Chandeleur South A	29.80933	-88.86107	AMOY	0
Chandeleur South A	29.80933	-88.86107	BLSK	9
Chandeleur South A	29.80933	-88.86107	BRPE	0
Chandeleur South A	29.80933	-88.86107	CATE	16
Chandeleur South A	29.80933	-88.86107	LAGU	0
Chandeleur South A	29.80933	-88.86107	ROYT	400
Chandeleur South A	29.80933	-88.86107	SATE	863
Chandeleur South A	29.80933	-88.86107	ULGU	0
Chandeleur South A	29.80933	-88.86107	UNTE	0
Chandeleur South B	29.79898	-88.86416	BLSK	0
Chandeleur South B	29.79898	-88.86416	LAGU	0
Chandeleur South B	29.79898	-88.86416	UNTE	0
Chandeleur South C	29.78041	-88.87419	BLSK	80
Chandeleur South C	29.78041	-88.87419	BRPE	0
Chandeleur South C	29.78041	-88.87419	LAGU	15
Chandeleur South C	29.78041	-88.87419	ROYT	0
Chandeleur South C	29.78041	-88.87419	SATE	0
Freemason Island	29.78900	-88.97700	BLSK	90
Freemason Island	29.78900	-88.97700	BRPE	0





ColonyName	Latitude	Longitude	SpeciesCode	Nests
Freemason Island	29.78900	-88.97700	LAGU	0
Freemason Island	29.78900	-88.97700	UNTE	0
Gosier Islands South	29.52369	-89.09535	BLSK	0
Gosier Islands South	29.52369	-89.09535	BRPE	0
Gosier Islands South	29.52369	-89.09535	LAGU	0
Gosier Islands South	29.52369	-89.09535	ULGU	0
Gosier Islands South	29.52369	-89.09535	UNTE	0
New Harbor Island 1	29.87609	-88.87682	BRPE	12
New Harbor Island 1	29.87609	-88.87682	LAGU	1
New Harbor Island 2	29.85650	-88.87500	BRPE	650
New Harbor Island 2	29.85650	-88.87500	GREG	3
New Harbor Island 2	29.85650	-88.87500	LAGU	2
New Harbor Island 2	29.85650	-88.87500	MAFR	0
New Harbor Island 2	29.85650	-88.87500	SDHE	1
New Harbor Island 2	29.85650	-88.87500	TRHE	7

Table A-2. Raw data for 2011

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	BRPE	0
Chandeleur North A	29.96953	-88.82772	LAGU	148
Chandeleur North A	29.96953	-88.82772	ROSA	388
Chandeleur North A	29.96953	-88.82772	ROYT	170
Chandeleur North A	29.96953	-88.82772	SATE	1857
Chandeleur North B	29.94982	-88.82380	BLSK	53
Chandeleur North B	29.94982	-88.82380	CATE	36
Chandeleur North B	29.94982	-88.82380	GBTE	2
Chandeleur North B	29.94982	-88.82380	LAGU	63
Chandeleur North B	29.94982	-88.82380	LETE	0
Chandeleur North B	29.94982	-88.82380	ROYT	1196
Chandeleur North B	29.94982	-88.82380	SATE	3326
Chandeleur North C	29.92969	-88.82180	BLSK	32
Chandeleur North C	29.92969	-88.82180	GBTE	6
Chandeleur North D	29.90169	-88.82485	BLSK	1
Chandeleur North D	29.90169	-88.82485	BRPE	0
Chandeleur North D	29.90169	-88.82485	CATE	33
Chandeleur North D	29.90169	-88.82485	LAGU	0
Chandeleur North D	29.90169	-88.82485	ROYT	1978
Chandeleur North D	29.90169	-88.82485	SATE	2392



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North D	29.90169	-88.82485	UNGU	0
Chandeleur North D	29.90169	-88.82485	UNSB	0
Chandeleur North E	29.88840	-88.82646	BLSK	6
Chandeleur North F	29.88181	-88.82835	CATE	13
Chandeleur North F	29.88181	-88.82835	LAGU	17
Chandeleur North F	29.88181	-88.82835	ROSA	53
Chandeleur North F	29.88181	-88.82835	ROYT	4454
Chandeleur North F	29.88181	-88.82835	SATE	17426
Chandeleur North F	29.88181	-88.82835	UNSB	0
Chandeleur North G	29.86513	-88.83262	BLSK	21
Chandeleur North G	29.86513	-88.83262	GBTE	5
Chandeleur North G	29.86513	-88.83262	LETE	33
Chandeleur North H	29.85238	-88.83664	BLSK	188
Chandeleur North H	29.85238	-88.83664	GBTE	6
Chandeleur South A	29.80933	-88.86107	BLSK	17
Chandeleur South A	29.80933	-88.86107	CATE	24
Chandeleur South B	29.79898	-88.86416	BLSK	58
Chandeleur South B	29.79898	-88.86416	BRPE	72
Chandeleur South B	29.79898	-88.86416	GBTE	6
Chandeleur South B	29.79898	-88.86416	LAGU	358
Chandeleur South B	29.79898	-88.86416	ROYT	237
Chandeleur South B	29.79898	-88.86416	SATE	744
Chandeleur South C	29.78041	-88.87419	LAGU	30
Chandeleur South D	29.77038	-88.88294	BLSK	96
Chandeleur South D	29.77038	-88.88294	CATE	108
Chandeleur South D	29.77038	-88.88294	GBTE	4
Chandeleur South D	29.77038	-88.88294	LAGU	0
Chandeleur South D	29.77038	-88.88294	ROYT	2686
Chandeleur South D	29.77038	-88.88294	SATE	9273
Gosier Islands South	29.52369	-89.09535	BLSK	219
Gosier Islands South	29.52369	-89.09535	CATE	72
Gosier Islands South	29.52369	-89.09535	GBTE	16
Gosier Islands South	29.52369	-89.09535	ROYT	2
Gosier Islands South	29.52369	-89.09535	SATE	253
New Harbor Island 1	29.87609	-88.87682	BCNH	2
New Harbor Island 1	29.87609	-88.87682	BLSK	0
New Harbor Island 1	29.87609	-88.87682	BRPE	165
New Harbor Island 1	29.87609	-88.87682	GREG	0
New Harbor Island 1	29.87609	-88.87682	LAGU	396



ColonyName	Latitude	Longitude	SpeciesCode	Nests
New Harbor Island 1	29.87609	-88.87682	ROSA	0
New Harbor Island 1	29.87609	-88.87682	ROYT	0
New Harbor Island 1	29.87609	-88.87682	SATE	0
New Harbor Island 1	29.87609	-88.87682	SNEG	0
New Harbor Island 1	29.87609	-88.87682	TRHE	1
New Harbor Island 1	29.87609	-88.87682	USTE	0
New Harbor Island 2	29.85650	-88.87500	BRPE	1289
New Harbor Island 2	29.85650	-88.87500	CAEG	0
New Harbor Island 2	29.85650	-88.87500	GREG	6
New Harbor Island 2	29.85650	-88.87500	LAGU	2
New Harbor Island 2	29.85650	-88.87500	MAFR	0
New Harbor Island 2	29.85650	-88.87500	REEG	0
New Harbor Island 2	29.85650	-88.87500	TRHE	1
New Harbor Island 3	29.85420	-88.86340	ANHI	0
New Harbor Island 3	29.85420	-88.86340	BBWD	0
New Harbor Island 3	29.85420	-88.86340	BCNH	1
New Harbor Island 3	29.85420	-88.86340	BRPE	585
New Harbor Island 3	29.85420	-88.86340	GBHE	0
New Harbor Island 3	29.85420	-88.86340	LAGU	345
New Harbor Island 3	29.85420	-88.86340	LEBI	0
New Harbor Island 3	29.85420	-88.86340	MAFR	0
New Harbor Island 3	29.85420	-88.86340	MODU	0
New Harbor Island 3	29.85420	-88.86340	SNEG	1
New Harbor Island 3	29.85420	-88.86340	TRHE	50
New Harbor Island 3	29.85420	-88.86340	UNSB	0
New Harbor Island 3	29.85420	-88.86340	WFIB	0
New Harbor Island 3	29.85420	-88.86340	WHEG	0
New Harbor Island 3	29.85420	-88.86340	YCNH	1

Table A-3. Raw data for 2012

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	BLSK	23
Chandeleur North A	29.96953	-88.82772	CATE	0
Chandeleur North A	29.96953	-88.82772	LAGU	22
Chandeleur North B	29.94982	-88.82380	BLSK	26
Chandeleur North B	29.94982	-88.82380	GBTE	1
Chandeleur North B	29.94982	-88.82380	LAGU	5
Chandeleur North B	29.94982	-88.82380	ROYT	39



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North B	29.94982	-88.82380	SATE	77
Chandeleur North C	29.92969	-88.82180	CATE	42
Chandeleur North C	29.92969	-88.82180	LAGU	48
Chandeleur North D	29.90169	-88.82485	BLSK	42
Chandeleur North D	29.90169	-88.82485	CATE	2
Chandeleur North D	29.90169	-88.82485	GBTE	4
Chandeleur North E	29.88840	-88.82646	BLSK	69
Chandeleur North E	29.88840	-88.82646	GBTE	5
Chandeleur North F	29.88181	-88.82835	BLSK	9
Chandeleur North G	29.86513	-88.83262	CATE	7
Chandeleur North G	29.86513	-88.83262	LAGU	0
Chandeleur North G	29.86513	-88.83262	ROSA	8284
Chandeleur North G	29.86513	-88.83262	ROYT	5703
Chandeleur North G	29.86513	-88.83262	SATE	4519
Chandeleur North H	29.85238	-88.83664	BLSK	72
Chandeleur North H	29.85238	-88.83664	GBTE	9
Chandeleur North I	29.84536	-88.83966	BLSK	74
Chandeleur North I	29.84536	-88.83966	GBTE	3
Chandeleur North I	29.84536	-88.83966	LAGU	2
Chandeleur North J	29.84770	-88.83590	BLSK	33
Chandeleur North J	29.84770	-88.83590	GBTE	3
Chandeleur North K	29.83180	-88.84350	BLSK	9
Chandeleur North K	29.83180	-88.84350	LAGU	1
Chandeleur South A	29.80933	-88.86107	BLSK	55
Chandeleur South A	29.80933	-88.86107	CATE	125
Chandeleur South A	29.80933	-88.86107	LAGU	0
Chandeleur South A	29.80933	-88.86107	LETE	37
Chandeleur South B	29.79898	-88.86416	BLSK	21
Chandeleur South B	29.79898	-88.86416	GBTE	1
Chandeleur South C	29.78041	-88.87419	BLSK	36
Chandeleur South C	29.78041	-88.87419	CATE	31
Chandeleur South C	29.78041	-88.87419	GBTE	0
Chandeleur South C	29.78041	-88.87419	LAGU	0
Chandeleur South C	29.78041	-88.87419	ROYT	1818
Chandeleur South C	29.78041	-88.87419	SATE	2882
Chandeleur South D	29.77038	-88.88294	BLSK	27
Chandeleur South D	29.77038	-88.88294	CATE	122
Chandeleur South D	29.77038	-88.88294	GBTE	8
Chandeleur South D	29.77038	-88.88294	LAGU	0



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur South D	29.77038	-88.88294	ROYT	932
Chandeleur South D	29.77038	-88.88294	SATE	2294
New Harbor Island 2	29.85650	-88.87500	BRPE	942
New Harbor Island 2	29.85650	-88.87500	GREG	8
New Harbor Island 2	29.85650	-88.87500	LAGU	0
New Harbor Island 2	29.85650	-88.87500	REEG	1
New Harbor Island 2	29.85650	-88.87500	TRHE	3
New Harbor Island 2	29.85650	-88.87500	YCNH	0
New Harbor Island 3	29.85420	-88.86340	BRPE	1291
New Harbor Island 3	29.85420	-88.86340	LAGU	270
New Harbor Island 3	29.85420	-88.86340	MAFR	0
New Harbor Island 3	29.85420	-88.86340	TRHE	3
New Harbor Island 3	29.85420	-88.86340	WHEG	9

Table A-4. Raw data for 2013

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	BRPE	0
Chandeleur North A	29.96953	-88.82772	LAGU	40
Chandeleur North A	29.96953	-88.82772	ROYT	344
Chandeleur North A	29.96953	-88.82772	SATE	2318
Chandeleur North B	29.94982	-88.82380	CATE	5
Chandeleur North B	29.94982	-88.82380	LAGU	129
Chandeleur North B	29.94982	-88.82380	ROYT	719
Chandeleur North B	29.94982	-88.82380	SATE	624
Chandeleur North C	29.92969	-88.82180	BLSK	1
Chandeleur North C	29.92969	-88.82180	CATE	8
Chandeleur North C	29.92969	-88.82180	GBTE	2
Chandeleur North C	29.92969	-88.82180	LAGU	0
Chandeleur North C	29.92969	-88.82180	ROYT	818
Chandeleur North C	29.92969	-88.82180	SATE	2424
Chandeleur North D	29.90169	-88.82485	BLSK	54
Chandeleur North D	29.90169	-88.82485	GBTE	13
Chandeleur North E	29.88840	-88.82646	BLSK	76
Chandeleur North E	29.88840	-88.82646	GBTE	1
Chandeleur North F	29.88181	-88.82835	BLSK	131
Chandeleur North F	29.88181	-88.82835	CATE	0
Chandeleur North F	29.88181	-88.82835	GBTE	4
Chandeleur North F	29.88181	-88.82835	LAGU	62



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North F	29.88181	-88.82835	ROYT	1879
Chandeleur North F	29.88181	-88.82835	SATE	6258
Chandeleur North G	29.86513	-88.83262	BLSK	64
Chandeleur North G	29.86513	-88.83262	CATE	22
Chandeleur North G	29.86513	-88.83262	GBTE	1
Chandeleur North G	29.86513	-88.83262	ROYT	111
Chandeleur North G	29.86513	-88.83262	SATE	175
Chandeleur South A	29.80933	-88.86107	BLSK	134
Chandeleur South A	29.80933	-88.86107	CATE	16
Chandeleur South A	29.80933	-88.86107	GBTE	0
Chandeleur South A	29.80933	-88.86107	LAGU	1
Chandeleur South A	29.80933	-88.86107	ROYT	2
Chandeleur South A	29.80933	-88.86107	SATE	439
Chandeleur South B	29.79898	-88.86416	BLSK	76
Chandeleur South B	29.79898	-88.86416	BRPE	0
Chandeleur South B	29.79898	-88.86416	CATE	50
Chandeleur South B	29.79898	-88.86416	LAGU	50
Chandeleur South B	29.79898	-88.86416	ROYT	1019
Chandeleur South B	29.79898	-88.86416	SATE	7371
Chandeleur South C	29.78041	-88.87419	BLSK	54
Chandeleur South C	29.78041	-88.87419	BRPE	0
Chandeleur South C	29.78041	-88.87419	GBTE	3
Chandeleur South C	29.78041	-88.87419	ROYT	0
Chandeleur South C	29.78041	-88.87419	SATE	0
Freemason Island	29.78900	-88.97700	BLSK	30
Freemason Island	29.78900	-88.97700	BRPE	0
Freemason Island	29.78900	-88.97700	LAGU	0
Freemason Island	29.78900	-88.97700	ROYT	0
Freemason Island	29.78900	-88.97700	SATE	0
New Harbor Island 1	29.87609	-88.87682	BLSK	7
New Harbor Island 1	29.87609	-88.87682	LAGU	8
New Harbor Island 1	29.87609	-88.87682	UNTE	0
New Harbor Island 3	29.85420	-88.86340	BRPE	1756
New Harbor Island 3	29.85420	-88.86340	GREG	4
New Harbor Island 3	29.85420	-88.86340	LAGU	271
New Harbor Island 3	29.85420	-88.86340	MAFR	0



Table A-5. Raw data for 2015

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	AMOY	0
Chandeleur North A	29.96953	-88.82772	BRPE	0
Chandeleur North A	29.96953	-88.82772	CAEG	0
Chandeleur North A	29.96953	-88.82772	LAGU	41
Chandeleur North A	29.96953	-88.82772	ROYT	960
Chandeleur North A	29.96953	-88.82772	SATE	4340
Chandeleur North B	29.94982	-88.82380	BLSK	130
Chandeleur North B	29.94982	-88.82380	CATE	57
Chandeleur North B	29.94982	-88.82380	GBTE	8
Chandeleur North B	29.94982	-88.82380	LAGU	0
Chandeleur North B	29.94982	-88.82380	ROYT	272
Chandeleur North B	29.94982	-88.82380	SATE	92
Chandeleur North C	29.92969	-88.82180	AMOY	0
Chandeleur North C	29.92969	-88.82180	CATE	8
Chandeleur North C	29.92969	-88.82180	LAGU	0
Chandeleur North C	29.92969	-88.82180	ROYT	0
Chandeleur North D	29.90169	-88.82485	BLSK	51
Chandeleur North D	29.90169	-88.82485	GBTE	3
Chandeleur North E	29.88840	-88.82646	BLSK	139
Chandeleur North E	29.88840	-88.82646	GBTE	5
Chandeleur North F	29.88181	-88.82835	BLSK	28
Chandeleur North F	29.88181	-88.82835	GBTE	3
Chandeleur North F	29.88181	-88.82835	LAGU	0
Chandeleur North F	29.88181	-88.82835	ROYT	434
Chandeleur North F	29.88181	-88.82835	SATE	135
Chandeleur North G	29.86513	-88.83262	BLSK	70
Chandeleur North G	29.86513	-88.83262	GBTE	2
Chandeleur North G	29.86513	-88.83262	LETE	29
Chandeleur North H	29.85238	-88.83664	BLSK	117
Chandeleur North H	29.85238	-88.83664	GBTE	8
Chandeleur South A	29.80933	-88.86107	CATE	2
Chandeleur South A	29.80933	-88.86107	ROYT	0
Chandeleur South B	29.79898	-88.86416	BLSK	118
Chandeleur South B	29.79898	-88.86416	GBTE	8
Chandeleur South B	29.79898	-88.86416	LAGU	0
Chandeleur South C	29.78041	-88.87419	BRPE	0
Chandeleur South C	29.78041	-88.87419	CAEG	0
Chandeleur South C	29.78041	-88.87419	LAGU	47



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur South C	29.78041	-88.87419	ROYT	2870
Chandeleur South C	29.78041	-88.87419	SATE	14951
Chandeleur South D	29.77038	-88.88294	BLSK	79
Chandeleur South D	29.77038	-88.88294	GBTE	1
Chandeleur South E	29.76502	-88.88709	BLSK	1
Chandeleur South E	29.76502	-88.88709	CATE	11
Chandeleur South E	29.76502	-88.88709	LAGU	0
Chandeleur South E	29.76502	-88.88709	ROYT	1836
Chandeleur South E	29.76502	-88.88709	SATE	3374
Chandeleur South F	29.76426	-88.88748	BLSK	75
Chandeleur South F	29.76426	-88.88748	GBTE	2
Curlew Island	29.66636	-88.96112	BLSK	132
Curlew Island	29.66636	-88.96112	CATE	9
Curlew Island	29.66636	-88.96112	GBTE	3
Curlew Island	29.66636	-88.96112	LAGU	1
Curlew Island	29.66636	-88.96112	ROYT	2281
Curlew Island	29.66636	-88.96112	SATE	7521
Freemason Island	29.78900	-88.97700	BLSK	0
Freemason Island	29.78900	-88.97700	BRPE	0
Freemason Island	29.78900	-88.97700	LAGU	0
Freemason Island	29.78900	-88.97700	ROYT	0
Freemason Island	29.78900	-88.97700	SATE	0
Gosier Islands North	29.55170	-89.06444	BLSK	68
Gosier Islands North	29.55170	-89.06444	CATE	45
Gosier Islands North	29.55170	-89.06444	GBTE	12
Gosier Islands North	29.55170	-89.06444	LAGU	0
Gosier Islands North	29.55170	-89.06444	ROYT	1037
Gosier Islands North	29.55170	-89.06444	SATE	1219
Gosier Islands South	29.52369	-89.09535	BLSK	53
Gosier Islands South	29.52369	-89.09535	CATE	61
Gosier Islands South	29.52369	-89.09535	GBTE	13
Gosier Islands South	29.52369	-89.09535	ROYT	17
Gosier Islands South	29.52369	-89.09535	SATE	49
New Harbor Island 1	29.87609	-88.87682	BRPE	0
New Harbor Island 1	29.87609	-88.87682	LAGU	199
New Harbor Island 2	29.85650	-88.87500	BRPE	0
New Harbor Island 2	29.85650	-88.87500	LAGU	46
New Harbor Island 3	29.85420	-88.86340	BRPE	2676
New Harbor Island 3	29.85420	-88.86340	GREG	3





ColonyName	Latitude	Longitude	SpeciesCode	Nests
New Harbor Island 3	29.85420	-88.86340	LAGU	338
New Harbor Island 3	29.85420	-88.86340	MAFR	0
New Harbor Island 3	29.85420	-88.86340	REEG	6
New Harbor Island 3	29.85420	-88.86340	SNEG	0
New Harbor Island 3	29.85420	-88.86340	TRHE	2
New Harbor Island 3	29.85420	-88.86340	UNNH	0

Table A-6. Raw data for 2018

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	BLSK	247
Chandeleur North A	29.96953	-88.82772	CATE	1
Chandeleur North A	29.96953	-88.82772	GBTE	15
Chandeleur North A	29.96953	-88.82772	LAGU	1
Chandeleur North B	29.94982	-88.82380	BLSK	30
Chandeleur North B	29.94982	-88.82380	GBTE	3
Chandeleur North C	29.92969	-88.82180	BLSK	13
Chandeleur North C	29.92969	-88.82180	CATE	81
Chandeleur North C	29.92969	-88.82180	GBTE	3
Chandeleur North C	29.92969	-88.82180	LAGU	0
Chandeleur North C	29.92969	-88.82180	ROYT	576
Chandeleur North C	29.92969	-88.82180	SATE	1282
Chandeleur North D	29.90169	-88.82485	BLSK	151
Chandeleur North D	29.90169	-88.82485	CATE	1
Chandeleur North D	29.90169	-88.82485	GBTE	34
Chandeleur North D	29.90169	-88.82485	LAGU	0
Chandeleur North E	29.88840	-88.82646	AMOY	1
Chandeleur North E	29.88840	-88.82646	BLSK	94
Chandeleur North E	29.88840	-88.82646	GBTE	11
Chandeleur North E	29.88840	-88.82646	LAGU	3
Chandeleur North F	29.88181	-88.82835	BLSK	79
Chandeleur North F	29.88181	-88.82835	CATE	20
Chandeleur North F	29.88181	-88.82835	GBTE	1
Chandeleur North F	29.88181	-88.82835	LAGU	0
Chandeleur North F	29.88181	-88.82835	ROYT	884
Chandeleur North F	29.88181	-88.82835	SATE	5861
Chandeleur North G	29.86513	-88.83262	BLSK	202
Chandeleur North G	29.86513	-88.83262	CATE	2
Chandeleur North G	29.86513	-88.83262	GBTE	5



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North H	29.85238	-88.83664	BLSK	24
Chandeleur North H	29.85238	-88.83664	GBTE	3
Chandeleur North I	29.84536	-88.83966	BLSK	87
Chandeleur South A	29.80933	-88.86107	BLSK	13
Chandeleur South B	29.79898	-88.86416	BLSK	123
Chandeleur South B	29.79898	-88.86416	GBTE	5
Chandeleur South C	29.78041	-88.87419	BLSK	15
Chandeleur South C	29.78041	-88.87419	CATE	178
Chandeleur South C	29.78041	-88.87419	GBTE	0
Chandeleur South C	29.78041	-88.87419	LAGU	1
Chandeleur South C	29.78041	-88.87419	ROYT	6715
Chandeleur South C	29.78041	-88.87419	SATE	11921
Chandeleur South D	29.77038	-88.88294	BLSK	225
Chandeleur South D	29.77038	-88.88294	CATE	12
Chandeleur South D	29.77038	-88.88294	GBTE	15
Chandeleur South D	29.77038	-88.88294	LAGU	27
Chandeleur South D	29.77038	-88.88294	ROYT	821
Chandeleur South D	29.77038	-88.88294	SATE	1663
Chandeleur South E	29.76502	-88.88709	CATE	19
Curlew Island	29.66636	-88.96112	BLSK	240
Curlew Island	29.66636	-88.96112	CATE	18
Curlew Island	29.66636	-88.96112	GBTE	14
Curlew Island	29.66636	-88.96112	LAGU	0
Gosier Islands North	29.55170	-89.06444	BLSK	120
Gosier Islands North	29.55170	-89.06444	BRPE	50
Gosier Islands North	29.55170	-89.06444	CATE	8
Gosier Islands North	29.55170	-89.06444	FOTE	38
Gosier Islands North	29.55170	-89.06444	GBTE	5
Gosier Islands North	29.55170	-89.06444	LAGU	984
Gosier Islands North	29.55170	-89.06444	ROYT	6469
Gosier Islands North	29.55170	-89.06444	SATE	9684
New Harbor Island 1	29.87609	-88.87682	BLSK	4
New Harbor Island 1	29.87609	-88.87682	BRPE	0
New Harbor Island 1	29.87609	-88.87682	FOTE	6
New Harbor Island 1	29.87609	-88.87682	LAGU	5
New Harbor Island 1	29.87609	-88.87682	ROYT	0
New Harbor Island 1	29.87609	-88.87682	SATE	0
New Harbor Island 1	29.87609	-88.87682	TRHE	0
New Harbor Island 2	29.85650	-88.87500	BRPE	0



ColonyName	Latitude	Longitude	SpeciesCode	Nests
New Harbor Island 2	29.85650	-88.87500	LAGU	18
New Harbor Island 3	29.85420	-88.86340	BRPE	4114
New Harbor Island 3	29.85420	-88.86340	GREG	4
New Harbor Island 3	29.85420	-88.86340	LAGU	128
New Harbor Island 3	29.85420	-88.86340	TRHE	0

Table A-7. Raw data for 2021

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.96953	-88.82772	LAGU	103
Chandeleur North A	29.96953	-88.82772	ROYT	2385
Chandeleur North A	29.96953	-88.82772	SATE	5365
Chandeleur North B	29.94982	-88.82380	BLSK	389
Chandeleur North B	29.94982	-88.82380	GBTE	34
Chandeleur North B	29.94982	-88.82380	LAGU	13
Chandeleur North B	29.94982	-88.82380	SATE	0
Chandeleur North C	29.92969	-88.82180	BLSK	115
Chandeleur North C	29.92969	-88.82180	GBTE	5
Chandeleur North D	29.90169	-88.82485	BLSK	186
Chandeleur North D	29.90169	-88.82485	CATE	61
Chandeleur North D	29.90169	-88.82485	FOTE	18
Chandeleur North D	29.90169	-88.82485	GBTE	22
Chandeleur North D	29.90169	-88.82485	LAGU	129
Chandeleur North D	29.90169	-88.82485	LETE	22
Chandeleur North D	29.90169	-88.82485	WIPH	0
Chandeleur North E	29.88840	-88.82646	LAGU	465
Chandeleur North F	29.88181	-88.82835	LAGU	308
Chandeleur North G	29.86513	-88.83262	BLSK	25
Chandeleur North G	29.86513	-88.83262	LAGU	1
Chandeleur North H	29.85238	-88.83664	BLSK	105
Chandeleur North H	29.85238	-88.83664	CATE	120
Chandeleur North H	29.85238	-88.83664	GBTE	4
Chandeleur North H	29.85238	-88.83664	LAGU	37
Chandeleur North H	29.85238	-88.83664	ROYT	19
Chandeleur North H	29.85238	-88.83664	SATE	10
Chandeleur South A	29.80933	-88.86107	BLSK	163
Chandeleur South A	29.80933	-88.86107	CATE	20
Chandeleur South A	29.80933	-88.86107	FOTE	27
Chandeleur South A	29.80933	-88.86107	LAGU	207



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur South A	29.80933	-88.86107	ROYT	966
Chandeleur South A	29.80933	-88.86107	SATE	724
Chandeleur South B	29.79898	-88.86416	BLSK	106
Chandeleur South B	29.79898	-88.86416	FOTE	17
Chandeleur South B	29.79898	-88.86416	GBTE	5
Chandeleur South C	29.78041	-88.87419	BLSK	117
Chandeleur South C	29.78041	-88.87419	CATE	23
Chandeleur South C	29.78041	-88.87419	FOTE	15
Chandeleur South C	29.78041	-88.87419	GBTE	6
Chandeleur South C	29.78041	-88.87419	LAGU	338
Chandeleur South C	29.78041	-88.87419	SATE	0
Chandeleur South D	29.77038	-88.88294	BLSK	86
Chandeleur South D	29.77038	-88.88294	CATE	105
Chandeleur South D	29.77038	-88.88294	GBTE	2
Chandeleur South D	29.77038	-88.88294	LAGU	238
Chandeleur South D	29.77038	-88.88294	ROYT	2601
Chandeleur South D	29.77038	-88.88294	SATE	1130
New Harbor Island 2	29.85650	-88.87500	BRPE	0
New Harbor Island 3	29.85420	-88.86340	BRPE	4684
New Harbor Island 3	29.85420	-88.86340	GREG	4
New Harbor Island 3	29.85420	-88.86340	LAGU	5
New Harbor Island 3	29.85420	-88.86340	TRHE	0

Table A-8. Raw data for 2022

ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North A	29.98087	-88.83291	LAGU	11
Chandeleur North B	29.97076	-88.82893	BLSK	182
Chandeleur North B	29.97076	-88.82893	CATE	30
Chandeleur North B	29.97076	-88.82893	GBTE	5
Chandeleur North B	29.97076	-88.82893	LAGU	21
Chandeleur North B	29.97076	-88.82893	UNWA	0
Chandeleur North C	29.95987	-88.82602	BLSK	175
Chandeleur North C	29.95987	-88.82602	GBTE	13
Chandeleur North C	29.95987	-88.82602	LAGU	73
Chandeleur North C	29.95987	-88.82602	UNSB	0
Chandeleur North D	29.93918	-88.82409	BLSK	134
Chandeleur North D	29.93918	-88.82409	GBTE	1
Chandeleur North D	29.93918	-88.82409	LAGU	0



ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur North E	29.92881	-88.82233	BLSK	3
Chandeleur North E	29.92881	-88.82233	CATE	81
Chandeleur North E	29.92881	-88.82233	LAGU	156
Chandeleur North E	29.92881	-88.82233	ROYT	304
Chandeleur North E	29.92881	-88.82233	RUTU	0
Chandeleur North E	29.92881	-88.82233	SATE	9
Chandeleur North E	29.92881	-88.82233	UNSB	0
Chandeleur North F	29.91867	-88.82238	BLSK	139
Chandeleur North F	29.91867	-88.82238	FOTE	1
Chandeleur North F	29.91867	-88.82238	GBTE	9
Chandeleur North G	29.90875	-88.82357	BLSK	32
Chandeleur North G	29.90875	-88.82357	GBTE	3
Chandeleur North G	29.90875	-88.82357	LAGU	47
Chandeleur North H	29.89640	-88.82546	BLSK	41
Chandeleur North H	29.89640	-88.82546	GBTE	2
Chandeleur North H	29.89640	-88.82546	LAGU	202
Chandeleur North I	29.87844	-88.82964	BLSK	129
Chandeleur North I	29.87844	-88.82964	CATE	86
Chandeleur North I	29.87844	-88.82964	GBTE	5
Chandeleur North I	29.87844	-88.82964	LAGU	582
Chandeleur North J	29.86293	-88.83355	CATE	29
Chandeleur North J	29.86293	-88.83355	LAGU	36
Chandeleur North J	29.86293	-88.83355	ROSA	2
Chandeleur North J	29.86293	-88.83355	ROYT	717
Chandeleur North J	29.86293	-88.83355	SATE	1114
Chandeleur North K	29.85188	-88.83900	BLSK	142
Chandeleur North K	29.85188	-88.83900	FOTE	2
Chandeleur North K	29.85188	-88.83900	GBTE	5
Chandeleur North K	29.85188	-88.83900	LETE	28
Chandeleur South A	29.78162	-88.87653	BLSK	168
Chandeleur South A	29.78162	-88.87653	BRPE	1
Chandeleur South A	29.78162	-88.87653	CATE	180
Chandeleur South A	29.78162	-88.87653	FOTE	3
Chandeleur South A	29.78162	-88.87653	GBTE	8
Chandeleur South A	29.78162	-88.87653	LAGU	71
Chandeleur South A	29.78162	-88.87653	ROSA	4
Chandeleur South A	29.78162	-88.87653	ROYT	3897
Chandeleur South A	29.78162	-88.87653	RUTU	0
Chandeleur South A	29.78162	-88.87653	SATE	7619



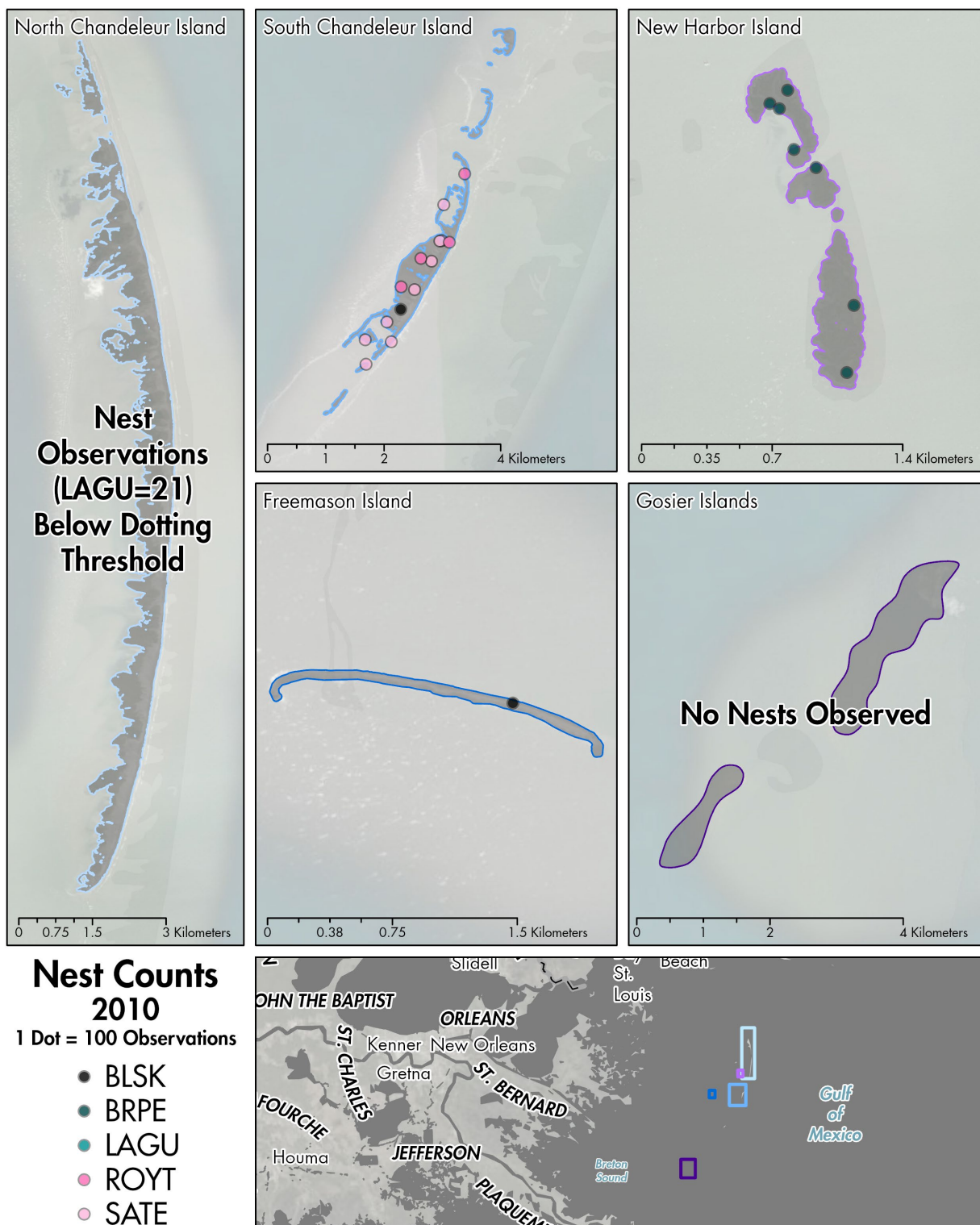
ColonyName	Latitude	Longitude	SpeciesCode	Nests
Chandeleur South A	29.78162	-88.87653	WIPL	0
Chandeleur South B	29.77178	-88.88301	CATE	4
Chandeleur South B	29.77178	-88.88301	LAGU	19
Chandeleur South B	29.77178	-88.88301	ROYT	909
Chandeleur South B	29.77178	-88.88301	SATE	2581
New Harbor Island 1	29.87639	-88.87658	BRPE	0
New Harbor Island 1	29.87639	-88.87658	GBTE	0
New Harbor Island 1	29.87639	-88.87658	LAGU	0
New Harbor Island 1	29.87639	-88.87658	LETE	0
New Harbor Island 1	29.87639	-88.87658	ROYT	0
New Harbor Island 1	29.87639	-88.87658	RUTU	0
New Harbor Island 1	29.87639	-88.87658	SATE	0
New Harbor Island 1	29.87639	-88.87658	UNSB	0
New Harbor Island 3	29.85406	-88.86426	BCNH	0
New Harbor Island 3	29.85406	-88.86426	BRPE	7479
New Harbor Island 3	29.85406	-88.86426	GREG	6
New Harbor Island 3	29.85406	-88.86426	LAGU	29
New Harbor Island 3	29.85406	-88.86426	MAFR	0
New Harbor Island 3	29.85406	-88.86426	REEG	3
New Harbor Island 3	29.85406	-88.86426	ROSP	0
New Harbor Island 3	29.85406	-88.86426	RUTU	0
New Harbor Island 3	29.85406	-88.86426	SNEG	0
New Harbor Island 3	29.85406	-88.86426	TRHE	2
New Harbor Island 3	29.85406	-88.86426	UNSB	0
New Harbor Island 3	29.85406	-88.86426	UNWA	0



## APPENDIX B. NEST COUNT DENSITY MAPS FOR BLSK, BRPE, LAGU, ROYT, AND SATE

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These maps depict locations and densities of Black Skimmers (BLSK), Brown Pelicans (BRPE), Laughing Gulls (LAGU), Royal Terns (ROYT) and Sandwich Terns (SATE) on the surveyed islands in each survey year (2010, 2011, 2012, 2013, 2015, 2018 2021, and 2022). A single dot represents 100 nests, and islands with no nest observations are indicated.

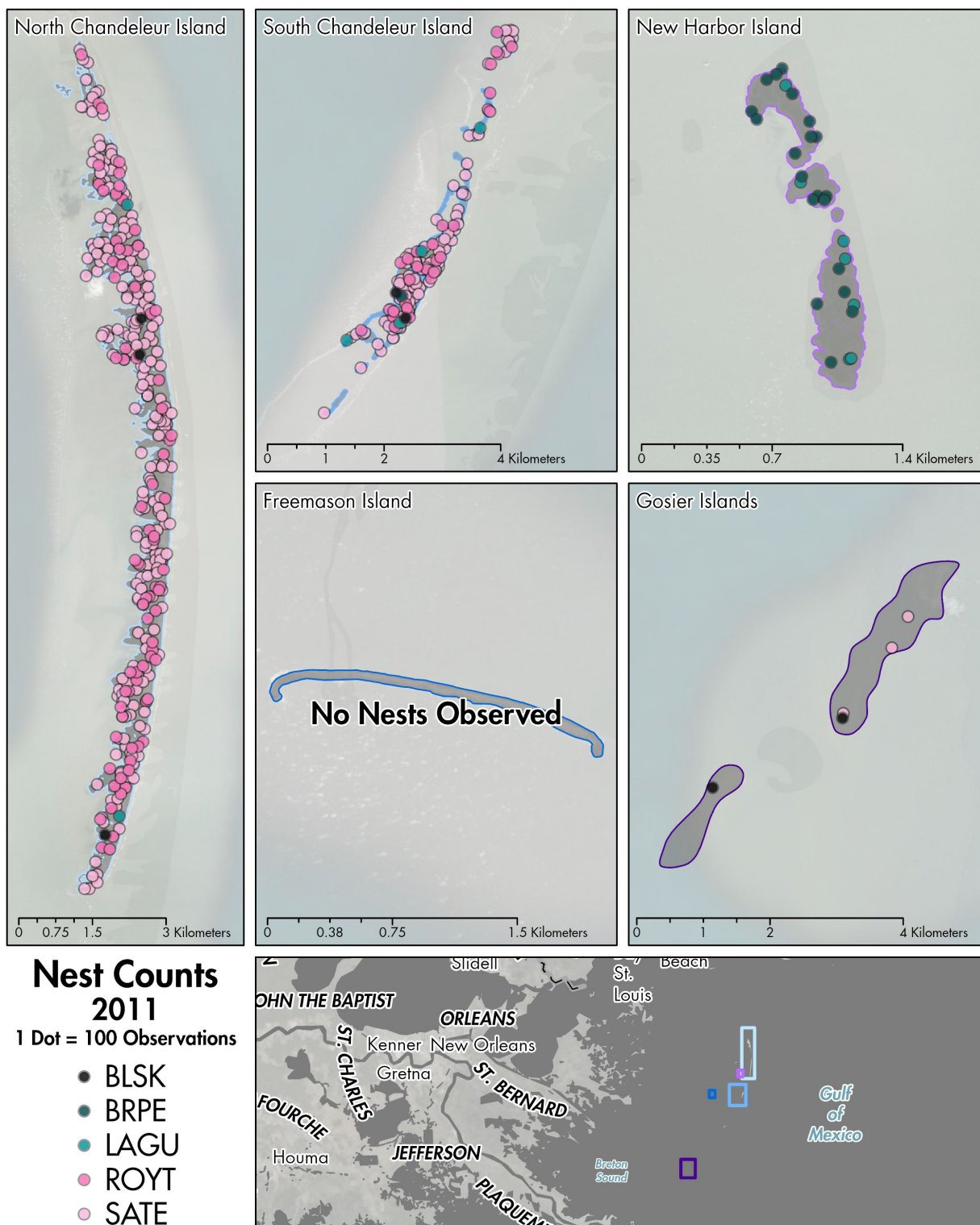


Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



Figure B-1. 2010 nest count density map.

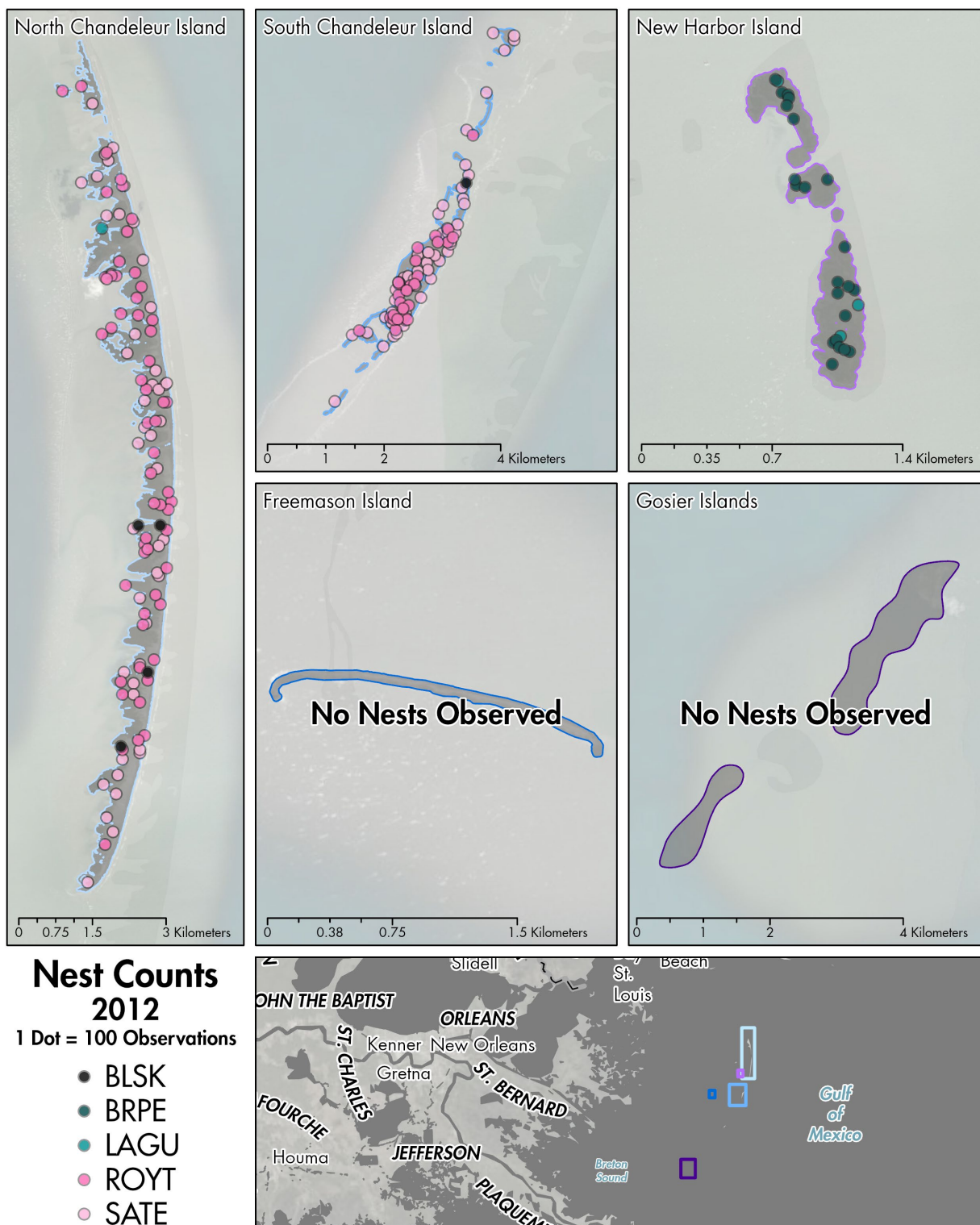




Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



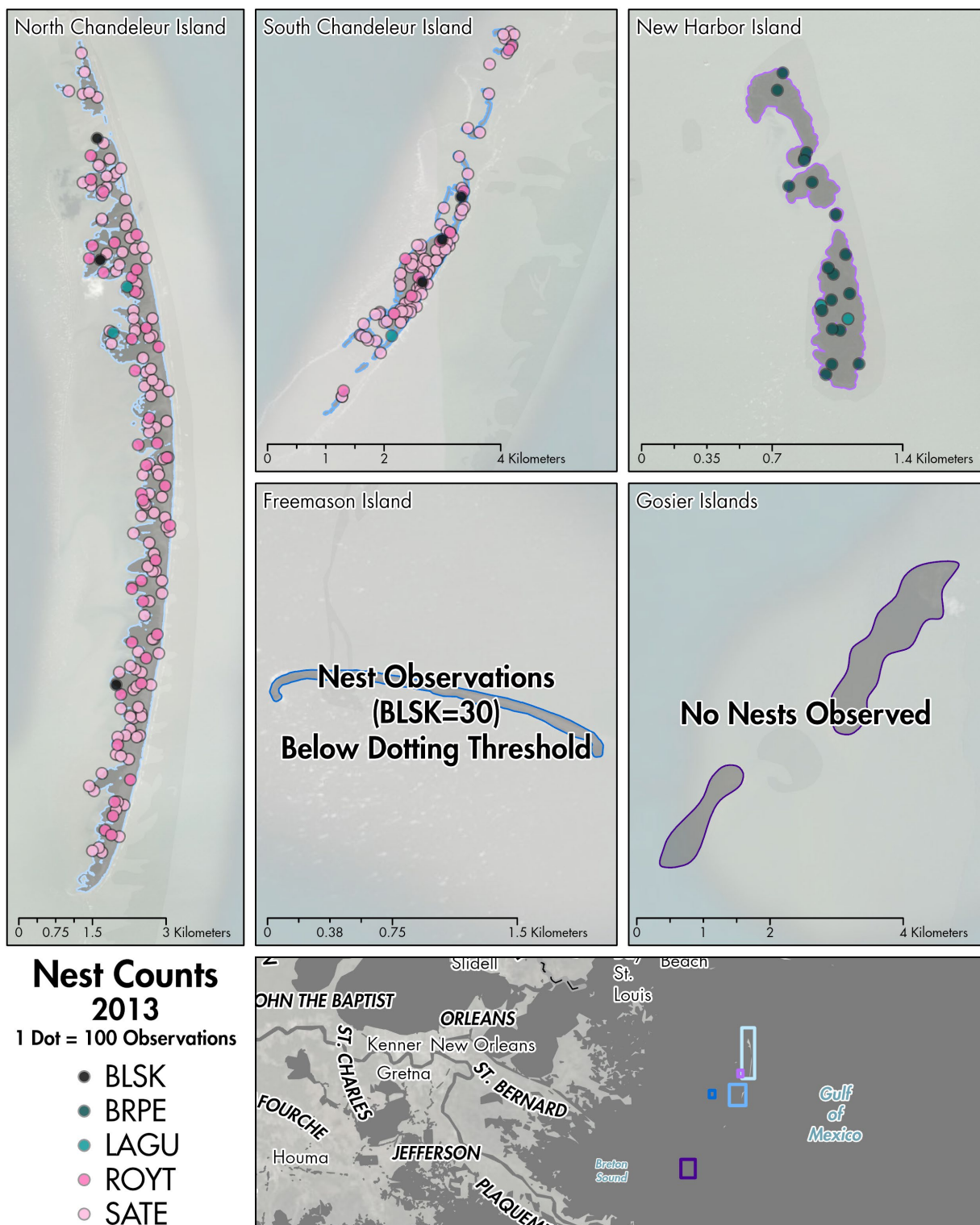
Figure B-2. 2011 nest count density map.



Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



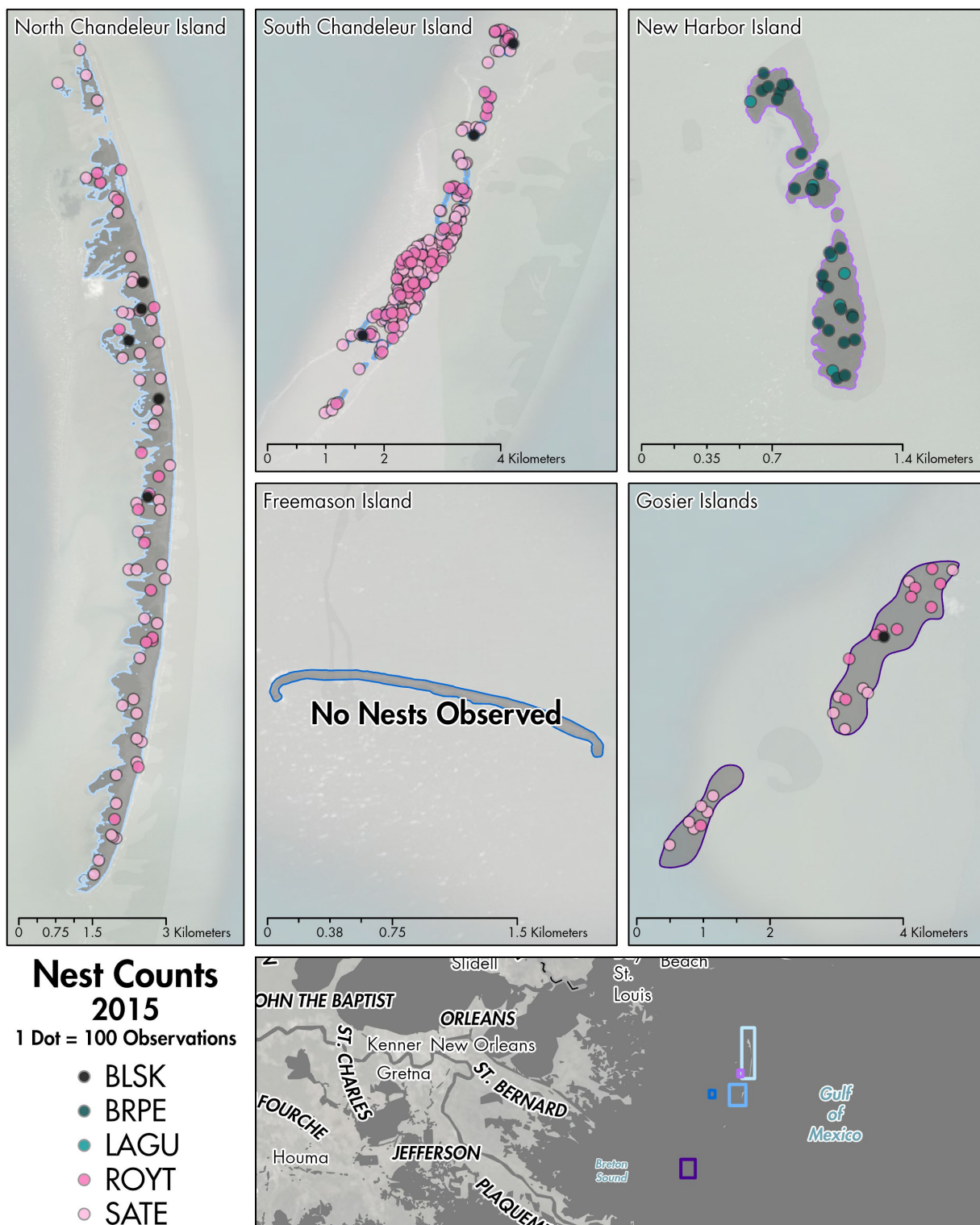
Figure B-3. 2012 nest count density map.



Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



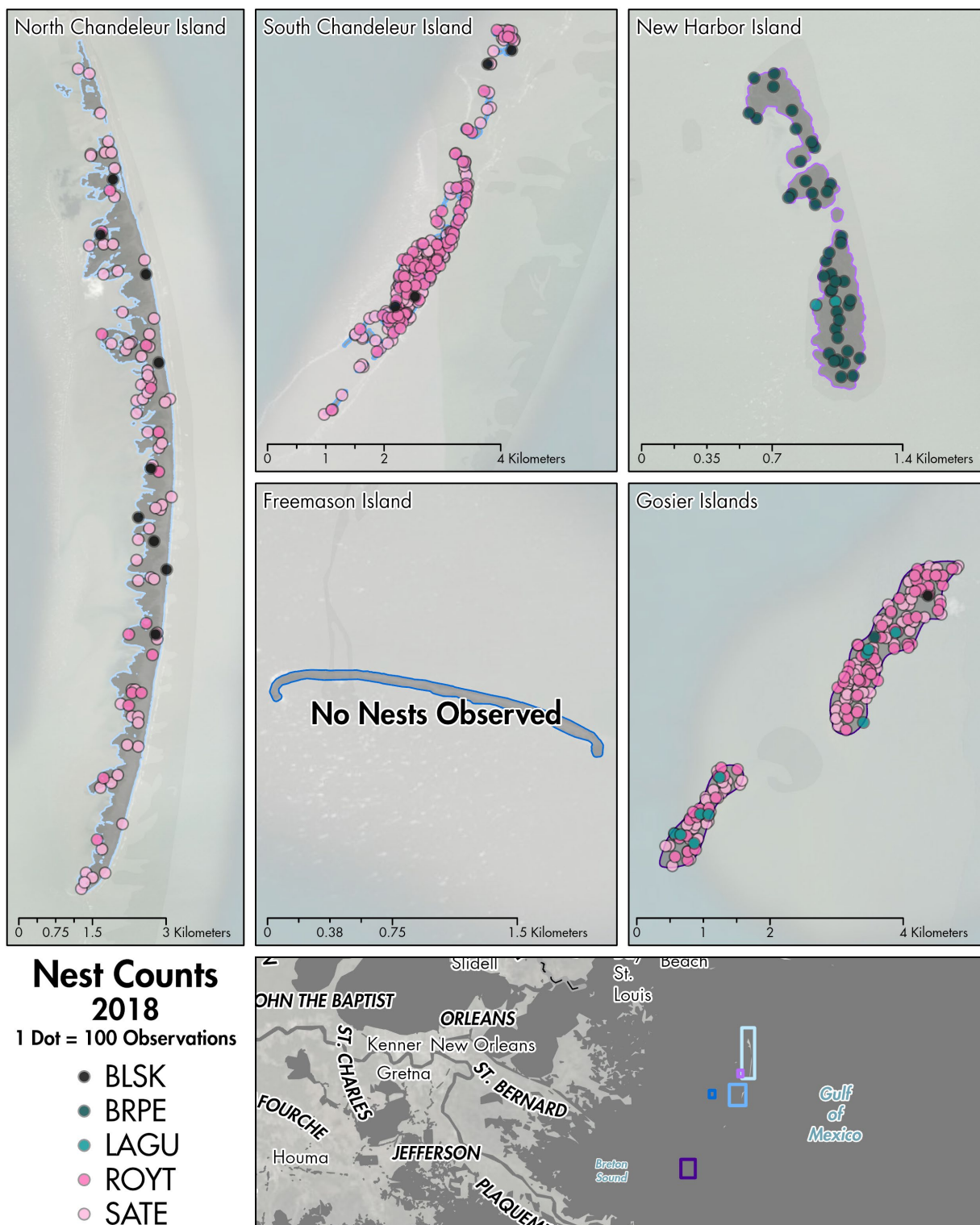
Figure B-4. 2013 nest count density map.



Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



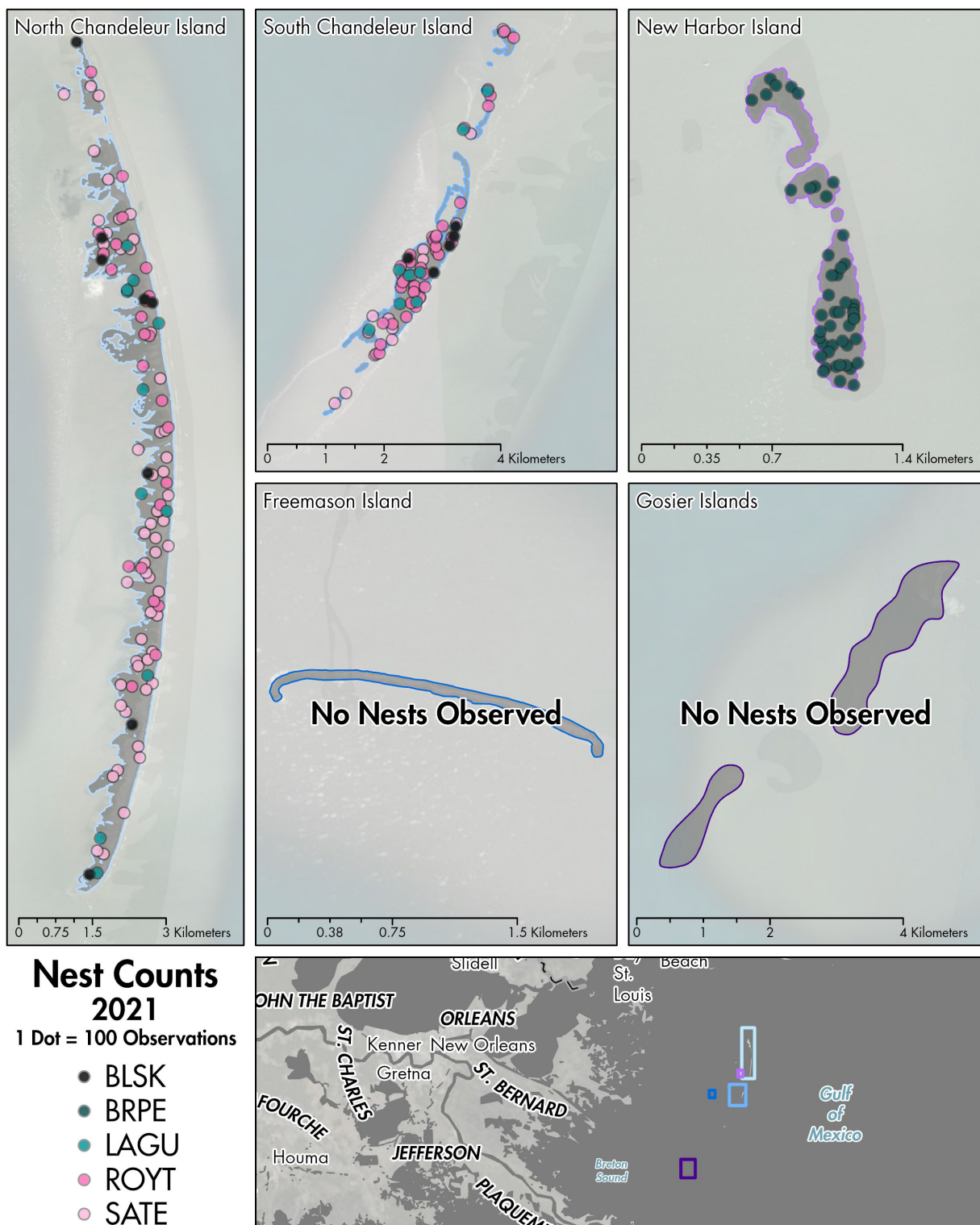
Figure B-5. 2015 nest count density map.



Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



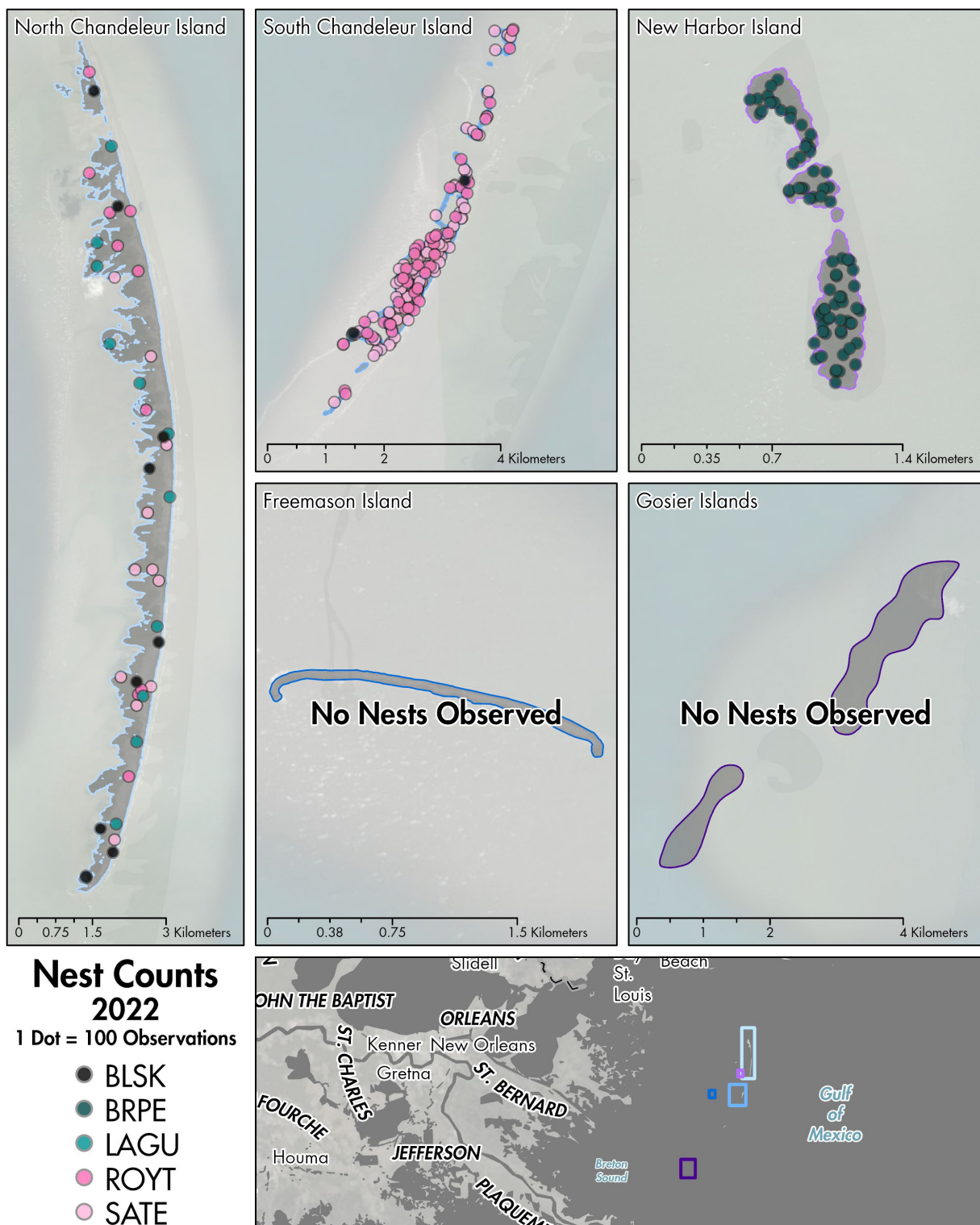
Figure B-6. 2018 nest count density map.



Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
Basemap Credits: Esri, Maxar, Earthstar Geographics



Figure B-7. 2021 nest count density map.



Data Source: Colibri Ecological Consulting LLC, The Water Institute, Louisiana Coastal Protection and Restoration Authority  
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Figure B-8. 2022 nest count density map.



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