Habitat Objectives for Priority Gulf Coast Joint Venture Shorebird Species
September 2022

A Product of the Gulf Coast Joint Venture Science Team's Shorebird Working Group

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The Gulf Coast Joint Venture (GCJV) employs the following suite of 8 shorebird species for conservation planning in the GCJV region (Figure 1):

Snowy Plover (*Charadrius nivosus*)
Wilson's Plover (*Charadrius wilsonia*)
Long-billed Curlew (*Numenius americanus*)
Hudsonian Godwit (*Limosa haemastica*)
Western Sandpiper (*Calidris mauri*)
Stilt Sandpiper (*Caladris himantopus*)
Buff-breasted Sandpiper (*Caladris subruficollis*)
Short-billed Dowitcher (*Limnodromus griseus*)

In 2012 the GCJV adopted population and habitat objectives for these species and co-occurring shorebirds using inland managed wetlands and grassland sites, such as rice fields, aquaculture ponds, and flooded pastures, during fall migration (Vermillion 2012). This document provides updates to those initial objectives and depicts for the first time objectives for inland wetlands and grasslands in spring and for additional habitats in fall and spring. Following are the habitat classes now included in GCJV shorebird planning (Figure 2):

- **Beach/Inlet** - maritime mainland and barrier island beaches, extending from the swash zone up to sparsely vegetated (approximately ≤20%) dune areas. This includes washover areas and shorelines of channels and inlets bisecting beach habitats, sand/shell bay shorelines, and sand/shell berms on smaller islands in maritime settings. Sediments in the beach/inlet habitat class are generally wave-deposited and regularly re-worked.
- **Coastal Marsh, Flats, & Reefs -** contiguous coastal emergent estuarine and palustrine marsh and embedded waterbodies, delta splays created where rivers and streams meet coastal bays (i.e., the Atchafalaya River delta), tidally or wind exposed flats in bay systems (i.e., the Laguna Madre of Texas), and tidally exposed oyster or other mollusk reefs. This includes delta splays created through natural or artificial breaches in river levees and areas of impounded coastal marsh regardless of hydrological regime. Except where impounded, this habitat is typically tidally influenced, though tidal amplitude effects may be minor in freshwater emergent marshes.
- **Inland Saturated Soil, Shallow Open Water, & Flooded Grassland -** typically found on active or idle crop or pasturelands, as well as temporarily and seasonally flooded palustrine emergent wetlands inland from contiguous coastal marshes. These habitats are not permanently flooded, but are subject to short-term inundation resulting from precipitation, or longer periods of flooding (up to several months) due to active water management (i.e., rice fields, aquaculture ponds, moist-soil units). Water depths suitable for shorebird use range from 0 (saturated soil) to approximately 6 inches.
- **Inland Dry Grasslands -** dominated by non-woody vegetation, primarily grasses, and found in the same agricultural and pasture zone as the above class but differ from flooded grasslands in that there is no standing surface water present.

Priority species that use each of the above habitat classes are identified, by season where applicable, as well as other species expected to compete for the same foraging resources in each habitat type (Appendix 1). As in the 2012 plan, energetic models were used to generate habitat objectives. Energetic model components are described below.

Population Estimates (Appendix 2) – A 2016 white paper from the U.S. Shorebird Conservation Plan (USSCP) partnership *Flyway Populations of USA/Canada Shorebirds* (available at https://www.shorebirdplan.org/science/assessment-conservation-status-shorebirds/) was the source for continental population estimates. The U.S. Fish and Wildlife Service's Shorebird Coordinator stepped those estimates down to the scale of the GCJV region, with subsequent amendments by the GCJV's Shorebird Working Group (SWG). The eBird ShorebirdViz tool (https://shorebirdviz.ebird.org/species/ameavo?week=1) (Sullivan et al. 2009) was used to estimate regional breeding populations for Killdeer and Long-billed Curlew. White, White-faced, and Glossy Ibis were identified as co-occurring with Hudsonian Godwit in inland saturated soil, open shallow water, and flooded grassland habitats during spring. Ibis population estimates were generated using a combination of survey data from Texas and Louisiana, the Southeast Waterbird Conservation Plan (Hunter et al. 2006), and eBird data (Sullivan et al. 2009).

Population Objectives (Appendix 3) **–** Fall and winter population objectives are a combination of adult population estimates for the GCJV portions of the BCRs described above, with the addition of two juveniles per pair, and a multiplier representing desired population growth that was developed through the USSCP partnership, based on each species' conservation status (see *Shorebirds of Conservation Concern in the United States of America 2016, available at* https://www.shorebirdplan.org/science/assessment-conservation-status-shorebirds/). Spring population objectives are the same as those for fall, except for an assumed 20% mortality from fall migration to the start of the spring migration period. Ibis population estimates were used as objectives.

> **Population Objectives Allocation –** We used 2018 eBird Spatiotemporal Exploratory Model (STEM) (https://science.ebird.org/en/status-and-trends/faq) (Fink et al. 2020) outputs summed across relevant time steps and clipped to relevant geographies to proportionally allocate population objectives to GCJV Initiative Areas for fall and spring (Figure 1 and Appendix 4).
>
> We further used STEM outputs, summed across relevant time steps and clipped to spatial layers depicting shorebird habitat classes (Figure 3) to apportion relative habitat use by class within Initiative Areas (Appendix 5). Where applicable, percent inland dry grassland habitat use by species was estimated using SWG expert opinion.

Figure 1: Gulf Coast Joint Venture Region and Initiative Areas

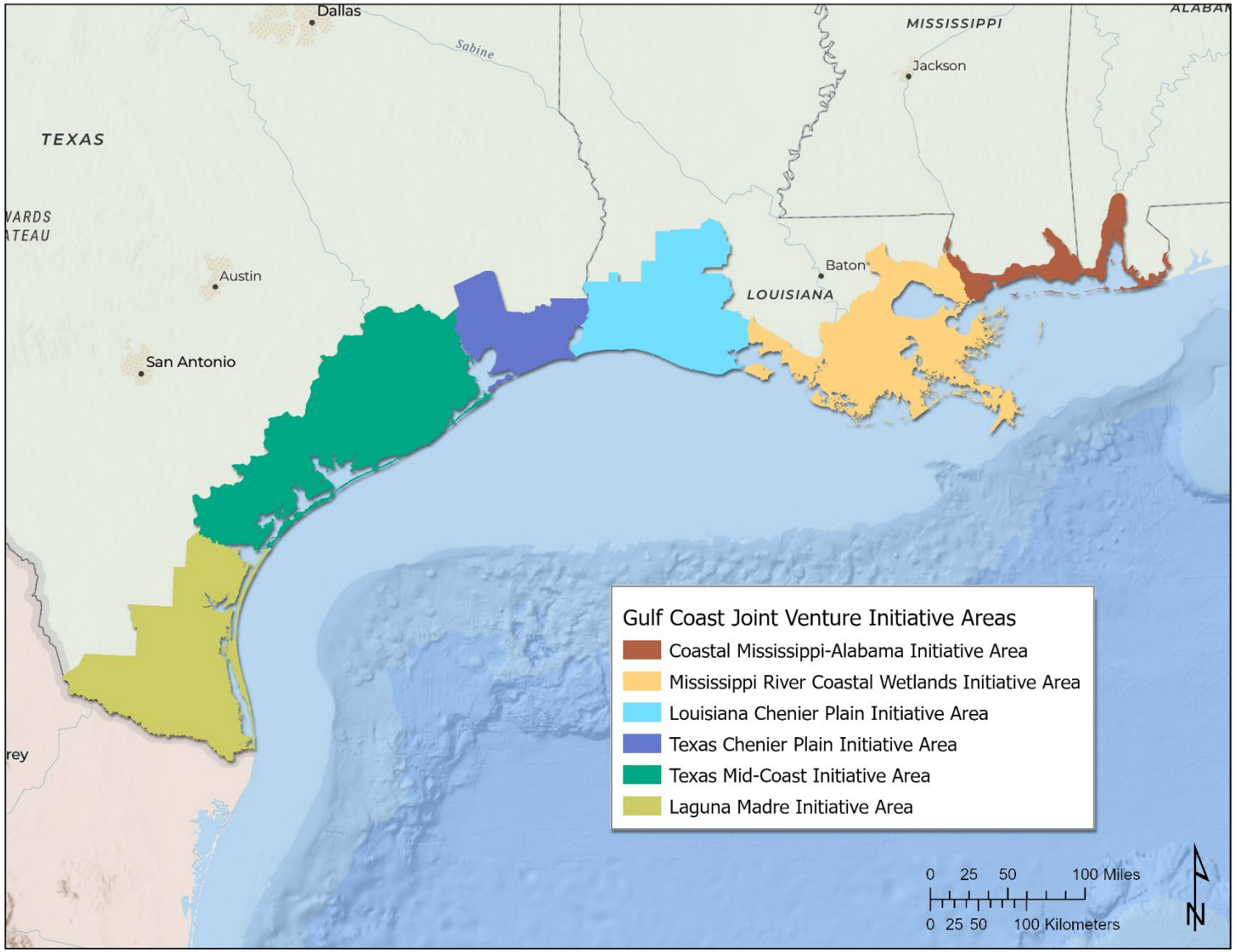
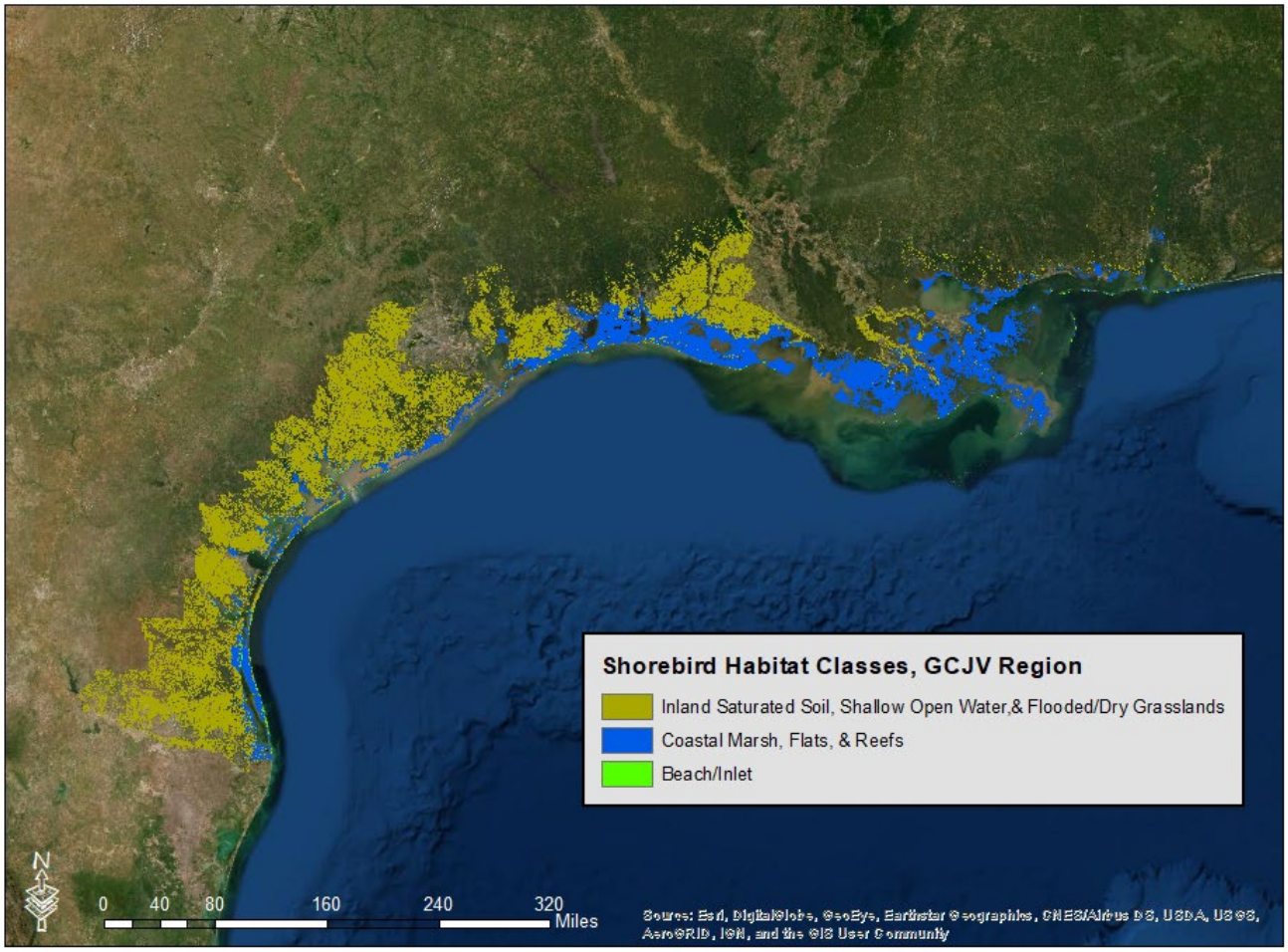


Figure 2: Gulf Coast Joint Venture Shorebird Habitats



Habitat Objectives (Table 1) **–** Habitat objectives were estimated for each species, habitat type, and season at the Initiative Area scale. Because Marsh, Flats, & Reefs, and Beach/Inlet habitat classes do not exhibit strong seasonal variation in availability, we chose to depict only the season for which the habitat objective was greatest (i.e., fall). Because the availability of Inland Saturated Soil, Shallow Open Water, & Flooded Grasslands habitats vary substantially across seasons, and because Hudsonian Godwit only migrates through the GCJV region in spring, we depict objectives for both seasons.

Components utilized for derivation of habitat objectives were shorebird energy days, species-specific energy requirements, macroinvertebrate prey energy content and assimilation factors, and estimated prey density by habitat type.

Shorebird Energy Days – For most species, stopover duration of 10 days was assumed for fall and spring migrants, based on review of Lehnen and Krementz (2005) and Henkel and Taylor (2015). Stopover duration of 42 days was used for Dunlin (as in Vermillion 2012, and similar to Henkel and Taylor 2015). A 109-day residency was used for over-wintering birds in fall energetic models, corresponding to the length of days in the International Shorebird Survey's (ISS) fall migration period for the southern United States (https://www.manomet.org/wp-content/uploads/2018/03/ISS-Protocols_April2019.pdf). For the spring inland saturated soil, open shallow water, and flooded grassland model, an 83-day residency was used for locally breeding species, corresponding to the ISS spring migration period for the southern United States.

Energy Requirements - – From Kersten and Piersma (1987), the amount of energy in kilojoules (kJ) required to maintain a shorebird's resting metabolic rate (RMR) is expressed by:

$$\mathbf{RMR\ (kJ) = 437\ (Body\ Mass\ (kg))^{0.729}}$$

Shorebird weights for the calculation of RMR came from Sibley (2000). Additional energy is required for daily activities such as flight and for thermoregulation (i.e., field metabolic rate, FMR). Kersten and Piersma (1987) estimated FMR as follows:

$$\mathbf{FMR\ (kJ) = RMR\ x\ 3}$$

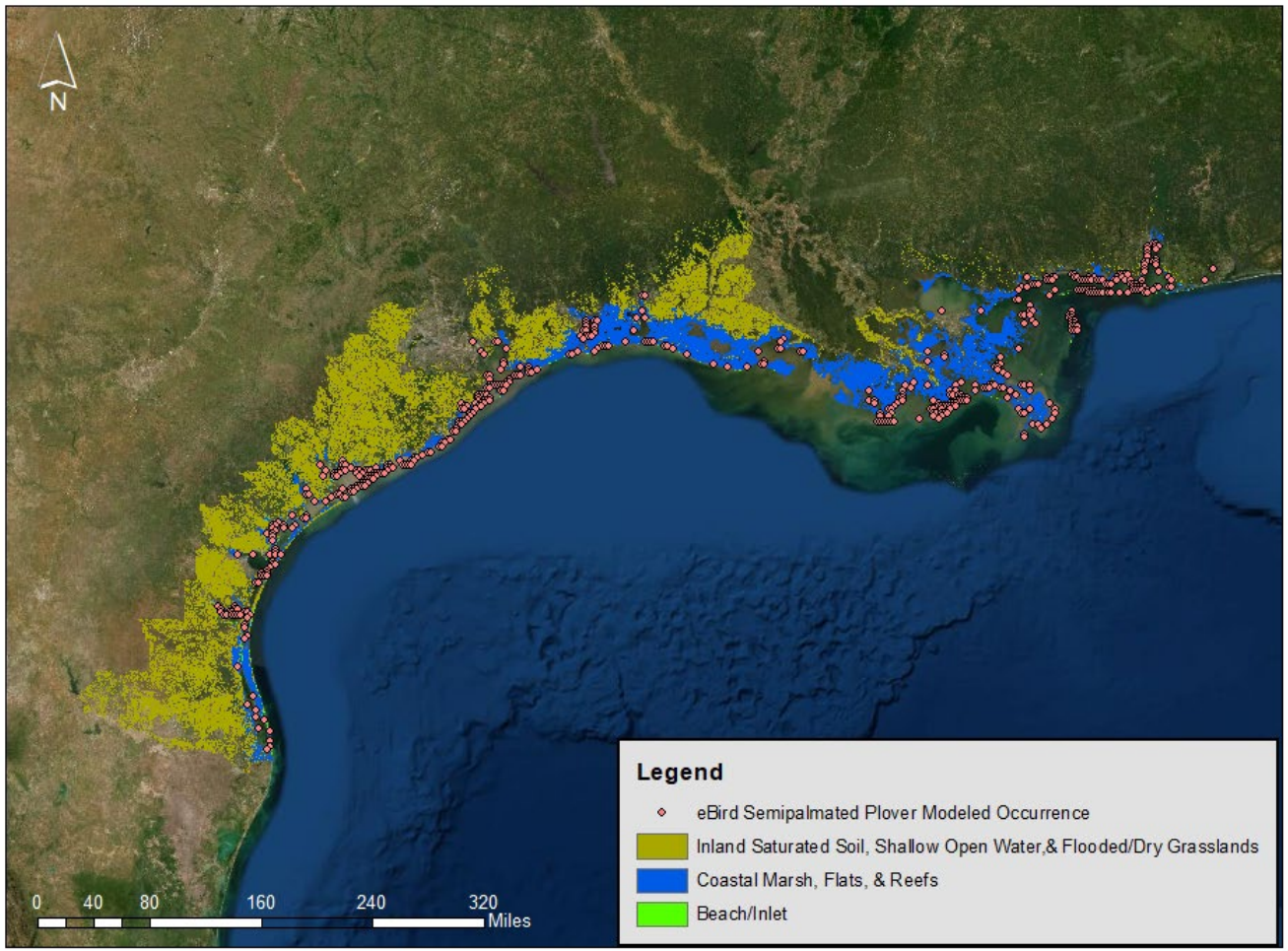
Macroinvertebrates were used as representative shorebird food items in the energetic models. Cummins and Wuycheck (1977) calculated the energy yield from terrestrial macroinvertebrates as 23.8 kJ g^{-1}. We used 73% average assimilation efficiency of birds feeding on macroinvertebrates (Castro et. al. 1989). Therefore, the net energy content (NEC) that birds can derive from macroinvertebrates is:

$$\mathbf{23.8\ kJ\ g^{-1}\ x\ 0.73 = 17.374\ kJ\ g_{dw}^{-1}}\ (\text{dw} = \text{dry weight}).$$

Dry weight of required macroinvertebrates is thus calculated as follows:

$$\mathbf{(FMR)d^{-1}\ x\ (17.374\ kJ\ g_{dw}^{-1})^{-1}}.$$

Figure 3: eBird STEM Semipalmated Plover Modeled Occurrence in the GCJV Region



In addition to maintaining FMR, migrant shorebirds must increase their mass by approximately 1 g per day to build reserves for migration (Loesch et al. 2000). Given above assimilation efficiency, approximately 2 g of macroinvertebrates are required to increase a shorebird's weight by 1 g. Ibis energetic needs were derived from Kushlan (1977).

Prey Density – A macroinvertebrate prey density of 2 $g_{dw}\,m^{-2}$ was used in the inland saturated soil, open shallow water, and flooded grassland energetic models (Augustin et al. 1999). A density of 1.18 $g_{dw}\,m^{-2}$ was used in the beach/inlet energetic models (McLelland 2013), and 1.27 $g_{dw}\,m^{-2}$ was used for the marsh, flats, and reefs energetic models (Weber and Haig 1996).

Table 1. Shorebird habitat objectives (acres) by habitat class, GCJV Initiative Area, and season

	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi – Alabama	GCJV Total
Fall Beach/Inlet	11,705	13,295	2,676	2,633	8,172	5,545	**44,025**
Fall Marsh, Flats, & Reefs	20,984	22,168	5,926	6,266	23,634	3,918	**82,895**
Fall Inland Saturated Soil, Shallow Open Water, & Flooded Grassland	12,622	43,905	5,668	70,896	12,426	1,101	**146,619**
Spring Inland Saturated Soil, Shallow Open Water, & Flooded Grassland	7,179	51,434	10,911	47,347	10,718	1,046	**128,635**

The habitat objectives depicted above are for foraging habitat available to shorebirds during a sufficient portion of a typical day to meet their foraging needs. Consequently, for tracking habitat status relative to habitat objectives it is necessary to estimate the average proportion of each broad habitat class that is typically available to foraging shorebirds. For example, 1) all or portions of some coastal marsh ponds may consistently be too deep for daily shorebird foraging, even with daily tidal variation, 2) all or portions of some flooded agricultural fields or crawfish

aquaculture ponds may be too deep or too heavily vegetated to enable shorebird foraging, and 3) some portions of beaches and inlets may be too consistently high and free from tidal exchange to provide suitable foraging substrate. Table 2 depicts current estimates of habitat availability for shorebird foraging within habitat classes that can be mapped and assessed.

Table 2: Shorebird Foraging Habitat Availability Estimations

Habitat		**% Available for Foraging**	**Source of Estimate**
Beaches and Inlets		50%	SWG
Marsh Ponds, Flats, and Reefs	Marsh Ponds	5%	SWG
	Flats and Reefs	50%	SWG
Inland Saturated Soil, Shallow Open Water, and Flooded Grasslands	Saturated Soil	100%	SWG
	Shallow Open Water	49-71% (varies by GCJV Initiative Area)	2010 GCJV Field Assessment
	Flooded Grasslands	5-6% (varies by GCJV Initiative Area)	2010 GCJV Field Assessment

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Literature Cited

Castro, G., N. Stoyan, and J.P. Myers. 1989. Assimilation efficiencies in birds: a function of taxon or food type? Comp. Biochem. Physiol. 92:271-278.

Cummins, K. W., and J. C. Wuycheck. 1971. Caloric equivalents for investigations in ecological energetics. Mitteilungen Internationale Verenin. Limnological No. 18, Stuttgart, Germany. 145 pp.

Fink, D., T. Auer, A. Johnston, V. Ruiz-Gutierrez, W.M. Hochachka, and S. Kelling. 2020. Modeling avian full annual cycle distribution and population trends with citizen science data. Ecological Applications 30:e02056.

Henkel, J.R., and C.M. Taylor. 2015. Migration strategy predicts stopover ecology in shorebirds on the northern Gulf of Mexico. Animal Migration 2:63-75.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States regional waterbird conservation plan. https://static1.squarespace.com/static/5bb3865d2727be6f94acf2fc/t/5c79a2efe5e5f0214c34c48c/1551475442564/SE_US_Waterb_Plan_2006.pdf

Kersten, M., and T. Piersma. 1987. High levels of energy expenditure in shorebirds: metabolic adaptations to an energetically expensive way of life. Ardea 75:175-187.

Kushlan, J.A. 1977. Population energetics of the American white ibis. Auk 94:114-122.

Lehnen, S. E. and D. G. Krementz. 2005. Turnover rates of fall-migrating pectoral sandpipers through the Lower Mississippi Alluvial Valley. The Journal of Wildlife Management 69(2):671–680.

Loesch, C.R., D.J. Twedt, K. Tripp, W.C. Hunter, and M.S. Woodrey. 2000. Development of management objectives for waterfowl and shorebirds in the Mississippi alluvial valley. Pages 8-11 in Strategies for bird conservation: the Partners in Flight planning process (R.Bonney, D.N. Pashley, R.J. Cooper, and L. Niles, Editors). Proceedings of the 3rd Partners in Flight Workshop, 1-5 October 1995, Cape May, New Jersey.

McClelland, J.A. 2013. Caminada headland beach and dune restoration project (BA-45) – pre-construction benthic organism survey. Unpublished report. Louisiana Universities Marine Consortium and the Barataria-Terrebonne National Estuary Program.

Sullivan, B.L., C.L. Wood, M.J. Iliff, R.E. Bonney, D. Fink, and S. Kelling. 2009. eBird: a citizen-based bird observation network in the biological sciences. Biological Conservation 142:2282-2292.

Vermillion, W.G. 2012. Fall habitat objectives for priority Gulf Coast Joint Venture shorebird species using managed wetlands and grasslands, version 4.0. Gulf Coast Joint Venture, Lafayette, LA. 31 pp.

Weber, L.M., and S.M. Haig. 1996. Shorebird use of South Carolina managed and natural coastal wetlands. The Journal of Wildlife Management 60(1):73-82.

Appendix 1: Priority and Other Species Included in Habitat-Specific Energetic Models

Species (Priorities in Bold)	Habitat		
	Beach/Inlet	**Marsh (including Impounded), Flats, & Reefs**	**Inland Saturated Soil, Open Shallow Water, Flooded & Dry Grasslands**
Black-necked Stilt (*Himantopus mexicanus*)			X
American Avocet (*Recurvirostra americana*)			X
American Oystercatcher (*Haematopus palliatus*)		X	
Black-bellied Plover (*Pluvialis squatarola*)	X		X
American Golden-Plover[1] (*Pluvialis dominica*)			X
Killdeer (*Charadrius vociferus*)			X
Semipalmated Plover (*Charadrius semipalmatus*)		X	X
Piping Plover (*Charadrius melodus*)	X	X	
Wilson's Plover (*Charadrius wilsonia*)	X	X	
Snowy Plover (*Charadrius nivosus*)	X	X	
Upland Sandpiper (*Bartramia longicauda*)			X
Whimbrel[1] (*Numenius phaeopus*)		X	X
Long-billed Curlew (*Numenius americanus*)	X	X	X
Hudsonian Godwit[1] (*Limosa haemastica*)			X
Marbled Godwit[1] (*Limosa fedoa*)		X	X
Ruddy Turnstone (*Arenaria interpres*)	X		
Red Knot (*Calidris canutus*)	X		
Stilt Sandpiper (*Calidris himantopus*)		X	X
Sanderling (*Calidris alba*)	X	X	
Dunlin (*Calidris alpina*)	X	X	X
Baird's Sandpiper (*Calidris bairdii*)	X		X
Least Sandpiper (*Calidris minutilla*)	X	X	X
White-rumped Sandpiper[1] (*Calidris fuscicollis*)			X
Buff-breasted Sandpiper (*Calidris subruficollis*)	X		X

Species (Priorities in Bold)	Habitat		
	Beach/Inlet	**Marsh (including Impounded), Flats, & Reefs**	**Inland Saturated Soil, Open Shallow Water, Flooded & Dry Grasslands**
Pectoral Sandpiper (*Calidris melanotos*)			X
Semipalmated Sandpiper (*Calidris pusilla*)		X	X
Western Sandpiper (*Caladris mauri*)	X	X	X
Short-billed Dowitcher (*Limnodromus griseus*)	X	X	X
Long-billed Dowitcher (*Limnodromus scolopaceus*)		X	X
Greater Yellowlegs (*Tringa melanoleuca*)		X	X
Willet (*Tringa semipalmata*)	X	X	
Lesser Yellowlegs (*Tringa flavipes*)		X	X
Wilson's Phalarope (*Phalaropus tricolor*)		X	X
White-faced Ibis[1] (*Plegadis chihi*)			X
Glossy Ibis[1] (*Plegadis falcinellus*)			X
White Ibis[1] (*Eudocimus albus*)			X

[1]Spring only

Appendix 2: North American and Gulf Coast Joint Venture Region Shorebird and Ibis Population Estimates (Individuals)

Species	North American Estimate	GCJV Fall Estimate	GCJV Winter Estimate	GCJV Spring Estimate	GCJV Breeding Estimate
Black-necked Stilt	175,000	10,000	5,000	10,000	8,000
American Avocet	460,000	26,000	26,000	26,000	5,000
American Oystercatcher	12,700	550	550	550	520
Black-bellied Plover	418,000	117,500	8,000	117,500	0
American Golden-Plover	500,000	0	0	225,000	0
Killdeer	2,000,000	80,000	50,000	80,000	30,000
Semipalmated Plover	200,000	30,000	1,500	30,000	0
Piping Plover	8,400	2,897	2,883	2,897	0
Wilson's Plover	8,600	3,200	100	3,200	3,200
Snowy Plover	25,800	6,000	6,000	6,000	3,400
Upland Sandpiper	750,000	562,500	0	562,500	0
Whimbrel	80,000	3,000	250	15,000	0
Long-billed Curlew	140,000	67,400	7,500	67,400	700
Hudsonian Godwit	77,000	0	0	28,000	0
Marbled Godwit	174,000	15,000	2,000	15,000	0
Ruddy Turnstone	245,000	15,000	1,500	15,000	0
Red Knot	139,000	7,000	1,000	7,000	0
Stilt Sandpiper	823,000	475,000	5,000	489,000	0
Sanderling	300,000	25,000	10,000	25,000	0
Dunlin	1,550,000	80,000	60,000	80,000	0
Baird's Sandpiper	300,000	30,000	0	30,000	0
Least Sandpiper	700,000	280,000	40,000	280,000	0

Species	North American Estimate	GCJV Fall Estimate	GCJV Winter Estimate	GCJV Spring Estimate	GCJV Breeding Estimate
White-rumped Sandpiper	1,690,000	0	0	845,000	0
Buff-breasted Sandpiper	56,000	40,000	0	40,000	0
Pectoral Sandpiper	1,600,000	576,000	0	576,000	0
Semipalmated Sandpiper	2,500,000	675,000	0	675,000	0
Western Sandpiper	3,500,000	130,000	65,000	130,000	0
Short-billed Dowitcher	153,000	26,600	8,000	26,600	0
Long-billed Dowitcher	965,000	280,000	60,000	280,000	0
Greater Yellowlegs	137,000	50,000	6,000	50,000	0
Willet	335,000	73,000	15,000	73,000	58,000
Lesser Yellowlegs	400,000	148,000	5,000	148,000	0
Wilson's Phalarope	1,080,000	108,000	0	108,000	0
White-faced Ibis	NA	NA	NA	56,000	56,000
Glossy Ibis	NA	NA	NA	400	400
White Ibis	NA	NA	NA	98,000	98,000

Appendix 3: Population Objectives (Individuals)

Species	GCJV Fall Objective	GCJV Fall to Winter Objective	GCJV Spring Objective	GCJV Breeding Objective
Black-necked Stilt	20,000	10,000	16,000	12,800
American Avocet	54,600	54,600	43,680	8,400
American Oystercatcher	1,375	1,375	1,100	1,040
Black-bellied Plover	246,750	16,800	197,400	0
American Golden-Plover	0	0	414,000	0
Killdeer	168,000	105,000	134,400	50,400
Semipalmated Plover	60,000	3,000	48,000	0
Piping Plover	6,373	6,343	5,099	0
Wilson's Plover	8,000	250	6,400	6,400
Snowy Plover	15,000	15,000	12,000	6,800
Upland Sandpiper	1,125,000	0	900,000	0
Whimbrel	6,900	575	27,600	0
Long-billed Curlew	155,020	17,250	124,016	1,288
Hudsonian Godwit	0	0	51,520	0
Marbled Godwit	34,500	4,600	27,600	0
Ruddy Turnstone	34,500	3,450	27,600	0
Red Knot	15,400	2,200	12,320	0
Stilt Sandpiper	950,000	10,000	782,400	0
Sanderling	52,500	21,000	42,000	0
Dunlin	184,000	138,000	147,200	0
Baird's Sandpiper[1]	30,000	0	48,000	0
Least Sandpiper	560,000	80,000	448,000	0
White-rumped Sandpiper	0	0	1,352,000	0
Buff-breasted Sandpiper	92,000	0	73,600	0
Pectoral Sandpiper	1,324,800	0	1,059,840	0

Species	GCJV Fall Objective	GCJV Fall to Winter Objective	GCJV Spring Objective	GCJV Breeding Objective
Semipalmated Sandpiper	1,552,500	0	1,242,000	0
Western Sandpiper	273,000	136,500	218,400	0
Short-billed Dowitcher	61,180	18,400	48,944	0
Long-billed Dowitcher	588,000	126,000	470,400	0
Greater Yellowlegs	100,000	12,000	80,000	0
Willet	167,900	34,500	134,320	106,720
Lesser Yellowlegs	340,400	11,500	272,320	0
Wilson's Phalarope	216,000	0	172,800	0

Appendix 4: eBird-based Relative Abundance Proportions by Initiative Area and Season

Species	Season	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi-Alabama
Black-necked Stilt	Fall	6%	15%	7%	50%	20%	2%
Black-necked Stilt	Winter	7%	19%	10%	40%	23%	1%
Black-necked Stilt	Spring	9%	32%	12%	35%	11%	1%
Black-necked Stilt	Breeding	7%	19%	10%	40%	23%	1%
American Avocet	Fall	12%	43%	13%	26%	5%	1%
American Avocet	Winter	13%	47%	19%	19%	2%	0%
American Avocet	Spring	6%	50%	19%	23%	2%	0%
American Avocet	Breeding	13%	47%	19%	19%	2%	0%
American Oystercatcher	Fall	10%	25%	4%	1%	44%	15%
American Oystercatcher	Winter	14%	56%	8%	1%	12%	9%
American Oystercatcher	Spring	15%	42%	4%	2%	29%	9%
American Oystercatcher	Breeding	14%	56%	8%	1%	12%	9%
Black-bellied Plover	Fall	10%	15%	4%	19%	42%	8%
Black-bellied Plover	Winter	26%	35%	7%	8%	18%	5%
Black-bellied Plover	Spring	15%	26%	7%	18%	28%	6%
American Golden-Plover	Spring	10%	76%	4%	10%	1%	0%

Species	Season	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi-Alabama
Killdeer	Fall	5%	33%	7%	27%	20%	8%
Killdeer	Winter	6%	26%	6%	33%	23%	7%
Killdeer	Spring	6%	37%	9%	29%	15%	4%
Killdeer	Breeding	6%	26%	6%	33%	23%	7%
Semipalmated Plover	Fall	3%	12%	3%	13%	57%	13%
Semipalmated Plover	Winter	8%	27%	7%	5%	39%	13%
Semipalmated Plover	Spring	5%	20%	8%	30%	28%	9%
Piping Plover	Fall	21%	24%	5%	5%	38%	7%
Piping Plover	Winter	11%	22%	6%	5%	43%	12%
Piping Plover	Spring	8%	26%	6%	6%	41%	14%
Wilson's Plover	Fall	14%	15%	3%	4%	53%	10%
Wilson's Plover	Winter	3%	12%	3%	1%	73%	7%
Wilson's Plover	Spring	9%	13%	4%	9%	57%	8%
Wilson's Plover	Breeding	3%	12%	3%	1%	73%	7%
Snowy Plover	Fall	23%	45%	8%	7%	8%	9%
Snowy Plover	Winter	23%	51%	10%	6%	6%	4%
Snowy Plover	Spring	29%	43%	9%	4%	2%	13%
Snowy Plover	Breeding	23%	51%	10%	6%	6%	4%
Upland Sandpiper	Fall	17%	77%	3%	3%	0%	0%
Upland Sandpiper	Spring	12%	76%	5%	6%	1%	0%

Species	Season	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi-Alabama
Whimbrel	Fall	3%	11%	4%	2%	64%	17%
Whimbrel	Winter	17%	71%	11%	1%	0%	0%
Whimbrel	Spring	2%	13%	44%	36%	5%	0%
Long-billed Curlew	Fall	71%	27%	1%	1%	0%	0%
Long-billed Curlew	Winter	50%	46%	2%	1%	0%	0%
Long-billed Curlew	Spring	50%	45%	4%	1%	)%	0%
Long-billed Curlew	Breeding	50%	46%	2%	1%	0%	0%
Hudsonian Godwit	Spring	12%	81%	3%	3%	0%	0%
Marbled Godwit	Fall	17%	45%	10%	2%	22%	3%
Marbled Godwit	Winter	17%	57%	13%	4%	8%	1%
Marbled Godwit	Spring	15%	64%	16%	2%	2%	1%
Ruddy Turnstone	Fall	23%	24%	4%	5%	33%	10%
Ruddy Turnstone	Winter	30%	38%	7%	4%	15%	5%
Ruddy Turnstone	Spring	22%	29%	7%	10%	25%	7%
Red Knot	Fall	46%	25%	3%	0%	20%	7%
Red Knot	Winter	13%	19%	3%	0%	57%	8%
Red Knot	Spring	13%	20%	4%	0%	49%	14%

Species	Season	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi-Alabama
Stilt Sandpiper	Fall	6%	14%	4%	66%	10%	0%
Stilt Sandpiper	Winter	19%	20%	9%	50%	3%	0%
Stilt Sandpiper	Spring	4%	23%	10%	58%	5%	0%
Sanderling	Fall	16%	17%	5%	6%	41%	15%
Sanderling	Winter	26%	28%	8%	8%	20%	9%
Sanderling	Spring	18%	24%	6%	8%	32%	13%
Dunlin	Fall	10%	24%	3%	30%	27%	6%
Dunlin	Spring	5%	15%	4%	30%	37%	9%
Baird's Sandpiper	Fall	13%	65%	15%	7%	0%	0%
Baird's Sandpiper	Spring	10%	76%	9%	4%	0%	0%
Least Sandpiper	Fall	6%	20%	4%	47%	21%	2%
Least Sandpiper	Winter	18%	41%	7%	22%	11%	2%
Least Sandpiper	Spring	10%	36%	7%	32%	12%	2%
White-rumped Sandpiper	Spring	6%	48%	13%	28%	5%	0%
Buff-breasted Sandpiper	Fall	13%	82%	2%	3%	0%	0%
Buff-breasted Sandpiper	Spring	4%	90%	3%	3%	0%	0%
Pectoral Sandpiper	Fall	0%	12%	3%	69%	14%	2%

Species	Season	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi-Alabama
Pectoral Sandpiper	Spring	6%	51%	9%	29%	5%	0%
Semipalmated Sandpiper	Fall	1%	5%	1%	46%	33%	14%
Semipalmated Sandpiper	Spring	2%	17%	8%	50%	18%	5%
Western Sandpiper	Fall	6%	11%	2%	19%	49%	12%
Western Sandpiper	Winter	28%	24%	4%	16%	24%	4%
Western Sandpiper	Spring	6%	13%	3%	18%	50%	11%
Short-billed Dowitcher	Fall	4%	7%	3%	23%	51%	11%
Short-billed Dowitcher	Winter	5%	24%	5%	2%	48%	15%
Short-billed Dowitcher	Spring	1%	8%	5%	19%	55%	12%
Long-billed Dowitcher	Fall	2%	25%	6%	61%	5%	0%
Long-billed Dowitcher	Winter	4%	37%	9%	43%	7%	0%
Long-billed Dowitcher	Spring	3%	33%	11%	49%	5%	0%
Greater Yellowlegs	Fall	8%	31%	7%	35%	16%	3%
Greater Yellowlegs	Winter	10%	35%	7%	31%	15%	2%
Greater Yellowlegs	Spring	7%	33%	7%	37%	14%	2%
Willet	Fall	24%	22%	5%	8%	32%	9%
Willet	Winter	41%	33%	7%	6%	9%	4%

Species	Season	Laguna Madre	Texas Mid-Coast	Texas Chenier Plain	Louisiana Chenier Plain	Mississippi River Coastal Wetlands	Coastal Mississippi-Alabama
Willet	Spring	22%	26%	11%	20%	17%	4%
Willet	Breeding	41%	33%	7%	6%	9%	4%
Lesser Yellowlegs	Fall	2%	12%	5%	62%	17%	2%
Lesser Yellowlegs	Winter	7%	23%	7%	49%	13%	1%
Lesser Yellowlegs	Spring	4%	24%	7%	48%	15%	2%
Wilson's Phalarope	Fall	39%	33%	4%	21%	3%	0%
Wilson's Phalarope	Spring	14%	57%	10%	18%	0%	0%
White-faced Ibis	Spring	4%	35%	9%	42%	10%	0%
Glossy Ibis	Spring	0%	17%	20%	46%	13%	4%
White Ibis	Spring	5%	24%	10%	34%	24%	3%

Appendix 5: eBird-based Relative Abundance Proportions by GCJV Shorebird Habitat Categories

Species	Season	Initiative Area																	
		Laguna Madre			Texas Mid-Coast			Texas Chenier Plain			Louisiana Chenier Plain			Mississippi River Coastal Wetlands			Coastal Mississippi-Alabama		
		Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland
Black-necked Stilt	Fall	9%	33%	59%	7%	26%	68%	2%	47%	52%	0%	23%	77%	1%	57%	42%	16%	65%	20%
Black-necked Stilt	Spring	14%	35%	50%	9%	27%	64%	3%	48%	49%	2%	50%	49%	3%	74%	23%	17%	74%	9%
American Avocet	Fall	9%	66%	25%	13%	45%	41%	16%	80%	5%	9%	13%	79%	16%	62%	22%	35%	64%	0%
American Avocet	Spring	15%	72%	13%	27%	61%	12%	19%	78%	4%	22%	66%	12%	30%	65%	4%	31%	69%	0%
American Oystercatcher	Fall	52%	42%	6%	37%	45%	18%	38%	53%	8%	72%	23%	5%	38%	62%	0%	68%	32%	0%
American Oystercatcher	Spring	61%	35%	4%	48%	37%	16%	33%	58%	8%	83%	17%	0%	32%	68%	0%	65%	35%	1%
Black-bellied Plover	Fall	29%	55%	15%	33%	45%	22%	40%	52%	7%	20%	15%	65%	23%	76%	1%	64%	35%	1%
Black-bellied Plover	Spring	29%	59%	12%	25%	35%	40%	21%	34%	45%	16%	13%	71%	29%	67%	4%	66%	33%	1%
American Golden-Plover	Spring	7%	6%	88%	1%	2%	97%	2%	6%	92%	1%	2%	97%	2%	7%	91%	78%	8%	14%
Killdeer	Fall	4%	13%	83%	2%	6%	92%	3%	27%	71%	1%	24%	75%	1%	48%	51%	10%	24%	67%

Species	Season	Initiative Area																	
		Laguna Madre			Texas Mid-Coast			Texas Chenier Plain			Louisiana Chenier Plain			Mississippi River Coastal Wetlands			Coastal Mississippi-Alabama		
		Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland
Killdeer	Spring	6%	17%	77%	3%	8%	89%	3%	34%	63%	1%	30%	68%	1%	51%	48%	13%	28%	59%
Semipalmated Plover	Fall	39%	50%	11%	38%	46%	16%	48%	46%	6%	25%	20%	55%	28%	71%	1%	63%	36%	1%
Semipalmated Plover	Spring	25%	65%	10%	15%	27%	58%	7%	22%	70%	6%	10%	84%	33%	60%	6%	63%	36%	1%
Piping Plover	Fall	42%	34%	24%	39%	43%	18%	70%	27%	3%	64%	32%	4%	45%	55%	0%	72%	28%	0%
Piping Plover	Spring	46%	36%	18%	46%	41%	13%	68%	31%	1%	70%	27%	4%	57%	43%	0%	70%	30%	0%
Wilson's Plover	Fall	30%	57%	14%	34%	50%	16%	61%	35%	4%	59%	39%	3%	37%	62%	1%	59%	41%	0%
Wilson's Plover	Spring	34%	53%	13%	33%	49%	18%	63%	35%	2%	59%	40%	1%	40%	60%	0%	64%	36%	0%
Snowy Plover	Fall	41%	41%	18%	40%	45%	15%	69%	28%	4%	62%	34%	4%	47%	53%	0%	80%	20%	0%
Snowy Plover	Spring	31%	53%	16%	39%	44%	17%	68%	31%	1%	58%	36%	6%	56%	44%	0%	30%	20%	0%
Upland Sandpiper	Fall	2%	9%	89%	0%	2%	98%	1%	4%	95%	0%	3%	97%	0%	8%	92%	0%	0%	100%
Upland Sandpiper	Spring	1%	7%	91%	0%	2%	97%	1%	7%	93%	0%	2%	98%	1%	7%	92%	41%	59%	0%
Whimbrel	Fall	22%	63%	15%	29%	58%	13%	60%	40%	0%	70%	25%	4%	40%	60%	0%	56%	44%	0%

Species	Season	Initiative Area																	
		Laguna Madre			Texas Mid-Coast			Texas Chenier Plain			Louisiana Chenier Plain			Mississippi River Coastal Wetlands			Coastal Mississippi-Alabama		
		Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland
Whimbrel	Spring	13%	41%	47%	21%	51%	29%	1%	8%	91%	7%	14%	79%	20%	58%	22%	68%	32%	0%
Long-billed Curlew	Fall	14%	36%	50%	25%	38%	38%	50%	46%	4%	63%	34%	3%	37%	63%	0%	22%	78%	0%
Long-billed Curlew	Spring	16%	38%	46%	22%	35%	43%	26%	36%	38%	58%	38%	4%	0%	0%	0%	0%	0%	0%
Hudsonian Godwit	Spring	0%	3%	97%	0%	1%	99%	0%	6%	93%	0%	1%	99%	0%	0%	100%	0%	0%	0%
Marbled Godwit	Fall	31%	63%	7%	30%	54%	15%	38%	60%	2%	62%	35%	3%	36%	64%	0%	64%	36%	0%
Marbled Godwit	Spring	23%	68%	8%	26%	61%	12%	26%	71%	3%	54%	46%	0%	56%	44%	0%	90%	10%	0%
Ruddy Turnstone	Fall	54%	31%	14%	46%	39%	16%	50%	42%	8%	65%	32%	4%	30%	69%	1%	71%	27%	2%
Ruddy Turnstone	Spring	56%	30%	14%	46%	38%	17%	40%	49%	11%	39%	41%	20%	27%	72%	1%	75%	23%	2%
Red Knot	Fall	42%	28%	31%	53%	33%	15%	54%	46%	0%	100%	0%	0%	55%	45%	0%	68%	32%	0%
Red Knot	Spring	26%	30%	45%	46%	40%	14%	45%	54%	1%	0%	0%	0%	63%	37%	0%	76%	24%	0%
Stilt Sandpiper	Fall	2%	13%	85%	1%	12%	87%	2%	35%	63%	0%	3%	97%	0%	10%	90%	25%	65%	9%
Stilt Sandpiper	Spring	7%	35%	58%	3%	14%	83%	2%	39%	59%	0%	25%	75%	0%	12%	88%	48%	52%	0%
Sanderling	Fall	47%	33%	19%	43%	41%	15%	56%	37%	7%	63%	33%	3%	31%	68%	0%	74%	24%	1%

Species	Season	Initiative Area																	
		Laguna Madre			Texas Mid-Coast			Texas Chenier Plain			Louisiana Chenier Plain			Mississippi River Coastal Wetlands			Coastal Mississippi-Alabama		
		Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland
Sanderling	Spring	50%	37%	13%	46%	39%	15%	51%	41%	7%	61%	36%	3%	39%	61%	0%	74%	24%	1%
Dunlin	Fall	21%	63%	16%	22%	41%	37%	33%	60%	7%	6%	4%	90%	27%	68%	5%	54%	44%	2%
Dunlin	Spring	32%	58%	10%	17%	33%	51%	16%	41%	43%	4%	6%	90%	23%	69%	8%	59%	39%	1%
Baird's Sandpiper	Fall	10%	32%	58%	13%	19%	67%	24%	23%	54%	20%	26%	54%	0%	59%	41%	67%	33%	0%
Baird's Sandpiper	Spring	4%	7%	89%	2%	7%	91%	8%	30%	62%	25%	39%	36%	35%	56%	8%	58%	42%	0%
Least Sandpiper	Fall	15%	33%	53%	7%	14%	79%	7%	48%	44%	1%	14%	85%	4%	56%	40%	43%	47%	10%
Least Sandpiper	Spring	18%	53%	29%	5%	12%	82%	5%	36%	58%	2%	23%	75%	6%	54%	39%	51%	46%	3%
White-rumped Sandpiper	Spring	5%	17%	78%	3%	10%	88%	3%	23%	74%	2%	18%	81%	9%	43%	48%	62%	38%	0%
Buff-breasted Sandpiper	Fall	0%	0%	100%	0%	0%	100%	1%	1%	98%	2%	1%	97%	17%	24%	59%	37%	11%	51%
Buff-breasted Sandpiper	Spring	0%	0%	100%	0%	0%	100%	0%	1%	99%	0%	0%	100%	0%	0%	100%	100%	0%	0%
Pectoral Sandpiper	Fall	1%	4%	95%	0%	2%	98%	1%	15%	84%	0%	3%	97%	1%	23%	76%	13%	15%	72%

Species	Season	Initiative Area																	
		Laguna Madre			Texas Mid-Coast			Texas Chenier Plain			Louisiana Chenier Plain			Mississippi River Coastal Wetlands			Coastal Mississippi-Alabama		
		Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland
Pectoral Sandpiper	Spring	3%	10%	87%	0%	3%	97%	1%	12%	87%	0%	5%	95%	0%	10%	90%	31%	35%	35%
Semipalmated Sandpiper	Fall	22%	58%	20%	20%	34%	46%	29%	50%	21%	1%	4%	95%	7%	30%	62%	63%	37%	1%
Semipalmated Sandpiper	Spring	18%	53%	28%	12%	36%	52%	9%	42%	49%	3%	17%	80%	15%	60%	25%	64%	34%	2%
Western Sandpiper	Fall	24%	62%	14%	24%	41%	35%	35%	58%	7%	5%	6%	90%	26%	67%	7%	62%	37%	0%
Western Sandpiper	Spring	14%	69%	17%	25%	42%	34%	29%	44%	27%	8%	7%	85%	32%	65%	3%	64%	34%	2%
Short-billed Dowitcher	Fall	18%	69%	13%	23%	63%	14%	24%	70%	6%	9%	17%	73%	21%	77%	2%	59%	40%	0%
Short-billed Dowitcher	Spring	35%	55%	10%	29%	52%	19%	13%	55%	31%	7%	26%	67%	25%	74%	1%	58%	41%	1%
Long-billed Dowitcher	Fall	11%	32%	57%	2%	10%	89%	1%	23%	76%	0%	2%	98%	2%	17%	82%	36%	51%	13%
Long-billed Dowitcher	Spring	7%	26%	66%	2%	10%	87%	0%	15%	85%	0%	7%	93%	1%	6%	94%	50%	43%	6%
Greater Yellowlegs	Fall	15%	36%	49%	6%	18%	76%	3%	41%	55%	1%	27%	72%	3%	67%	30%	31%	54%	15%
Greater Yellowlegs	Spring	12%	26%	62%	5%	14%	81%	3%	33%	64%	1%	20%	80%	2%	46%	52%	29%	54%	17%

Species	Season	Initiative Area																	
		Laguna Madre			Texas Mid-Coast			Texas Chenier Plain			Louisiana Chenier Plain			Mississippi River Coastal Wetlands			Coastal Mississippi-Alabama		
		Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland	Beach	Marsh	Inland
Willet	Fall	34%	49%	17%	34%	48%	18%	30%	62%	8%	26%	72%	2%	15%	84%	1%	66%	31%	2%
Willet	Spring	32%	46%	21%	31%	50%	19%	17%	65%	18%	15%	79%	6%	16%	84%	1%	65%	32%	3%
Lesser Yellowlegs	Fall	4%	23%	73%	3%	19%	78%	2%	40%	59%	0%	13%	86%	1%	45%	54%	19%	49%	32%
Lesser Yellowlegs	Spring	11%	31%	58%	5%	14%	81%	2%	30%	68%	1%	22%	78%	1%	34%	65%	15%	44%	41%
Wilson's Phalarope	Fall	1%	16%	84%	0%	24%	76%	1%	60%	39%	0%	16%	84%	0%	36%	64%	28%	49%	23%
Wilson's Phalarope	Spring	5%	23%	72%	1%	11%	88%	2%	40%	58%	2%	63%	35%	5%	65%	30%	42%	19%	40%
White-faced Ibis	Spring	3%	16%	81%	1%	9%	90%	0%	32%	67%	0%	22%	78%	0%	30%	70%	0%	66%	34%
Glossy Ibis	Spring	3%	2%	95%	5%	22%	72%	0%	40%	60%	0%	31%	69%	0%	70%	30%	19%	80%	1%
White Ibis	Spring	28%	38%	35%	12%	19%	69%	3%	29%	68%	1%	23%	76%	1%	47%	52%	5%	42%	53%