Fall Habitat Objectives for Priority Gulf Coast Joint Venture Shorebird Species Using Managed Wetlands and Grasslands
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A Product of the Gulf Coast Joint Venture Monitoring, Evaluation, and Research Team’s Shorebird Working Group

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The Gulf Coast Joint Venture (GCJV) Management Board directed the Shorebird Working Group (SWG) of the GCJV Monitoring, Evaluation, and Research Team to select a set of approximately 6 – 8 priority shorebirds for conservation planning in the GCJV area. The SWG chose the following shorebirds:

Snowy Plover
Wilson’s Plover
Long-billed Curlew
Hudsonian Godwit
Western Sandpiper
Stilt Sandpiper
Buff-breasted Sandpiper
Short-billed Dowitcher

Subsequently, the SWG began discussion and development of population and habitat objectives for those priority shorebird species. The SWG evaluated those priority shorebird species that commonly use managed wetlands and grassland sites, such as impoundments managed for waterfowl on state or federal lands, rice fields, aquaculture ponds, prairies and pastures. This shallow water/mudflat habitat is assumed limited during the period of southbound shorebird migration in the Gulf coastal plain (Reinecke et al. 1988, Twedt 1999, Elliott and McKnight 2000). The extent and availability of suitable grassland habitat available to southbound priority shorebird species which preferentially use that habitat is unknown. Extent of habitat use may also vary markedly from year to year.

The fall migration period considered here spans from July 15 to November 5, per International Shorebird Survey (ISS) guidelines (ISS 2006). It is hoped that future iterations of this document will consider species-specific migration chronologies and incorporate habitat provision recommendations accordingly.

From the list above, species that use managed wetlands and grasslands during southbound migration include Long-billed Curlew, Western Sandpiper, Stilt Sandpiper, Buff-breasted Sandpiper, and Short-billed Dowitcher. Whereas Hudsonian Godwit uses managed wetlands, it is primarily a northbound passage migrant through the GCJV region (Elphick and Klima 2002). Because very low numbers are recorded during southbound migration it was not considered during the derivation of population estimates and habitat objectives.
Numerous assumptions are imbedded within the estimation methods for habitat objectives:

**Population Size** - In most cases, the ultimate source of population numbers is Morrison et al.’s (2006) North American estimates, which were derived from a variety of data sources and accuracy among estimates varies widely. Subsequently, some of Morrison et al.’s estimates have been further refined using more recent survey data or alternate analysis methods, such as Breeding Bird Survey abundance extrapolation. A combination of survey data, landcover information, and expert opinion were used to estimate the proportion of each species’ population occurring within southeastern United States Bird Conservation Regions (BCRs) (Appendix A). For the purpose of this planning exercise, the GCJV SWG considered the portions of the following BCRs that fall within the GCJV area: BCR 25 (West Gulf Coastal Plain/Ouachitas; BCR 26 (Mississippi Alluvial Valley); BCR 27 (Southeastern Coastal Plain), and BCR 37 (Gulf Coastal Prairie) (Figures 1 – 3). Published data on habitat preferences and expert opinion were used to partition shorebird habitat use in the BCR among three habitat groups: 1) beach-inlet, 2) intertidal, and 3), managed and all inland wetlands, agriculture, and grasslands.

**Fall Population Objectives** – Fall 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. The addition of juveniles to the population estimates was made to account for presumably higher post-breeding population; population and habitat estimates based only on breeding adults could result in resource shortages critical for juvenile survival.

**Turnover Rate** – It was assumed that 10 days was the average length of time spent by shorebirds migrating south through the GCJV area. This assumption was previously used in the Lower Mississippi Valley Joint Venture’s shorebird planning process (Twedt et al. 1999), and tested by Lehnen and Krementz (2005), who found it to be acceptable, with certain caveats. For some shorebird species, however, a portion of the population remains within the GCJV area from arrival in fall until departure in spring. For those species, the SWG estimated the proportion of the population that transit through the area, and the proportion that remain through the winter period. Christmas Bird Count (CBC) data was considered for some species to estimate approximate wintering population sizes. For the winter residents, habitat planning considered the time period from arrival in fall (July 15) until November 5, the beginning of the North American shorebird winter period (ISS 2006), the assumption being that the combination of normal precipitation patterns combined with waterfowl management and agricultural/aquaculture practices should provide adequate habitat beyond that date.
Figure 1: Bird Conservation Region 25 & 26 and the Gulf Coast Joint Venture Region

Legend
- BCR 25
- BCR 26
- Gulf Coast Joint Venture Region
Figure 2: Bird Conservation Region 27 and the Gulf Coast Joint Venture Region
Figure 3: Bird Conservation Region 37 and the Gulf Coast Joint Venture Region
Energy Requirements – From Kersten and Piersma (1987), the amount of energy in kilojoules (kJ) required to maintain a shorebird’s existence (basal) metabolic rate (EMR) is expressed by:

\[ \text{EMR (kJ)} = 912 \times (\text{Body Mass (kg)})^{0.704} \]

As with previous shorebird planning efforts in the southeastern U.S., chironomid larvae were used as a representative shorebird prey item. Cummins and Wuycheck (1977) calculated the energy yield from chironomid larvae as 23.8 kJ g\(^{-1}\). Castro et al. (1989) reviewed avian assimilation efficiency studies and calculated the average assimilation efficiency of birds feeding on invertebrates as 73%. Therefore, the net energy content (NEC) that birds can derive from chironomid larvae is:

\[ 23.8 \text{ kJ g}^{-1} \times 0.73 = 17.374 \text{ kJ g}_{\text{dw}}^{-1} \]  

(dw = dry weight).

To determine the dry weight of invertebrates a given bird species requires, it is necessary to multiply its EMR by the NEC figure above:

\[ (\text{EMR})_{\text{d}}^{-1} \times (17.374 \text{ kJ g}_{\text{dw}}^{-1} \text{d}^{-1})^{-1} \]

In addition to maintaining EMR, a migrating shorebird must also store additional energy reserves to complete migration. It is assumed that migrant shorebirds must increase their mass by approximately 1 g per day to build reserves for migration. Given the average assimilation efficiency used above for birds feeding on invertebrates (73%), approximately 2 g of invertebrates are required to increase a shorebird’s weight by 1 g. These 2 g are in addition to the amount required by a shorebird to maintain its EMR.

Prey Density – Twedt et al. (1999) assumed that managed shallow-water/mudflat habitat in the Mississippi Alluvial Valley produced approximately 2 g\(_{\text{dw}}\)m\(^{-2}\) of chironomid larvae. Similarly, Hunter et al. (2005) used 2.4 g\(_{\text{dw}}\)m\(^{-2}\) of chironomid larvae to calculate the amount of managed habitat needed for shorebirds along the south Atlantic coast. Subsequent research by Lyons and Collazo (2006) at sites along the Atlantic Coast showed this estimate to be close to observed values at two of three sites. Consequently, this prey density estimate was used in calculating desired habitat acreage for this exercise.

Other Shorebirds with Significantly Similar Habitat Needs – For each priority shorebird species, the SWG developed a list of other shorebird species believed to have significantly similar habitat requirements. Continental population estimates for those species come from Morrison et al. 2006, and were stepped down to the level of fall managed/inland habitat in the GCJV portions of BCRs 25, 26, 27, and 37, using the process described above for priority shorebirds (see also Appendices A and B). Those species’ habitat needs were included in habitat calculations.
Figure 4. Gulf Coast Joint Venture Initiative Areas
**Habitat Allocation** – A combination of monitoring data and landcover information was used to make recommendations regarding allocation of shorebird habitat by GCJV Initiative Areas (IA) (Figure 4) (Esslinger and Wilson 2001, Esslinger and Wilson 2002, Manlove et al. 2002a, Manlove et al. 2002b, Wilson and Esslinger 2002, Wilson et al. 2002). For BCRs 25, 26, and 27, calculated habitat needs were allocated to the IA level based upon the amount of emergent marsh habitat within the IA, relative to the total amount in the GCJV portion of each BCR. Shorebird migration information from Skagen et al. (1999) was used to make recommendations regarding allocation of shorebird habitat by GCJV IA in BCR 37. Skagen et al. compiled shorebird survey and observational data from numerous sources and generated distribution maps for all shorebirds migrating south through midcontinental North America (Figure 5). Shading patterns on the maps indicate the approximate number of birds per 100 kilometer block expected during the fall migration period. The GCJV GIS Analyst created a grid layer based upon this abundance data for priority GCJV shorebird species. This layer was combined with a layer denoting the amount of potential inland-managed habitat in BCR 37 within each IA. A corrected abundance based upon potential habitat was generated for each IA in BCR 37 (with the exception of the portion of BCR 37 that lies within the Coastal Mississippi-Alabama Wetlands IA, where the total habitat objective was less than one acre). Where Skagen et al. (1999) data did not exist, the minimum grid cell value from that publication (5 birds) was used. Summing those grid cells within and across IA in BCR 37 provided a percentage that was applied to GCJV priority shorebird species habitat objectives for allocation purposes.

**Priority Species**

**Long-billed Curlew** – Long-billed Curlew migrates through the GCJV area in fall and spring, and is considered a common to locally abundant winter resident in the Texas portion of the JV (Lockwood and Freeman 2004), and uncommon in winter along the Louisiana coast (Lowery 1974). Turcotte and Watts (1999) characterized it as a rare and irregular transient on the Mississippi coast. Imhof (1976) described the species as an occasional migrant on the Alabama coast. Small numbers of birds can be found in summer along the Texas and Louisiana coasts, and there are occasional nesting attempts in Texas (Lowery 1974, Lockwood and Freeman 2004). Lockwood and Freeman describe the fall migration period in Texas as extending from mid-July to early November.

Helmers (1992) placed Long-billed Curlew in the terrestrial/aquatic gleaner/prober foraging guild, and characterized the habitat utilized as having dry/saturated substrate, with vegetation of moderate/dense density and short/medium height. Dugger and Dugger (2002) stated that the species used a variety of habitats in migration, including dry short-grass prairie, wet pasture, tidal mudflats, fallow fields, harvested rice fields, and salt marsh.
Morrison et al.’s (2001) North American population estimate for Long-billed Curlew was 20,000 individuals, but surveys conducted for this species subsequent to that date have produced estimates ranging from approximately 55,000 to 123,500 individuals (Morrison et al. 2006). Prior to Morrison et al.’s 2006 revision, the SWG chose 100,000 as the estimated population of this species; this estimate is used for GCJV planning purposes. American population is estimated to migrate through or winter in the GCJV region. The population objective for Long-billed Curlew for the GCJV region during fall is 40,040 individuals (adults plus juveniles). It is estimated that approximately 60% (24,024) of the birds passing through the GCJV region in fall will use managed and/or inland wetlands, agriculture or grasslands, although the SWG acknowledged that in certain portions of the GCJV region, birds vary habitat use between unmanaged coastal habitats and managed inland habitats. Additionally, the SWG estimated that approximately 40% of the birds migrating to BCR 37 would remain for 10 days, and the remaining 60% would stay in that BCR throughout the fall period (114 days).
Other bird species determined to have largely overlapping habitat needs with Long-billed Curlew are Killdeer and Black-bellied Plover. The SWG noted, however, that competition for food resources between this and other species is poorly understood.

The GCJV’s habitat goal for Long-billed Curlew is to provide approximately **6,836 acres** (~2,766 hectares) of dry to saturated managed habitat, moderately to densely vegetated in short to medium height vegetation (primarily grasses, and preferably native) from July 15 to November 5 (see Table 1 and Appendices C and D). The majority (>99%) of this habitat should be provided in BCR 37, with the remainder in BCR 27 (Table 2). Use of the GCJV portions of BCR 25 and 26 by migrant Long-billed Curlew is believed to be negligible.

**Western Sandpiper** – Western Sandpiper migrates through the GCJV area in fall and spring, and is also locally common along the Texas, Louisiana Mississippi and Alabama coasts during winter (Lowery 1974, Imhof, 1976, Turcotte and Watts 1999, Lockwood and Freeman 2004). Small numbers of birds can also be found along the coast during summer. Lockwood and Freeman describe the Texas fall migration period as mid-July to early November. In Mississippi, Western Sandpiper fall migration peaks in August (Turcotte and Watts 1999).

Helmers (1992) characterized Western Sandpiper as an aquatic prober/gleaner, foraging in saturated to flooded substrates with vegetation sparse or lacking. If present, vegetation height is short. Wilson (1994) stated that migration habitat in interior locations was typically pond or lake margins, and that intertidal mudflats were used in coastal areas. The maximum water depth that the species will forage in is approximately 4 inches (in) (~10 cm), with most foraging occurring on bare ground and areas flooded up to about ¾ in (~2 cm) deep (Wilson 1994).

The North American population of Western Sandpiper is estimated at 3,500,000 (Morrison et al. 2006). Approximately 52% (1,806,875) of those birds migrate through or winter in the GCJV region. The population objective for the species in the GCJV region during fall is 3,613,750 individuals (adults plus juveniles). It is estimated that approximately 32% (1,153,950) of the birds passing through the GCJV region in fall will use managed and/or inland wetlands, agriculture or grasslands, and that approximately half of those birds would remain for about 10 days, the remainder over-wintering in the region, primarily in BCR 37.

The SWG identified Semipalmated Sandpiper, Least Sandpiper, Dunlin, Pectoral Sandpiper, and Stilt Sandpiper as having significantly similar fall habitat requirements as Western Sandpiper. The SWG also felt that there was significant habitat needs overlap between Western Sandpiper, Lesser Yellowlegs, and Black-necked Stilt.
The GCJV’s habitat goal for Western Sandpiper is to provide approximately **43,920 acres** (~17,773 hectares) of saturated to flooded managed habitat, with sparse (or no) short vegetation, from July 15 to November 5 (see Table 1 and Appendices C and E). Optimal flooding depth is 0 (saturated) - ¾ in (~2 cm). Approximately 98% of this habitat should be provided in BCR 37, with the remainder divided between BCRs 25, 26, and 27 (Table 2).

**Stilt Sandpiper** – Lockwood and Freeman (2004) characterize Stilt Sandpiper as an uncommon to locally common migrant in Texas, and a rare to uncommon resident along the Texas coast in winter. They noted that up to 4,000 individuals over-winter annually at Laguna Atascosa National Wildlife Refuge in Cameron County, Texas. Lowery (1974) deemed the species to be an uncommon to moderately common fall migrant through Louisiana, and cited one winter record in 1973. Numerous winter records of Stilt Sandpiper have been noted in Louisiana subsequent to that time (National Audubon Society CBC data, 2007) and the species is now considered uncommon to rare in winter. Turcotte and Watts (1999) designated Stilt Sandpiper as a common spring and fall migrant, coastal and inland Mississippi. Imhof (1976) described it as fairly common in migration on Alabama’s Gulf coast, very rare in spring in Alabama’s coastal plain, and uncommon in fall throughout the state. Fall migration in Texas extends from early July to late October (Lockwood and Freeman 2004).

Helmers (1992) described Stilt Sandpiper as an aquatic prober/gleaner, using saturated to flooded substrates, with zero to sparse, short vegetation. Klima and Jehl (1998), however, emphasized the species’ preference for flooded versus saturated mudflat foraging habitat. They characterized Stilt Sandpiper as principally a pond-foraging species in migration and winter, commonly feeding in water depths of greater than 1¾ in (~4.5 cm). The maximum water depth the species typically forages in is about 3 in (~8 cm) (Bonaparte 1826, Hayman et al. 1986, Takekawa and Warnock 2000).

The North American population of Stilt Sandpiper is estimated at 820,000 (Morrison et al. 2006). Approximately 63% (517,010) of those birds migrate through or winter in the GCJV region. The population objective for the species in the GCJV region during fall is 1,034,020 individuals (adults plus juveniles). It is estimated that approximately 81% (836,564) of the birds passing through the GCJV region in fall will use managed and/or inland wetlands, agriculture or grasslands. Additionally, from Lockwood and Freeman (2004) and CBC data, an estimated 5,000 Stilt Sandpiper remain through the winter in BCR 37.

Bird species believed to have significantly similar foraging habitat needs include Semipalmated Sandpiper, Least Sandpiper, Dunlin, Pectoral Sandpiper, Western Sandpiper, Long-billed and Short-billed Dowitcher, Greater Yellowlegs, and Wilson’s Phalarope. The SWG also considered Lesser Yellowlegs and Black-
necked Stilt to potentially have significant habitat utilization overlap with Stilt Sandpiper.

The GCJV’s habitat goal for Stilt Sandpiper is to provide approximately 8,454 acres (~3,421 hectares) of saturated to flooded managed habitat, with sparse (or no) short vegetation, from July 15 to November 5 (see Table 1 and Appendices C and D). Optimal flooding depths range from approximately ¼ - 3 in (~2 – 8 cm) (Bonaparte 1826, Hayman et al. 1986, Takekawa and Warnock 2000). Approximately 94% of this habitat should be provided in BCR 37, 5% in BCRs 25 and 26, and 1% in BCR 27 (Table 2).

**Buff-breasted Sandpiper** – Lockwood and Freeman (2004) described Buff-breasted Sandpiper as a rare to uncommon migrant through east Texas, becoming common to uncommon along the coast. Fall migration dates for the species in Texas range from late July to late October. Lowery (1974) classified the species as an uncommon to moderately common migrant through Louisiana. Turcotte and Watts (1999) described Buff-breasted Sandpiper as irregular and uncommon to rare in migration in Mississippi. It is occasional in spring and uncommon in fall in Alabama (Imhof 1976).

Helmers (1992) placed the species in the aquatic/terrestrial gleaner foraging guild. This appellation, however, is somewhat misleading, as the species is predominantly found in terrestrial short-grass habitats (Lowery 1974, Lanctot and Laredo 1994, Lockwood and Freeman 2004). It does, however, frequently use margins of natural wetlands (Lanctot and Laredo 1994), and in southwest Louisiana, forages on mud, and at the dry dirt-water interface in agricultural fields that are being flooded for rice culture (W. Vermillion, pers. obs.). Lowery (1974) included golf courses, new grainfields, pastures, and recently burned marshes among the species’ typical Louisiana habitats. Sod farms are also used along the Gulf Coast (Jorgensen et al. 2006). Some habitats used are subject to frequent pesticide and/or herbicide applications. The impacts of those chemicals on Buff-breasted Sandpiper are not known.

Morrison et al. (2006) estimated the North American population of Buff-breasted Sandpiper at 30,000. Based upon recent monitoring efforts, research, and expert opinion, the SWG opined that an estimate of 40,000 individuals may be more accurate. Therefore, it was deemed prudent to allocate areas based on a larger versus smaller estimate, to avoid underestimation of necessary requirements. Approximately 96% (38,360) of those birds are believed to migrate through the GCJV region. The population objective for the species in the GCJV region during fall is 76,720 individuals (adults plus juveniles). It is estimated that approximately 95% (73,112) of the birds passing through the GCJV region in fall will use managed and/or inland wetlands, agriculture or grasslands.

Shorebird species that the SWG considered to have direct habitat overlap with Buff-breasted Sandpiper are Least Sandpiper, Semipalmated Sandpiper, Western
Sandpiper, Pectoral Sandpiper, Upland Sandpiper, Baird’s Sandpiper, Black-bellied Plover and Killdeer.

The GCJ’s habitat goal for Buff-breasted Sandpiper in the GCJV region is to provide approximately 714 acres (~288 hectares) of short-grass habitat, and/or bare-soil/water interface habitat from July 15 to November 5 (see Table 1 and Appendices C and D). Ideally, that habitat should not be subject to pesticide and/or herbicide application. Habitat allocation recommendations are to provide approximately 93% in BCR 37, 6% in BCR 25 and 26, and 1% in BCR 27 (Table 2).

**Short-billed Dowitcher** – Short-billed Dowitcher is an uncommon to rare migrant through east Texas, and a locally common winter resident along the Texas coast (Lockwood and Freeman 2004). Lowery (1974) characterized the species as an abundant migrant through Louisiana, and a moderately common winter resident along the coast. It is a common spring and fall coastal migrant and an uncommon inland migrant in Mississippi, and a fairly common coastal wintering bird in that state (Turcotte and Watts 1999). Imhof (1976) stated it was common along the Alabama coast in migration and winter, rare inland in spring, and uncommon to fairly common inland in fall.

The Short-billed Dowitcher is an aquatic prober/gleaner in saturated to flooded substrates having zero to sparse, short vegetation (Helmers 1992). Jehl et al. (2001) stated that during migration, the species commonly used tidal flats, beaches, flooded agricultural fields, sewage ponds, and salt marsh. Jehl et al. did not provide estimates for preferred water depths for foraging, but Takekawa and Warnock (2000) said that Long-billed Dowitcher foraged in saturated soil (shorelines) and in areas flooded from ¾ - 6¼ in (~2 – 16 cm) deep.

The North American population estimate for Short-billed Dowitcher is 153,000 (Morrison et al. 2006). About 26% of the North American population migrates through the GCJV region. The overall population objective for the species in all habitats in the GCJV region is 79,514 individuals, It is estimated that approximately 21% (16,600) of this amount will use managed and/or inland wetlands or agriculture while transiting the region.

The SWG determined that the other bird species with significant habitat overlap compared to this species were Long-billed Dowitcher, Stilt Sandpiper, Greater Yellowlegs, Lesser Yellowlegs, Dunlin, and Wilson’s Phalarope.

The GCJ’s habitat goal for Short-billed Dowitcher in the GCJV region is to provide approximately 223 acres (~90 hectares) of saturated to flooded managed habitat, with sparse (or no) short vegetation, from July 15 to November 5 (see Table 1 and Appendices C and D). Optimal flooding depths range from approximately ¾ - 6¼ in (~2 – 16 cm) (Takekawa and Warnock 2000). Habitat
allocation recommendations are to provide approximately 92% in BCR 37, 5% in BCR 25 and 26, and 3% in BCR 27 (Table 2).

Other Shorebird Species with Significantly Similar Habitat Needs

Black-bellied Plover – Black-bellied Plover is an uncommon to common migrant through eastern Texas, a common to abundant winter resident along the Texas coast, and a rare to uncommon winter resident inland in southeastern Texas (Lockwood and Freeman 2004). Lowery (1974) characterized Black-bellied Plover as common to abundant in coastal Louisiana from early September to early May, but said that the species was seldom seen inland, even during migration. In contrast, Floyd (2000) stated that the species was a fairly common winter resident and migrant in Acadia Parish, Louisiana, which is centered approximately 50 miles from the Gulf of Mexico. Similarly, Rosenberg and Sillett (1991) found Black-bellied Plover to be an uncommon migrant and common winter resident in the southwest Louisiana rice prairies. Turcotte and Watts (1999) classified Black-bellied Plover as an uncommon inland migrant and a common coastal winter resident in Mississippi. Along the Alabama coast, it is common to abundant during migration, common in winter, and uncommon during summer (Imhof 1976).

Black-bellied Plover is a terrestrial/aquatic gleaner on dry to saturated substrates having zero to sparse, short vegetation (Helmers 1992). The SWG considered the species’ habitat needs to potentially overlap with Long-billed Curlew and Buff-breasted Sandpiper.

The North American population estimate for Black-bellied Plover is 200,000 (Morrison et al. 2006). About 26% of the North American population migrates through the GCJV region. The overall population objective for the species in all habitats in the GCJV region is 104,280 individuals. It is estimated that approximately 12% (12,480) of this amount will use managed and/or inland wetlands or agriculture while transiting the region. Analysis and extrapolation of Black-bellied Plover numbers for inland CBCs within or adjacent to the GCJV region between 1995 and 2008 provides an estimate of approximately 1,090 Black-bellied Plover over-wintering in the inland portion of the GCJV region each year.

To minimize potential resource depletion by Black-bellied Plover of habitat provided for Long-billed Curlew and Buff-breasted Sandpiper, the SWG recommends provision of an additional 225 acres (~91 hectares) of dry to saturated managed habitat, moderately to densely vegetated in short to medium height vegetation (primarily grasses), and an additional 295 acres (~119 hectares) of short-grass habitat, and/or bare-soil/water interface habitat, from July 15 to November 5 (see Appendices C and D).
**Killdeer** – Killdeer is common to abundant year-round in the GCJV region (Lowery 1974, Imhof 1976, Turcotte and Watts 1999, Lockwood and Freeman 2004). This terrestrial/aquatic gleaner uses dry to saturated substrates having zero to sparse, short vegetation (Helmers 1992). The SWG considered this species’ habitat needs to significantly overlap with the Buff-breasted Sandpiper’s, and to potentially overlap with the Long-billed Curlew’s.

The North American population estimate for Killdeer is over 5,000,000 (Morrison et al. 2006). About 41% (2,065,000) of the North American population resides, migrates through, or winters in the GCJV region. The SWG estimated that approximately 95% of this amount uses managed and/or inland wetlands or agriculture while in the region. Including juvenile birds, the objective for this species on managed and/or inland wetlands and agriculture is 3,952,000 birds. The SWG believes that approximately 50% of this number moves through the GCJV region (10 day residence time) and 50% remains until at least the start of the winter period (114 days).

With the population objective above, and the assumption of 50% over-wintering birds, approximately 302,960 acres (~122,603 hectares) will be required to accommodate the needs of this species during fall migration and until the beginning of the winter period (Appendices C and D). Given this species plasticity regarding habitat use, and the SWG’s acknowledgment that its level of habitat overlap with Long-billed Curlew is poorly understood, it is highly unlikely that habitat provisioning for Buff-breasted Sandpiper and Long-billed Curlew will need to account for the entirety of this additional acreage. Alternately, the habitat objectives for Buff-breasted Sandpiper and Long-billed Curlew in the GCJV region could be increased by approximately **17,332 and 12,963 acres** (~7,014 and 5,245 ha) respectively, which would account for 10% of the Killdeer habitat objective above. This added acreage would also provide habitat for the estimated number of Killdeer over-wintering in the inland portion of the GCJV region as determined from analysis and extrapolation of CBC data from 1995 – 2008.

**Black-necked Stilt** – Lockwood and Freeman (2004) stated while Black-necked Stilt was a common summer resident along the Texas coastal prairies, the species was a rare to uncommon migrant in most of Texas, and rare to locally uncommon in the coastal prairies during winter. Lowery (1974) classified Black-necked Stilt as common to abundant in Louisiana from mid-March to November, and rare to uncommon for the remainder of the year. Rosenberg and Sillett (1991), however, characterized the species as a common year-round resident in the southwest Louisiana rice prairies, and tallied a high count of 575 individuals during one day in January. Black-necked Stilt is a locally common permanent resident in coastal Mississippi, but is usually scarce in winter (Turcotte and Watts 1999). Migrants occur uncommonly inland in that state (Turcotte and Watts 1999). It is an uncommon transient along the Alabama Gulf Coast, casual inland, and has bred in the head of Mobile Bay (Imhof 1976).
Helmers (1992) considered Black-necked Stilt an aquatic gleaner/sweeper, using flooded substrates with zero to short, sparse vegetation. The SWG opined the species’ habitat needs potentially overlapped with those of the priority shorebirds Stilt Sandpiper and Western Sandpiper.

The North American population estimate for Black-necked Stilt is 175,000 (Morrison et al. 2006). About 22% of the North American population is believed to reside in or migrate through the GCJV region. The overall population objective for the species in all habitats in the GCJV region is 76,685 individuals. Approximately 76% (59,010) of that amount will use managed and/or inland wetlands or agriculture while in the region. The SWG opined that approximately 11,810 of those birds would remain until the start of the winter period.

Habitat provisioning for Stilt Sandpiper and Western Sandpiper should include an additional 3,313 acres (~1,340 hectares) to accommodate competition for resources by Black-necked Stilt (Appendices C and D). Since Stilt Sandpiper typically uses flooded substrates more than Western Sandpiper, it is suggested that 70% (2,319 acres) of habitat needed for Black-necked Stilt be added to Stilt Sandpiper habitat objectives, with the remaining 994 acres added to Western Sandpiper habitat objectives.

Greater Yellowlegs – Greater Yellowlegs is a common to uncommon migrant throughout Texas, and is uncommon to locally uncommon in winter on that state’s coastal prairies (Lockwood and Freeman 2004). Lowery (1974) considered it to be common in Louisiana from late July to mid-November, and common along the coast in winter, but not elsewhere in the state. Rosenberg and Sillett (1991) stated Greater Yellowlegs was uncommon in winter in the Louisiana rice prairies. Greater Yellowlegs is regular transient through Mississippi and is an uncommon to rare winter resident in coastal areas (Turcotte and Watts 1999). Imhof (1976) deemed the species a common Alabama Gulf coast transient, wintering and summering bird, and a common to uncommon inland migrant and wintering bird.

Greater Yellowlegs are aquatic gleaners, foraging over flooded substrates with sparse to moderate, short to medium height vegetation (Helmers 1992). The GCJV SWG believes the species’ habitat requirements significantly overlap with those of priority shorebirds Stilt Sandpiper and Short-billed Dowitcher.

Morrison et al.’s (2006) North American population estimate for the species is 100,000 individuals. It is estimated that approximately 36,510 of those birds migrate through the GCJV region. The population objective for Greater Yellowlegs in the region is 73,020 birds. Habitat partitioning estimates have approximately 63% (46,092) of those birds using managed and/or inland wetlands or agricultural fields. Analysis and extrapolation of Greater Yellowlegs numbers for inland CBCs within or adjacent to the GCJV region between 1995 and 2008
provides an estimate of approximately 4,560 birds over-wintering in the inland portion of the GCJV region each year.

Habitat provisioning for Stilt Sandpiper and Short-billed Dowitcher should include an additional 1,583 acres (~640 hectares) to accommodate competition for resources by Greater Yellowlegs (Appendices C and D). The present recommendation is to divide this habitat allocation between the two species evenly (i.e., ~791.5 acres added to each species’ habitat objectives).

**Lesser Yellowlegs** – This species is a common migrant throughout Texas from early July to mid-October, and is uncommon to locally common during winter along the Texas coast (Lockwood and Freeman 2004). Abundance during migration is similar in Louisiana, but Lowery (1974) pointed out fluctuations in winter populations along the Louisiana coast dependent upon the severity of winter. Rosenberg and Sillett (1991) found the species to be uncommon in winter in the Louisiana rice prairies. It is a regular and common migrant throughout Mississippi, and is fairly common during winter along the coast (Turcotte and Watts 1999). Imhof (1976) described Lesser Yellowlegs as fairly common to common in Alabama during migration, and rare along the coast in summer and winter.

Lesser Yellowlegs are aquatic gleaners, foraging over flooded substrates with sparse to moderate, short to medium height vegetation (Helmers 1992). The GCJV SWG believes the species’ habitat requirements significantly overlap with those of priority shorebird Short-billed Dowitcher, and potentially with Western and Stilt Sandpiper as well.

The North American population of this species is estimated at 400,000 (Morrison et al. 2006). Approximately 37% of the population is believed to migrate through or winter in the GCJV region, and about 77% are estimated to use managed and/or inland wetlands or agricultural fields. The population objective for those habitats in the GCJV region is 224,760 birds. Analysis and extrapolation of Lesser Yellowlegs numbers for inland CBCs within or adjacent to the GCJV region between 1995 and 2008 provides an estimate of approximately 4,710 birds over-wintering in the inland portion of the region each year.

Habitat provisioning for Short-billed Dowitcher, Western Sandpiper and Stilt Sandpiper should include an additional 3,063 ac (~1,239 hectares) to accommodate potential resource competition with Lesser Yellowlegs (Appendices C and D). Initial recommendations are to provide 50% of this acreage through Short-billed Dowitcher habitat objectives, and 25% via Western and Stilt Sandpiper, respectively.

**Upland Sandpiper** – Upland Sandpiper is an uncommon to common fall migrant through Texas east of the Pecos River, from July to early October (Lockwood and Freeman 2004). In Louisiana, Lowery (1974) considered the species to be rare in
late July, uncommon to moderately common through August and into mid-September, becoming rare through the end of that month. Upland Sandpiper is an uncommon early fall migrant and spring transient in Mississippi (Turcotte and Watts 1999). Imhof (1976) called it an uncommon Alabama migrant, most often seen in spring in that state’s Black Belt prairie region, and less often along the coast.

Similar to Buff-breasted Sandpiper, the Upland Sandpiper is primarily a grassland species (Houston and Bowen 2001). In migration, the species shows more plasticity in habitat selection, using plowed fields and shrub-grassland habitats (Houston and Bowen 2001, Igl and Ballard 1999). The GCJV SWG believes that Upland Sandpiper habitat requirements significantly overlap with Buff-breasted Sandpiper habitat needs.

The North American population of Upland Sandpiper is estimated at 350,000 individuals (Morrison et al. 2006). Approximately 74% of the population is believed to migrate through the GCJV region, and 100% of those birds are thought to use managed and/or inland wetlands, agricultural fields, or grasslands. Population objectives for the GCJV region in fall are to provide habitat for 521,346 birds (adults plus juveniles).

Approximately 9,167 acres (~3,709 hectares) of grasslands, shrub-grasslands as defined by Igl and Ballard (1999) and suitable agricultural habitat will be required to support this population in the GCJV region during fall migration (Appendices C and D). Pending analysis of habitat availability, the initial recommendation of the SWG is to provide this habitat via planning and provisioning for Buff-breasted Sandpiper.

Semipalmated Sandpiper – Semipalmated Sandpiper is an uncommon to locally common fall migrant in Texas east of the Trans-Pecos region, passing through the state between mid-July to late October (Lockwood and Freeman 2001). Lowery (1974) categorized it as abundant between early September to late November in Louisiana. Semipalmated Sandpiper is an abundant coastal transient and an uncommon inland transient in Alabama and Mississippi (Imhof 1976, Turcotte and Watts 1999).

Semipalmated Sandpiper is an aquatic prober/gleaner, using saturated to flooded substrates with zero to sparse, short vegetation (Helmers 1992). Its habitat requirements are considered to significantly overlap with those of GCJV priority shorebird species Western Sandpiper, Stilt Sandpiper, and with Buff-breasted Sandpiper in certain settings, such as wetland edges.

Morrison et al. (2006) stated that the species’ North American population is 2,000,000 individuals. Approximately 27% of those birds are estimated to transit the GCJV region during migration. The SWG opined that 30% of those transients used managed and/or inland wetlands or agricultural fields. Considering
population objectives for the region this equals 337,200 Semipalmated Sandpiper using those habitats.

Approximately **2,237 acres** (~905 hectares) of habitat will be required to support these birds during fall migration (Appendices C and D). Initial recommendations are to provide 70% of this acreage through Western Sandpiper habitat objective planning and provisioning, 20% via Stilt Sandpiper habitat actions, and the remainder through Buff-breasted Sandpiper planning.

**Least Sandpiper** – Lockwood and Freeman (2004) described this species as the most common migrant shorebird in Texas, being common to abundant statewide during migration, and common along the coast in winter. Fall migration dates for Texas extend from mid-July to mid-November (Lockwood and Freeman 2004). Similarly, in Louisiana Lowery (1974) termed Least Sandpiper the commonest of the “peeps.” In Mississippi, Turcotte and Watts (1999) described this species as a common inland migrant, an abundant coastal migrant, and a common coastal winter resident. Imhof (1976) similarly classed Least Sandpiper as abundant in Alabama during migration and winter, but believed the species to often be more abundant inland than along the coast.

Like Western and Semipalmated sandpipers, Least Sandpiper is an aquatic prober/gleaner, using saturated to flooded substrates with zero to sparse, short vegetation (Helmers 1992). Its habitat requirements are considered to significantly overlap with those of GCJV priority shorebird species Western Sandpiper, Stilt Sandpiper, and with Buff-breasted Sandpiper in certain settings, such as wetland edges.

The North American population of Least Sandpiper is estimated at 700,000 individuals (Morrison et al. 2006), with an estimated 40% of those birds migrating through or wintering in the GCJV region. About 60% of the population is believed to use managed and/or inland wetlands, agricultural fields, or grasslands. The population objective for the species in managed and/or inland wetlands, agricultural fields, or grasslands in the GCJV region is 413,700 birds. Analysis and extrapolation of Least Sandpiper numbers for inland CBCs within or adjacent to the region between 1995 and 2008 provides an estimate of approximately 13,200 Least Sandpiper over-wintering in the inland portion of the GCJV region each year.

Approximately **2,944 acres** (~1,190 hectares) of suitable habitat will be required to support Least Sandpiper during migration and winter in the GCJV region (Appendices C and D). Initial recommendations are to provide 70% of this acreage through Western Sandpiper habitat objective planning and provisioning, 20% via Stilt Sandpiper habitat actions, and the remainder through Buff-breasted Sandpiper planning.
**Baird’s Sandpiper** – This species is an uncommon to common fall migrant in Texas between mid-July and mid-October (Lockwood and Freeman 2004). Lowery (1974) deemed Baird’s Sandpiper a regular but uncommon fall migrant, more frequently encountered in the western portion of the state. Rosenberg and Sillett (1991) considered the species to be rare in the southwest Louisiana rice prairies during their research, and Floyd (2000) noted only one spring record and no fall records for Acadia Parish, Louisiana. This species is rare fall migrant in Mississippi (Turcotte and Watts 1999), and is rare in spring and fall in Alabama (Imhof 1976). Lowery (1974) deemed Baird’s Sandpiper a regular but uncommon fall migrant, more frequently encountered in the western portion of the state. However, detection of this species may be under reported due to similarity with other “peep” species, or their more frequent use of drier habitats.

Helmers (1992) placed Baird’s Sandpiper in the aquatic prober/gleaner foraging guild, using saturated to flooded substrates with zero to sparse, short vegetation. A preference for inland habitats in migration has been noted, as has use of agricultural fields (Moskoff and Montgomerie 2002). Its habitat requirements were considered to overlap significantly with priority species Buff-breasted Sandpiper.

The estimated North American Baird’s Sandpiper population is 300,000 individuals (Morrison et al. 2006), and approximately 10% of those birds are estimated to move through the GCJV region. The GCJV SWG opined that approximately 95% of migrants through the region use managed and/or inland wetlands, agricultural fields, and grasslands. Because most adults during southbound migration follow a narrow corridor along the Rocky Mountains (Moskoff and Montgomerie 2002), and thus numbers of adults occurring elsewhere are negligible, fall population objectives for the GCJV region consider only southbound juveniles.

Approximately **220 acres** (~89 hectares) of additional habitat should be added to Buff-breasted Sandpiper habitat objectives for the GCJV region to accommodate potential resource competition with Baird’s Sandpiper (Appendices C and D).

**Pectoral Sandpiper** – Lockwood and Freeman (2004) described Pectoral Sandpiper as common to uncommon throughout most of Texas during fall, with migration dates ranging from mid-July to mid-November. It is also considered to be a common to abundant fall migrant in Louisiana (Lowery 1974, Rosenberg and Sillett 1991, Floyd 2000). Pectoral Sandpiper is a regular spring and fall migrant throughout Mississippi (Turcotte and Watts 1999). Imhof (1976) called it common in Alabama during migration, especially inland.

Pectoral Sandpiper is an aquatic prober/gleaner on saturated to flooded substrates with zero to sparse, short vegetation (Helmers 1992). It prefers areas with more vegetation than other shorebirds grouped in this foraging guild, however, including wet meadows, grassy lakeshores, and flooded pastures (Lowery 1974,
Holmes and Pitelka 1998). The SWG determined this species to have significant habitat overlap with Buff-breasted Sandpiper, Western Sandpiper, and Stilt Sandpiper.

The estimated North American Pectoral Sandpiper population is 500,000 birds (Morrison et al. 2006). Approximately 36% of the North American population is estimated to move through the GCJV region, with an estimated 92% of those birds using managed and/or inland wetlands, agricultural fields, and grasslands. Population objectives for the GCJV region are to support 304,440 Pectoral Sandpiper in those habitats during the fall migration period.

Approximately 3,535 acres (~1,430 hectares) of appropriate habitat are needed to support those population objectives (Appendices C and D). Initial recommendations are to provide 80% of that area through habitat planning and provisioning for Western Sandpiper and Stilt Sandpiper (40% per species), and the remaining 20% as part of Buff-breasted Sandpiper habitat planning.

Dunlin – Dunlin is a common to abundant winter resident along the Texas coast (Lockwood and Freeman 2004). Fall migration spans from early September to mid-November. Lockwood and Freeman (2004) noted that the species uses inland sites more frequently in fall versus spring. Lowery (1974) noted that the earliest fall records for the species in Louisiana were from the first week of September. Dunlin is an abundant fall migrant and winter resident along the Mississippi coast, and is widespread along inland shorelines in migration (Turcotte and Watts 1999). It is common to abundant during migration and winter along the Alabama coast, uncommon inland during the fall, and rare inland in spring and winter (Imhof 1976).

Helmers (1992) described Dunlin as an aquatic prober/gleaner, foraging over saturated to flooded substrates having zero to short, sparse vegetation. The SWG considered Dunlin to have significant habitat overlap with priority shorebird species Western Sandpiper, Stilt Sandpiper, and Short-billed Dowitcher.

Morrison et al.’s (2006) North American Dunlin population estimate is 1,525,000 birds. About 26% of those birds are believed to migrate through and/or winter in the GCJV region, with approximately 35% of that portion using managed and/or inland wetlands and agricultural fields. The SWG assumed that Dunlin would be present and using those inland sites for 42 days (6 weeks).

It is estimated that about 11,016 acres (~4,458 hectares) of shallowly-flooded, sparsely-vegetated habitat will be required to support this number of Dunlin (Appendices C and D). Initial recommendations are to parcel this amount out as part of habitat planning and partitioning for the three priority shorebird species above (i.e. 35% in Stilt Sandpiper habitat, 35% in Short-billed Dowitcher habitat, and 30% in Western Sandpiper habitat).
**Long-billed Dowitcher** – This species is a common to uncommon migrant throughout Texas, a common coastal winter resident, and a locally common winter resident inland in the southern part of the state (Lockwood and Freeman 2004). Lowery (1974) termed it numerous in freshwater and brackish situations near the coast in spring, fall, and winter, except during severe winters. Long-billed Dowitcher is a common to uncommon migrant in Mississippi, and a common coastal winter resident in that state (Turcotte and Watts 1999). Imhof (1976) considered it to be uncommon along the Alabama coast in migration, and rare inland.

Long-billed Dowitcher is an aquatic prober/gleaner in saturated to flooded substrates with zero to sparse, short vegetation (Helmers 1992). The SWG considered its habitat requirement to significantly overlap with those of priority shorebird species Stilt Sandpiper and Short-billed Dowitcher.

Though Morrison et al. (2006) placed the North American population estimate for this species at 500,000, the SWG decided to increase that estimate by 100%, based upon recent research and surveys, and expert opinion. About 28% of the North American population is estimated to move through and/or over-winter in the GCJV region. Members of the GCJV SWG noted a disparity in habitat partitioning in BCR 37 between Louisiana and Texas. Texas representatives on the SWG indicated that a large percentage (70%) of Long-billed Dowitcher use intertidal habitats in BCR 37, Texas, while Louisiana experts opined that 95% of birds in their state were using inland BCR 37 sites in the rice prairies, and only 5% used intertidal situations. To reflect this observed difference in habitat use, the Long-billed Dowitcher fall population objective for BCR 37 was divided between Texas and Louisiana, based on the approximate percent of the BCR occurring within each state. Thus, it is assumed that 60% of the BCR 37 population objective will be met in Texas, and 40% in Louisiana. Those figures were then portioned by habitat according to each state’s habitat partitioning percentages.

Analysis and extrapolation of Long-billed Dowitcher numbers for 13 inland CBCs within or adjacent to BCR 37 between 1995 and 2005 provides an estimate of approximately 45,800 Long-billed Dowitcher over-wintering in the inland portion of BCR 37 each year. That same dataset indicated that approximately 88% of Long-billed Dowitcher tallied during that period were in Louisiana, and 12% were in Texas. Over-wintering inland habitat responsibilities were therefore divided between states according to those percentages (i.e. 40,300 over-wintering in BCR 37 Louisiana, 5,500 inland over-wintering in BCR 37 Texas). Population objectives for managed and/or inland wetlands or agricultural fields in the BCR 25, 26, and 27 portions of the GCJV region are to support 60,800 birds. Approximately 130 of those birds are estimated to over-winter in the GCJV region (20 in BCR 27, 110 in BCR 25 and 26).

To accommodate the habitat overlap between Long-billed Dowitcher and the two priority species mentioned above, it is estimated that about 2,039 acres (~825 hectares) will be required in Texas, BCR 37, and 8,436 acres (~3,414 hectares) are needed in Louisiana, BCR 37 (Appendices C and D). An additional 860 acres
(~348 hectares) will be needed in the GCJV portion of BCR 25, 26, and 27. Initial recommendations are to provide 70% of needed acreage as part of Short-billed Dowitcher habitat planning, and 30% as part of Stilt Sandpiper planning.

**Wilson’s Phalarope** – Wilson’s Phalarope is a common to abundant migrant across Texas, with fall migration stretching from late June to late October (Lockwood and Freeman 2004). Lowery (1974) considered it uncommon to moderately common in Louisiana from late July to early September, an appellation supported by Rosenberg and Sillett (1991) and Floyd (2000) for the southwest Louisiana rice prairies. Wilson’s Phalarope is an uncommon late summer/early fall and spring migrant across Mississippi (Turcotte and Watts 1999). Imhof (1976) regarded the species as occasional in migration through Alabama, typically along the coast. During southbound migration, adults stage at hypersaline lakes in the western United States, and fly non-stop to the western coastal South America. (Colwell and Jehl 1994). Southbound migration by juveniles is more gradual and over a broader front (Colwell and Jehl 1994).

Helmers (1992) classified this species as an aquatic/pelagic gleaner on flooded substrates having zero to sparse/moderate, short vegetation. The SWG believed that this species’ habitat needs potentially overlapped significantly with Stilt Sandpiper’s and Short-billed Dowitcher’s.

The North American population of Wilson’s Phalarope is estimated at 1,500,000 birds. About 10% of those individuals are believed to pass through the GCJV region, with 50% of that subset using managed and/or inland wetlands or agricultural fields. Fall population objective for the GCJV region is to support 75,442 birds on those habitats (juveniles only).

Approximately **718 acres** (~290 hectares) of will be needed to support those birds during southbound migration through the GCJV region (Appendices C and D). That habitat can be allocated through habitat planning and provisioning for Stilt Sandpiper and Short-billed Dowitcher (50% per species).
Table 1. Fall Shorebird Habitat Objectives, Gulf Coast Joint Venture Region

<table>
<thead>
<tr>
<th>PRIORITY SPECIES</th>
<th>HABITAT NEEDS (ac)</th>
<th>ADDED HABITAT FOR OTHER SHOREBIRDS (ac)</th>
<th>TOTAL</th>
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<tr>
<td></td>
<td>BBPL</td>
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<td>BNST</td>
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<tr>
<td>LBCU</td>
<td>6,836</td>
<td>225</td>
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<td>WESA</td>
<td>43,920</td>
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<tr>
<td>STSA</td>
<td>8,454</td>
<td>2,319</td>
<td>791.5</td>
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<tr>
<td>BBSA</td>
<td>714</td>
<td>295</td>
<td>17,332</td>
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<tr>
<td>SBDO</td>
<td>223</td>
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</table>

**Long-billed Curlew** – Provide approximately 20,024 acres (~8,103 hectares) of dry to saturated managed habitat, moderately to densely vegetated in short to medium height vegetation (primarily grasses) from July 15 to November 5.

**Western Sandpiper** - Provide approximately 54,025 acres (~21,863 hectares) of saturated to flooded managed habitat, with sparse (or no) short vegetation, from July 15 to November 5. Optimal flooding depth is 0 - ¾ in (~2 cm).

**Stilt Sandpiper** – Provide approximately 22,396 acres (~9,063 hectares) of saturated to flooded managed habitat, with sparse (or no) short vegetation, from July 15 to November 5. Optimal flooding depths range from approximately ¾ - 3 in (~2 - 8 cm).

**Buff-breasted Sandpiper** – Provide approximately 28,952 acres (~11,716 hectares) of pesticide- and/or herbicide-free short-grass habitat, and/or bare-soil/water interface habitat from July 15 to November 5.

**Short-billed Dowitcher** – Provide approximately 14,696 acres (~5,947 hectares) of saturated to flooded managed habitat, with sparse (or no) short vegetation, from July 15 to November 5. Optimal flooding depths range from approximately ¾ - 6¾ in (~2 – 16 cm).
Table 2. Recommended Shorebird Habitat Allocation (ac) by Gulf Coast Joint Venture Initiative Areas and Bird Conservation Region (BCR)

<table>
<thead>
<tr>
<th>PRIORITY SPECIES</th>
<th>LAGUNA MADRE</th>
<th>TEXAS MID-COAST</th>
<th>CHENIER PLAIN</th>
<th>MISSISSIPPI RIVER COASTAL WETLANDS</th>
<th>COASTAL MISSISSIPPI – ALABAMA WETLANDS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>BCR 37</td>
<td>BCR 25</td>
<td>BCR 37</td>
<td>BCR 25</td>
<td>BCR 26</td>
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<tr>
<td>Long-billed Curlew</td>
<td>9,102</td>
<td>0</td>
<td>9,863</td>
<td>0</td>
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<tr>
<td>Western Sandpiper</td>
<td>8,356</td>
<td>23</td>
<td>26,141</td>
<td>63</td>
<td>5</td>
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<tr>
<td>Stilt Sandpiper</td>
<td>855</td>
<td>23</td>
<td>7,013</td>
<td>63</td>
<td>6</td>
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<tr>
<td>Buff-breasted Sandpiper</td>
<td>7,213</td>
<td>48</td>
<td>7,178</td>
<td>131</td>
<td>11</td>
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<tr>
<td>Short-billed Dowitcher</td>
<td>590</td>
<td>8</td>
<td>7,073</td>
<td>24</td>
<td>2</td>
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<tr>
<td>Total</td>
<td>26,116</td>
<td>102</td>
<td>57,268</td>
<td>281</td>
<td>24</td>
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</table>
Acknowledgements

This document was improved by input from current and former members of the GCJV Shorebird Working Group: Donna Dittmann, Lee Elliott, Bill Howe, Chuck Hunter, Dr. Clint Jeske, Stefani Melvin, Dr. Brent Ortego, Michael Seymour, Dr. Mark Woodrey, and with additional assistance from Steve Cardiff, Mark Parr, Jake Walker, Barry Wilson, and Nick Winstead.
References


## Appendix A. Gulf Coast Joint Venture Shorebird Population Estimates

<table>
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<td>BCR 27</td>
<td>BCR 37</td>
<td>BCR 25 &amp; 26</td>
<td>BCR 27</td>
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<tr>
<td>Black-bellied Plover</td>
<td>200,000</td>
<td>0.57</td>
<td>0.5</td>
<td>25</td>
<td>1,140</td>
<td>1,000</td>
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<td>Killdeer</td>
<td>&gt;5,000,000</td>
<td>5.7</td>
<td>0.6</td>
<td>35</td>
<td>285,000</td>
<td>30,000</td>
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<td>Black-necked Stilt</td>
<td>175,000</td>
<td>1.71</td>
<td>0.2</td>
<td>20</td>
<td>2,992</td>
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<td>Greater Yellowlegs</td>
<td>100,000</td>
<td>2.85</td>
<td>0.66</td>
<td>33</td>
<td>2,850</td>
<td>660</td>
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<td>Lesser Yellowlegs</td>
<td>400,000</td>
<td>2.85</td>
<td>0.66</td>
<td>33</td>
<td>11,400</td>
<td>2,640</td>
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<td>Upland Sandpiper</td>
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<td>0.1425</td>
<td>0.05</td>
<td>75</td>
<td>498</td>
<td>175</td>
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<td>Long-billed Curlew</td>
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<td>0</td>
<td>0.02</td>
<td>20</td>
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<td>20²</td>
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<td>24,000</td>
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<td>50</td>
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<td>7,000</td>
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<td>Least Sandpiper</td>
<td>700,000</td>
<td>14.25</td>
<td>0.5</td>
<td>25</td>
<td>99,750</td>
<td>3,500</td>
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<td>Baird’s Sandpiper</td>
<td>300,000</td>
<td>0.057</td>
<td>0.033</td>
<td>10</td>
<td>171</td>
<td>100²</td>
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<tr>
<td>Pectoral Sandpiper</td>
<td>500,000</td>
<td>5.7</td>
<td>0.66</td>
<td>30</td>
<td>28,500</td>
<td>3,300</td>
</tr>
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<td>-------------------------</td>
<td>------------------------------------------------------</td>
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<td></td>
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<td></td>
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<td>BCR 27</td>
<td>BCR 37</td>
<td>BCR 25 &amp; 26</td>
<td>BCR 27</td>
</tr>
<tr>
<td>Dunlin</td>
<td>1,525,000</td>
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<td>0.656</td>
<td>25</td>
<td>869</td>
<td>10,000</td>
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<td>Stilt Sandpiper</td>
<td>820,000</td>
<td>2.85</td>
<td>0.2</td>
<td>60</td>
<td>23,370</td>
<td>1,640</td>
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<tr>
<td>Buff-breasted Sandpiper</td>
<td>40,000&lt;sup&gt;5&lt;/sup&gt;</td>
<td>5.7</td>
<td>0.2</td>
<td>90</td>
<td>2,280</td>
<td>80</td>
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<tr>
<td>Short-billed Dowitcher</td>
<td>153,000</td>
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<td>0.7</td>
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<td>436</td>
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<tr>
<td>Long-billed Dowitcher</td>
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<td>0.2</td>
<td>25</td>
<td>28,500</td>
<td>2,000</td>
</tr>
<tr>
<td>Wilson’s Phalarope</td>
<td>1,500,000</td>
<td>0.0285</td>
<td>0.002</td>
<td>10</td>
<td>427</td>
<td>30</td>
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<sup>2</sup> From unpublished document drafted by Chuck Hunter, USFWS Region 4, with input from state, federal and non-governmental shorebird biologists and researchers.

<sup>3</sup> Assumed that 57% of BCR 25 & 26 migrant shorebird population transit GCJV portion of those BCRs; based on percent emergent marsh habitat in the GCJV portion of BCR 25 & 26 compared with that in the entirety of BCR 25 & 26.

<sup>4</sup> Assumed that 2% of Southeastern Coastal Plain migrant shorebirds (BCR 27, 28, 29, & 31) transit GCJV portion of BCR 27; based on percent emergent marsh habitat in the GCJV portion of BCR 27 compared with that in the entirety of BCR 27, 28, 29, & 31.

<sup>5</sup> Some population estimates for U.S. and Canadian populations differ from those published in Brown et al. (2006). Most of these are based on more recent thorough direct counts (Long-billed Curlew), a few are adjusted using BBS-based population estimates where existing published population estimates were considered very low (Solitary Sandpiper and Spotted Sandpiper).

<sup>6</sup> Population estimates for LBCU, BASA, DUNL, and LBDO in the BCR 27 portion of the GCJV region reflect both the amount of emergent marsh habitat in that area relative to the entire Southeastern Coastal Plain, and expert opinion of regional shorebird biologists and experts.
## Appendix B. Fall Shorebird Population Objectives, Managed and all Inland Wetlands, Agriculture and Grasslands, Gulf Coast Joint Venture Region

<table>
<thead>
<tr>
<th>Species</th>
<th>Population Objective, GCJV Region, All Habitats¹</th>
<th>Habitat Use, by Percent, by Species During Fall Migration in GCJV Region²</th>
<th>Population Objective, Managed and all Inland Wetlands, Agriculture, and Grasslands, GCJV Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BCR 25 &amp; 26</td>
<td>BCR 27</td>
<td>BCR 37</td>
</tr>
<tr>
<td>Black-bellied Plover</td>
<td>2,280</td>
<td>2,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Killdeer</td>
<td>570,000</td>
<td>60,000</td>
<td>3,500,000</td>
</tr>
<tr>
<td>Black-necked Stilt</td>
<td>5,985</td>
<td>700</td>
<td>70,000</td>
</tr>
<tr>
<td>Greater Yellowlegs</td>
<td>5,700</td>
<td>1,320</td>
<td>66,000</td>
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<tr>
<td>Lesser Yellowlegs</td>
<td>22,800</td>
<td>5,280</td>
<td>264,000</td>
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<tr>
<td>Upland Sandpiper</td>
<td>996</td>
<td>350</td>
<td>520,000</td>
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<td>Long-billed Curlew</td>
<td>0</td>
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<td>40,000</td>
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<td>Semipalmated Sandpiper</td>
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<td>Western Sandpiper</td>
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<td>Least Sandpiper</td>
<td>199,500</td>
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<td>Baird’s Sandpiper</td>
<td>171</td>
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<tr>
<td>Pectoral Sandpiper</td>
<td>57,000</td>
<td>6,600</td>
<td>300,000</td>
</tr>
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<td>Dunlin</td>
<td>1,738</td>
<td>20,000</td>
<td>762,500</td>
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<tr>
<td>Stilt Sandpiper</td>
<td>46,740</td>
<td>3,280</td>
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<tr>
<td>Buff-breasted Sandpiper</td>
<td>4,560</td>
<td>160</td>
<td>72,000</td>
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<tr>
<td>Short-billed Dowitcher</td>
<td>872</td>
<td>2,142</td>
<td>76,500</td>
</tr>
<tr>
<td>Species</td>
<td>Population Objective, GCJV Region, All Habitats&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Habitat Use, by Percent, by Species During Fall Migration in GCJV Region&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Population Objective, Managed and all Inland Wetlands, Agriculture, and Grasslands, GCJV Region</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>BCR 25 &amp; 26</td>
<td>BCR 27</td>
<td>BCR 37</td>
</tr>
<tr>
<td>Long-billed Dowitcher</td>
<td>57,000</td>
<td>4,000</td>
<td>500,000</td>
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<tr>
<td>Wilson’s Phalarope</td>
<td>427</td>
<td>30</td>
<td>150,000</td>
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</tbody>
</table>

<sup>1</sup> Fall 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.

<sup>2</sup> From unpublished document drafted by Chuck Hunter, USFWS Region 4, with input from state, federal and non-governmental shorebird biologists and researchers.

<sup>3</sup>100% of shorebird habitat use in BCR 25 & 26 occurs in managed and all inland wetlands, agriculture, and grasslands.

<sup>4</sup> Represents a change from the original document crafted by Chuck Hunter, USFWS Region 4 et al. Changes based on recent knowledge and expert opinion of GCJV Shorebird Working Group.

<sup>5</sup>GCJV Shorebird Working Group noted disparity in habitat partitioning between Long-billed Dowitchers in Texas BCR 37 versus Louisiana BCR 37; habitat objectives for managed and all inland wetlands, agriculture and grasslands were allocated based upon the percent of each state occurring in BCR 37 and the Working Group’s habitat partitioning estimates.
Appendix C. Fall Migrant Shorebird Habitat Needs

Assumptions:

1) >4,800,000 shorebirds use inland/managed habitats in the GCJV portions of BCR 25, 26, 27, and 37 (from U.S. Shorebird Conservation Plan, analysis of landcover data, and expert opinion)

2) Chironomid larvae used as representative prey item

3) From Kersten and Piersma (1987), amount of energy in kilojoules (kJ) required to maintain a shorebird’s existence (basal) metabolic rate (EMR) is expressed by EMR (kJ) = 912(Body Mass (kg))^{0.704}

4) Energy yield from chironomid larvae = 23.8 kJ g^{-1} (Cummins and Wuycheck 1977)

5) Assimilation efficiency of birds feeding on invertebrates = 73% (Castro et al. 1989); net energy content of chironomid larvae = 23.8 kJ g^{-1}(0.73) = 17.374 kJ g_{dw}^{-1} (dw = dry weight)

6) The mass, dry weight, of invertebrates that a shorebird of known or assumed weight requires to maintain its EMR is expressed by \( X_{gdw} = \left(\frac{EMR}{(17.374 \text{ kJ g}_{dw}^{-1}\text{ d}^{-1})}\right)^{1} \)

7) In order to complete migration, a shorebird must increase its body mass by about 1g d^{-1}, requiring ingestion of about 2g_{dw} of invertebrates beyond that required for EMR

8) Invertebrates per square meter of managed habitat = 2.4g

9) Turnover time for transient shorebirds = 10 days

10) Number of stops a transient shorebird makes in the GCJV region = 1

11) For species that over-winter in the GCJV region, shorebird-use-days calculated from July 15 to November 5 (International Shorebird Survey fall migration period)

12) Expert opinion set Dunlin turnover time in the GCJV region during fall as 42 days

13) Species weights come from Sibley (2000) or Birds of North America accounts
<table>
<thead>
<tr>
<th>Species</th>
<th>GCJV Fall Inland and Managed Habitat Objective</th>
<th>Species Weight (Grams per Bird)</th>
<th>Existence (Basal) Metabolic Rate (EMR) Energy Requirements (Kilojoules per Day per Bird)</th>
<th>Grams Chironomid Larvae per Day per Bird to Maintain EMR and Continue Migration (EMR + 2 grams)</th>
<th>Acres Required for Transient Portion of Population (10 Day Turnover Rate)</th>
<th>Acres Required for Wintering Portion of Population (114 Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black-bellied Plover</td>
<td>12,480 (1,090 to winter, 114 days)</td>
<td>240</td>
<td>333.936</td>
<td>21.22</td>
<td>248.85</td>
<td>271.49</td>
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<td>Killdeer</td>
<td>3,952,000 (1,976,000 to winter)</td>
<td>95</td>
<td>173.905</td>
<td>12.009</td>
<td>24,432.32</td>
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<td>Black-necked Stilt</td>
<td>59,010 (11,810 to winter)</td>
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<td>272.714</td>
<td>17.697</td>
<td>860.03</td>
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<td>Lesser Yellowlegs</td>
<td>224,760 (4,710 to winter)</td>
<td>80</td>
<td>154.089</td>
<td>10.869</td>
<td>2,462.53</td>
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<td>Greater Yellowlegs</td>
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<td>160</td>
<td>251.012</td>
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<td>Upland Sandpiper</td>
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<td>17.078</td>
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<td>Long-billed Curlew</td>
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<td>Western Sandpiper</td>
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<td>Least Sandpiper</td>
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<tr>
<td>Species</td>
<td>GCJV Fall Inland and Managed Habitat Objective</td>
<td>Species Weight (Grams per Bird)</td>
<td>Existence (Basal) Metabolic Rate (EMR) Energy Requirements (Kilojoules per Day per Bird)</td>
<td>Grams Chironomid Larvae per Day per Bird to Maintain EMR and Continue Migration (EMR + 2 grams)</td>
<td>Acres Required for Transient Portion of Population (10 Day Turnover Rate)</td>
<td>Acres Required for Wintering Portion of Population (114 Days)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------------</td>
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<td>---------------------------------------------------------------------------------</td>
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<tr>
<td>Dunlin</td>
<td>275,613 for 42 days¹</td>
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<td>9.243</td>
<td>11,016.23</td>
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<td>Stilt Sandpiper</td>
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<td>Wilson’s Phalarope</td>
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<td><strong>337,537.37</strong></td>
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<td><strong>412,766.89</strong></td>
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Appendix D. Derivation of GCJV Priority Shorebird Fall Habitat Needs

1) Black-bellied Plover - BBPL (significant habitat needs overlap with priority species Long-billed Curlew and Buff-breasted Sandpiper)

North American population BBPL estimate – 200,000

Maximum proportion of North American BBPL population passing through GCJV region during fall – ~26% (52,140)

Proportion of GCJV BBPL population using managed/inland wetlands, agriculture, and grasslands – ~12% (6,240)

GCJV BBPL fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 12,480

Estimated number of BBPL, from population objective, that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 1,090

Estimated number of BBPL, from population objective, that transit through GCJV region during fall migration but do not overwinter – 11,390

Estimated length of stay during fall migration, GCJV region – 10 days

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain BBPL existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 21.22

Grams of chironomid larva per square meter of managed habitat – 2.4

Habitat Needed, Transient BBPL, \( x = (BBPL-Use-Days)(EMR+2g \text{ per } BBPL \text{ per day})(Chironomid \text{ Larva Density}) \)

\[ x = [(11,390 \text{ BBPL})(10 \text{ days})](21.22 \text{g/BBPL/day})(1 \text{m}^2/2.4 \text{g}) \]
\[ x = 1,007,066 \text{ m}^2 = 100.71 \text{ ha} = 248.85 \text{ ac} \]

~248.85 acres habitat required for fall transient BBPL, GCJV region

Habitat Needed, Over-Wintering BBPL, \( x = (BBPL-Use-Days)(EMR+2g \text{ per } BBPL \text{ per day})(Chironomid \text{ Larva Density}) \)

\[ x = [(1,090 \text{ BBPL})(114 \text{ days})](21.22 \text{g/BBPL/day})(1 \text{m}^2/2.4 \text{g}) \]
\[ x = 1,098,665 \text{ m}^2 = 109.87 \text{ ha} = 271.49 \text{ ac} \]
~271.49 acres habitat required for over-wintering BBPL, GCJV region, from arrival to start of winter period

Total acreage, managed/inland wetlands, agriculture, and grasslands required for BBPL, fall, GCJV region = ~520 acres

2) Killdeer – KILL (significant habitat needs overlap with priority species Long-billed Curlew and Buff-breasted Sandpiper)

North American KILL population estimate - >5,000,000¹

Maximum proportion of North American KILL population passing through GCJV region during fall – ~41% (2,065,000)²

Proportion of GCJV KILL population using managed/inland wetlands, agriculture, and grasslands – 95% (1,976,000)²

GCJV KILL fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 3,952,000

Estimated number of KILL that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 1,976,000⁸

Estimated number of KILL, from population objective, that transit through GCJV region during fall migration but do not overwinter – 1,976,000

Estimated length of stay during fall migration, GCJV region – 10 days⁴

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days⁵

Grams of chironomid larva (used as representative shorebird food item) required to maintain KILL existence metabolic rate (EMR= 912 (Body Mass (kg))⁰.⁷⁰⁴) and to sustain migration (EMR + 2g) – 12.009⁶

Grams of chironomid larva per square meter of managed habitat – 2.4⁷

Habitat Needed, Transient KILL, x = (KILL-Use-Days)(EMR+2g per KILL per day)(Chironomid Larva Density)

x = [(1,976,000 KILL)(10 days)](12.009g/KILL/day)(1m²/2.4g)

x = 98,874,100 m² = 9,887.41 ha = 24,432.32 ac

~24,432.32 acres habitat required for fall transient KILL, GCJV region
Habitat Needed, Over-Wintering KILL, \( x = (\text{KILL-Use-Days})(\text{EMR+2g per KILL per day})(\text{Chironomid Larva Density}) \)

\[
x = [(1,976,000 \text{ KILL})(114 \text{ days})](12.009\text{g}/\text{KILL/day})(1\text{m}^2/2.4\text{g}) \\
x = 1,127,164,740 \text{m}^2 = 112,716.5 \text{ ha} = 278,528.5 \text{ ac} \\
\]

~278,528.5 acres habitat required for over-wintering KILL, GCJV region, from arrival to start of winter period

Total acreage required for KILL, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~302,960 acres (see KILL section of main document)

3) Black-necked Stilt – BNST (significant habitat needs overlap with priority species Stilt Sandpiper and Western Sandpiper)

North American BNST population estimate – 175,000\(^1\)

Maximum proportion of North American BNST population passing through GCJV region during fall – ~22% (38,342)\(^2\)

Proportion of GCJV BNST population using managed/inland wetlands, agriculture, and grasslands – ~77% (29,505)\(^2\)

GCJV BNST fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 59,010

Estimated number of BNST that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 11,810\(^3\)

Estimated number of BNST, from population objective, that transit through GCJV region during fall migration but do not overwinter – 47,200

Estimated length of stay during fall migration, GCJV region – 10 days\(^4\)

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days\(^5\)

Grams of chironomid larva (used as representative shorebird food item) required to maintain BNST existence metabolic rate (EMR= 912 (Body Mass (kg))\(^0.704\)) and to sustain migration (EMR + 2g) – 17.697\(^6\)

Grams of chironomid larva per square meter of managed habitat – 2.4\(^7\)
Habitat Needed, Transient BNST, \( x = (\text{BNST-Use-Days})(\text{EMR}+2\text{g per BNST per day})(\text{Chironomid Larva Density}) \)

\[ x = [(47,200 \text{ BNST})(10 \text{ days})](17.697\text{g/BNST/day})(1\text{ m}^2/2.4\text{g}) \\
\]

\[ x = 3,480,410 \text{ m}^2 = 348.04 \text{ ha} = 860.03 \text{ ac} \]

\(~860.03\text{ acres habitat required for fall transient BNST, GCJV region}~\)

Habitat Needed, Over-Wintering BNST, \( x = (\text{BNST-Use-Days})(\text{EMR}+2\text{g per BNST per day})(\text{Chironomid Larva Density}) \)

\[ x = [(11,810 \text{ BNST})(114 \text{ days})](17.697\text{g/BNST/day})(1\text{ m}^2/2.4\text{g}) \\
\]

\[ x = 9,927,574 \text{ m}^2 = 992.76 \text{ ha} = 2,453.16 \text{ ac} \]

\(~2,453.16\text{ acres habitat required for over-wintering BNST, GCJV region, from arrival to start of winter period}~\)

Total acreage required for BNST, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = \(~3,313\text{ acres}~\)

4) Greater Yellowlegs – GRYE (significant habitat needs overlap with priority species Stilt Sandpiper and Short-billed Dowitcher)

North American GRYE population estimate – 100,000\(^1\)

Maximum proportion of North American GRYE population passing through GCJV region during fall – \(~36\% (36,510)\(^2\)

Proportion of GCJV GRYE population using managed/inland wetlands, agriculture, and grasslands – 63\% (23,046)\(^2\)

GCJV GRYE fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 46,092

Estimated number of GRYE that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 4,560\(^3\)

Estimated number of GRYE, from population objective, that transit through GCJV region during fall migration but do not overwinter – 41,532

Estimated length of stay during fall migration, GCJV region – 10 days\(^4\)

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days\(^5\)
Grams of chironomid larva (used as representative shorebird food item) required to maintain GRYE existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 16.448^6

Grams of chironomid larva per square meter of managed habitat – 2.4^7

Habitat Needed, Transient GRYE, \( x = (\text{GRYE-Use-Days})(\text{EMR+2g per GRYE per day})(\text{Chironomid Larva Density}) \)

\[
x = [(41,532 \text{ GRYE})(10 \text{ days})](16.448\text{g/GRYE/day})(1\text{m}^2/2.4\text{g})
x = 2,846,326 \text{ m}^2 = 284.63 \text{ ha} = 703.34 \text{ ac}
\]

~703.34 acres habitat required for fall transient GRYE, GCJV region

Habitat Needed, Over-Wintering GRYE, \( x = (\text{GRYE-Use-Days})(\text{EMR+2g per GRYE per day})(\text{Chironomid Larva Density}) \)

\[
x = [(4,560 \text{ GRYE})(114 \text{ days})](16.448\text{g/GRYE/day})(1\text{m}^2/2.4\text{g})
x = 3,562,636 \text{ m}^2 = 356.26 \text{ ha} = 880.35 \text{ ac}
\]

~880.35 acres habitat required for over-wintering GRYE, GCJV region, from arrival to start of winter period

Total acreage required for GRYE, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~1,583 acres

5) Lesser Yellowlegs – LEYE (significant habitat needs overlap with priority species Short-billed Dowitcher, Western Sandpiper, and Stilt Sandpiper)

North American LEYE population estimate – 400,000^1

Maximum proportion of North American LEYE population passing through GCJV region during fall – ~37% (146,040)^2

Proportion of GCJV LEYE population using managed/inland wetlands, agriculture, and grasslands – 77% (112,380)^3

GCJV LEYE fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 224,760

Estimated number of LEYE that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 4,710^3

Estimated number of LEYE, from population objective, that transit through GCJV region during fall migration but do not overwinter – 220,050
Estimated length of stay during fall migration, GCJV region – 10 days

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain LEYE existence metabolic rate (EMR= 912 (Body Mass (kg))0.704) and to sustain migration (EMR + 2g) – 10.869

Grams of chironomid larva per square meter of managed habitat – 2.4

Habitat Needed, Transient LEYE, \(x = (\text{LEYE-Use-Days})(\text{EMR+2g per LEYE per day})(\text{Chironomid Larva Density})\)

\[x = [(220,050 \text{ LEYE})(10 \text{ days})](10.869g / \text{LEYE /day})(1m^2/2.4g)\]
\[x = 9,965,514 \text{ m}^2 = 996.55 \text{ ha} = 2,462.53 \text{ ac}\]

\(\sim2,462.53\) acres habitat required for fall transient LEYE, GCJV region

Habitat Needed, Over-Wintering LEYE, \(x = (\text{LEYE-Use-Days})(\text{EMR+2g per LEYE per day})(\text{Chironomid Larva Density})\)

\[x = [(4,710 \text{ LEYE})(114 \text{ days})](10.869g /\text{LEYE /day})(1m^2/2.4g)\]
\[x = 2,431,667 \text{ m}^2 = 243.17 \text{ ha} = 600.88 \text{ ac}\]

\(\sim600.88\) acres habitat required for over-wintering LEYE, GCJV region, from arrival to start of winter period

Total acreage required for LEYE, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = \(\sim3063\) acres

6) Upland Sandpiper – UPSA (significant habitat needs overlap with priority species Buff-breasted Sandpiper)

North American UPSA population estimate – 350,000

Maximum proportion of North American UPSA population passing through GCJV region during fall – \(~74\% (260,673)\)

Proportion of GCJV UPSA population using managed/inland wetlands, agriculture, and grasslands – \(100\%\)

GCJV UPSA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 521,346
Estimated length of stay during fall migration, GCJV region – 10 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain UPSA existence metabolic rate (EMR= 912 (Body Mass (kg))\(^{0.704}\)) and to sustain migration (EMR + 2g) – 17.078

Grams of chironomid larva per square meter of managed habitat – 2.4

Habitat Needed, Transient UPSA, \(x = (\text{UPSA-Use-Days})(\text{EMR+2g per UPSA per day})(\text{Chironomid Larva Density})\)

\[x = [(521,346 \text{ UPSA})(10 \text{ days})](17.078g/ \text{ UPSA per day})(1\text{m}^2/2.4g)\]

\[x = 37,098,112 \text{ m}^2 = 3709.81 \text{ ha} = 9,167.14 \text{ ac}\]

Total acreage required for UPSA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~9,167 acres

7) Long-billed Curlew – LBCU (GCJV Priority Shorebird Species)

North American LBCU population estimate – 100,000

Maximum proportion of North American LBCU population passing through GCJV region during fall – ~20% (20,020)

Proportion of GCJV LBCU population using managed/inland wetlands, agriculture, and grasslands – 60% (12,012)

GCJV LBCU fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 24,024

Estimated number of LBCU that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 14,400

Estimated number of LBCU, from population objective, that transit through GCJV region during fall migration but do not overwinter – 9,624

Estimated length of stay during fall migration, GCJV region – 10 days

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain LBCU existence metabolic rate (EMR= 912 (Body Mass (kg))\(^{0.704}\)) and to sustain migration (EMR + 2g) – 38.206
Grams of chironomid larva per square meter of managed habitat – 2.47

Habitat Needed, Transient LBCU, \( x = (LBCU\text{-Use-Days})(EMR + 2g \text{ per}\ LBCU\text{ per day})(Chironomid\ Larva\ Density) \)

\[
x = [(9,624\ LBCU)(10\ days)](38.206g/LBCU/day)(1m^2/2.4g) \\
x = 1,532,060\ m^2 = 153.206\ ha = 378.58\ ac
\]

~378.58 acres habitat required for fall transient LBCU, GCJV region

Habitat Needed, Over-Wintering LBCU, \( x = (LBCU\text{-Use-Days})(EMR + 2g \text{ per}\ LBCU\text{ per day})(Chironomid\ Larva\ Density) \)

\[
x = [(14,400\ LBCU)(114\ days)](38.206g/LBCU/day)(1m^2/2.4g) \\
x = 26,132,904\ m^2 = 2613.29\ ha = 6,457.58\ ac
\]

~6,457.58 acres habitat required for over-wintering LBCU, GCJV region, from arrival to start of winter period

Total acreage required for LBCU, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~6,836 acres

8) Semipalmated Sandpiper – SESA (significant habitat needs overlap with priority species Western Sandpiper, Stilt Sandpiper, and Buff-breasted Sandpiper)

North American SESA population estimate – 2,000,000

Maximum proportion of North American SESA population passing through GCJV region during fall – ~27% (535,400)

Proportion of GCJV SESA population using managed/inland wetlands, agriculture, and grasslands – ~31% (168,600)

GCJV SESA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 337,200

Estimated length of stay during fall migration, GCJV region – 10 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain SESA existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 6.446

Grams of chironomid larva per square meter of managed habitat – 2.47
Habitat Needed, Transient SESA, \( x = (\text{SESA-Use-Days})(\text{EMR} + 2\text{g per SESA per day})(\text{Chironomid Larva Density}) \)

\[
x = [(337,200 \text{ SESA})(10 \text{ days})](6.446\text{g/SESA/day})(1\text{m}^2/2.4\text{g})
x = 9,056,630 \text{ m}^2 = 905.67 \text{ ha} = 2,237.94 \text{ ac}
\]

**Total acreage required for SESA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~2,237 acres**

9) **Western Sandpiper – WESA** (GCJV Priority Shorebird Species)

**North American WESA population estimate** – 3,500,000\(^1\)

Maximum proportion of North American WESA population passing through GCJV region during fall – ~52% (1,806,875)\(^2\)

Proportion of GCJV WESA population using managed/inland wetlands, agriculture, and grasslands – ~32% (576,975)\(^2\)

GCJV WESA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 1,153,950

Estimated number of WESA that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 525,340\(^3,8\)

Estimated number of WESA, from population objective, that transit through GCJV region during fall migration but do not overwinter – 628,780\(^8\)

Estimated length of stay during fall migration, GCJV region – 10 days\(^4\)

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days\(^5\)

Grams of chironomid larva (used as representative shorebird food item) required to maintain WESA existence metabolic rate (EMR = 912 (Body Mass (kg))\(^0.704\)) and to sustain migration (EMR + 2g) – 6.446\(^6\)

Grams of chironomid larva per square meter of managed habitat – 2.4\(^7\)

Habitat Needed, Transient WESA, \( x = (\text{WESA-Use-Days})(\text{EMR} + 2\text{g per WESA per day})(\text{Chironomid Larva Density}) \)

\[
x = [(628,780 \text{ WESA})(10 \text{ days})](6.446\text{g/WESA/day})(1\text{m}^2/2.4\text{g})
x = 16,887,982 \text{ m}^2 = 1,688.8 \text{ ha} = 4,173.11 \text{ ac}
\]
~4,173.11 acres habitat required for fall transient WESA, GCJV region

Habitat Needed, Over-Wintering WESA, x = (WESA-Use-Days)(EMR+2g per WESA per day)(Chironomid Larva Density)

\[ x = [(525,340 \text{ WESA})(114 \text{ days})](6.446\text{g/WESA/day})(1\text{m}^2/2.4\text{g}) \]

\[ x = 161,056,372 \text{ m}^2 = 16,105.64 \text{ ha} = 39,747.2 \text{ ac} \]

~39,747.2 acres habitat required for over-wintering WESA, GCJV region, from arrival to start of winter period

Total acreage required for WESA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~43,920 acres

10) Least Sandpiper – LESA (significant habitat needs overlap with priority species Western Sandpiper, Stilt Sandpiper, and Buff-breasted Sandpiper)

North American LESA population estimate – 700,000

Maximum proportion of North American LESA population passing through GCJV region during fall – ~40% (278,250)

Proportion of GCJV LESA population using managed/inland wetlands, agriculture, and grasslands – ~74% (206,850)

GCJV LESA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 413,700

Estimated number of LESA that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 13,200

Estimated number of LESA, from population objective, that transit through GCJV region during fall migration but do not overwinter – 400,500

Estimated length of stay during fall migration, GCJV region – 10 days

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain LESA existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 5.191

Grams of chironomid larva per square meter of managed habitat – 2.4
Habitat Needed, Transient LESA, \( x = (\text{LESA-Use-Days})(\text{EMR+2g per LESA per day})(\text{Chironomid Larva Density}) \)

\[
x = [(400,500 \text{ LESA})(10 \text{ days})](5.191 \text{g/LESA/day})(1\text{m}^2/2.4\text{g})
\]

\[
x = 8,662,481 \text{ m}^2 = 866.25 \text{ ha} = 2,140.55 \text{ ac}
\]

~2,140.55 acres habitat required for fall transient LESA, GCJV region

Habitat Needed, Over-Wintering LESA, \( x = (\text{LESA-Use-Days})(\text{EMR+2g per LESA per day})(\text{Chironomid Larva Density}) \)

\[
x = [(13,200 \text{ LESA})(114 \text{ days})](5.191 \text{g/LESA/day})(1\text{m}^2/2.4\text{g})
\]

\[
x = 3,254,757 \text{ m}^2 = 325.48 \text{ ha} = 804.27 \text{ ac}
\]

~804.27 acres habitat required for over-wintering LESA, GCJV region, from arrival to start of winter period

Total acreage required for LESA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~2,944 acres

11) Baird’s Sandpiper – BASA (significant habitat needs overlap with priority species Buff-breasted Sandpiper)

North American BASA population estimate – 300,000

Maximum proportion of North American BASA population passing through GCJV region during fall – ~10% (30,271)

Proportion of GCJV BASA population using managed/inland wetlands, agriculture, and grasslands – ~95% (28,766)

GCJV BASA fall population objective (juveniles only, adults bypass GCJV region fall), managed/inland wetlands, agriculture, and grasslands – 28,766

Estimated length of stay during fall migration, GCJV region – 10 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain BASA existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 7.444

Grams of chironomid larva per square meter of managed habitat – 2.4

Habitat Needed, Transient BASA, \( x = (\text{BASA-Use-Days})(\text{EMR+2g per BASA per day})(\text{Chironomid Larva Density}) \)
x = [(28,766 BASA)(10 days)](7.444g/BASA/day)(1m²/2.4g)
x = 892,225 m² = 89.22 ha = 220.47 ac

Total acreage required for BASA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~220 acres

12) Pectoral Sandpiper – PESA (significant habitat needs overlap with priority species Buff-breasted Sandpiper, Western Sandpiper, and Stilt Sandpiper)

North American PESA population estimate – 500,000¹

Maximum proportion of North American PESA population passing through GCJV region during fall – ~36% (181,800)²

Proportion of GCJV PESA population using managed/inland wetlands, agriculture, and grasslands – 92% (166,470)²

GCJV PESA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 332,940

Estimated length of stay during fall migration, GCJV region – 10 days⁴

Grams of chironomid larva (used as representative shorebird food item) required to maintain PESA existence metabolic rate (EMR= 912 (Body Mass (kg))⁰.⁷⁰⁴) and to sustain migration (EMR + 2g) – 10.315⁶

Grams of chironomid larva per square meter of managed habitat – 2.4⁷

Habitat Needed, Transient PESA, x = (PESA-Use-Days)(EMR+2g per PESA per day)(Chironomid Larva Density)

x = [(332,940 PESA)(10 days)](10.315g/PESA/day)(1m²/2.4g)
x = 14,309,483 m² = 1,430.95 ha = 3,535.95 ac

Total acreage required for PESA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~3,535.95 acres

13) Dunlin – DUNL (significant habitat needs overlap with priority species Western Sandpiper, Stilt Sandpiper, and Short-billed Dowitcher)

North American DUNL population estimate – 1,525,000¹

Maximum proportion of North American DUNL population passing through GCJV region during fall – ~26% (392,119)²
Proportion of GCJV DUNL population using managed/inland wetlands, agriculture, and grasslands – ~35% (137,806)

GCJV DUNL fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 275,613

Estimated length of stay during fall migration, GCJV region – 42 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain DUNL existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 9.243

Grams of chironomid larva per square meter of managed habitat – 2.4

Habitat Needed, DUNL, fall GCJV region, \( x = (\text{DUNL-Use-Days})(\text{EMR+2g per DUNL per day})(\text{Chironomid Larva Density}) \)

\[
x = [(275,613 \text{ DUNL})(42 \text{ days})](9.243\text{g/ DUNL/day})(1\text{m}^2/2.4\text{g})
\]

\[
x = 44,581,091 \text{ m}^2 = 4,458.11 \text{ ha} = 11,016.23 \text{ ac}
\]

~11,016.23 acres habitat required for fall DUNL, GCJV region

Total acreage required for DUNL, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~11,016 acres

14) Stilt Sandpiper – STSA (GCJV Priority Shorebird Species)

North American STSA population estimate – 820,000

Maximum proportion of North American STSA population passing through GCJV region during fall – ~63% (517,010)

Proportion of GCJV STSA population using managed/inland wetlands, agriculture, and grasslands – ~81% (418,282)

GCJV STSA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 836,364

Estimated number of STSA that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – 5,000

Estimated number of STSA, from population objective, that transit through GCJV region during fall migration but do not overwinter – 831,364
Estimated length of stay during fall migration, GCJV region – 10 days

Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days

Grams of chironomid larva (used as representative shorebird food item) required to maintain STSA existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 9.243

Grams of chironomid larva per square meter of managed habitat – 2.4

Habitat Needed, Transient STSA, \( x = (\text{STSA-Use-Days})(\text{EMR+2g per STSA per day})(\text{Chironomid Larva Density}) \)

\[
x = [(831,364 \text{ STSA})(10 \text{ days})](9.243 \text{g/STSA/day})(1 \text{m}^2/2.4 \text{g})
\]

\[
x = 32,017,906 \text{ m}^2 = 3021.79 \text{ ha} = 7,911.8 \text{ ac}
\]

~7,911.8 acres habitat required for fall transient STSA, GCJV region

Habitat Needed, Over-Wintering STSA, \( x = (\text{STSA-Use-Days})(\text{EMR+2g per STSA per day})(\text{Chironomid Larva Density}) \)

\[
x = [(5,000 \text{ STSA})(114 \text{ days})](9.243 \text{g/STSA/day})(1 \text{m}^2/2.4 \text{g})
\]

\[
x = 2,195,212.5 \text{ m}^2 = 219.52 \text{ ha} = 542.45 \text{ ac}
\]

~542.45 acres habitat required for over-wintering STSA, GCJV region, from arrival to start of winter period

Total acreage required for STSA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~8,454 acres

15) Buff-breasted Sandpiper – BBSA (GCJV Priority Shorebird Species)

North American BBSA population estimate – 40,000

Maximum proportion of North American BBSA population passing through GCJV region during fall – ~96% (38,360)

Proportion of GCJV BBSA population using managed/inland wetlands, agriculture, and grasslands – ~95% (36,556)

GCJV BBSA fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 73,112

Estimated length of stay during fall migration, GCJV region – 10 days
Grams of chironomid larva (used as representative shorebird food item) required to maintain BBSA existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 9.496^6

Grams of chironomid larva per square meter of managed habitat – 2.4^7

Habitat Needed, Transient BBSA, x = (BBSA-Use-Days)(EMR+2g per BBSA per day)(Chironomid Larva Density)

\[ x = [(73,112 \text{ BBSA})(10 \text{ days})](9.496g/\text{BBSA/day})(1m^2/2.4g) \]
\[ x = 2,892,798 \text{ m}^2 = 298.28 \text{ ha} = 714.83 \text{ ac} \]

Total acreage required for BBSA, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~714 acres

16) Short-billed Dowitcher – SBDO (GCJV Priority Shorebird Species)

North American SBDO population estimate – 153,000\textsuperscript{1}

Maximum proportion of North American SBDO population passing through GCJV region during fall – ~26% (39,757)\textsuperscript{2}

Proportion of GCJV SBDO population using managed/inland wetlands, agriculture, and grasslands – ~21% (8,300)\textsuperscript{2}

GCJV SBDO fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – 16,600

Estimated length of stay during fall migration, GCJV region – 10 days\textsuperscript{4}

Grams of chironomid larva (used as representative shorebird food item) required to maintain SBDO existence metabolic rate (EMR= 912 (Body Mass (kg))^{0.704}) and to sustain migration (EMR + 2g) – 13.098^6

Grams of chironomid larva per square meter of managed habitat – 2.4^7

Habitat Needed, Transient SBDO, x = (SBDO-Use-Days)(EMR+2g per SBDO per day)(Chironomid Larva Density)

\[ x = [(16,600 \text{ SBDO})(10 \text{ days})](13.098g/\text{SBDO/day})(1m^2/2.4g) \]
\[ x = 904,945 \text{ m}^2 = 90.59 \text{ ha} = 223.86 \text{ ac} \]

Total acreage required for SBDO, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~223 acres
17) **Long-billed Dowitcher – LBDO** (significant habitat needs overlap with priority species Stilt Sandpiper and Short-billed Dowitcher)

**North American LBDO population estimate** – 1,000,000$^{1,8}$

**Maximum proportion of North American LBDO population passing through GCJV region during fall** – ~28% (250,000)$^2$

**Proportion of GCJV LBDO population using managed/inland wetlands, agriculture, and grasslands – BCR 37, TX - 30%; rest of GCJV region - 95%$^8$**

**GCJV LBDO fall population objective (adults plus 2 juveniles), managed/inland wetlands, agriculture, and grasslands – BCR 37, TX – 90,000; BCR 37, LA – 190,000; rest of GCJV region – 60,800**

**Estimated number of LBDO that overwinter in GCJV region, managed/inland wetlands, agriculture, and grasslands – BCR 37, TX – 5,500; BCR 37, LA – 40,300$^3$; rest of GCJV region – 130$^3$**

**Estimated number of LBDO, from population objective, that transit through GCJV region during fall migration but do not overwinter – BCR 37, TX – 84,500; BCR 37, LA – 149,700; rest of GCJV region – 30,370**

**Estimated length of stay during fall migration, GCJV region – 10 days$^4$**

**Maximum length of stay for over-wintering shorebirds from arrival in fall to beginning of winter period, GCJV region – 114 days$^5$**

**Grams of chironomid larva (used as representative shorebird food item) required to maintain LBDO existence metabolic rate (EMR= 912 (Body Mass (kg))$^{0.704}$) and to sustain migration (EMR + 2g) – 13.451$^6$**

**Grams of chironomid larva per square meter of managed habitat – 2.4$^7$**

**Habitat Needed, Transient LBDO, BCR 37 TX, x = (LBDO-Use-Days)(EMR+2g per LBDO per day)(Chironomid Larva Density)**

\[ x = [(84,500 \text{ LBDO})(10 \text{ days})](13.451 \text{ g/LBDO/day})(1 \text{ m}^2/2.4\text{ g}) \]

\[ x = 4,735,872.92 \text{ m}^2 = 473.59 \text{ ha} = 1,170.27 \text{ ac} \]

~1,170.57 acres habitat required for fall transient LBDO, BCR 37, TX

**Habitat Needed, Transient LBDO, BCR 37, LA, x = (LBDO-Use-Days)(EMR+2g per LBDO per day)(Chironomid Larva Density)**
\[ x = [(149,700 \text{ LBDO})(10 \text{ days})](13.451 \text{ g/LBDO/day})(1 \text{ m}^2/2.4 \text{ g}) \\
= 8,390,061.25 \text{ m}^2 = 839.01 \text{ ha} = 2,073.24 \text{ ac} \\
\]

~2,073.24 acres habitat required for fall transient LBDO, BCR 37, LA

Habitat Needed, Over-Wintering LBDO, BCR 37, TX, \( x = (\text{LBDO-Use-Days})(\text{EMR+2g per LBDO per day})(\text{Chironomid Larva Density}) \)

\[ x = [(5,500 \text{ LBDO})(114 \text{ days})](13.451/\text{LBDO/day})(1 \text{ m}^2/2.4 \text{ g}) \\
= 3,514,073.75 \text{ m}^2 = 351.41 \text{ ha} = 868.35 \text{ ac} \\
\]

~868.35 acres habitat required for over-wintering LBDO, BCR 37, TX, from arrival to start of winter period

Habitat Needed, Over-Wintering LBDO, BCR 37, LA, \( x = (\text{LBDO-Use-Days})(\text{EMR+2g per LBDO per day})(\text{Chironomid Larva Density}) \)

\[ x = [(40,300 \text{ LBDO})(114 \text{ days})](13.451/\text{LBDO/day})(1 \text{ m}^2/2.4 \text{ g}) \\
= 25,748,576.75 \text{ m}^2 = 2,574.86 \text{ ha} = 6,362.62 \text{ ac} \\
\]

~6,362.62 acres habitat required for over-wintering LBDO, BCR 37, LA, from arrival to start of winter period

Habitat Needed, Transient LBDO, GCJV region outside BCR 37, \( x = (\text{LBDO-Use-Days})(\text{EMR+2g per LBDO per day})(\text{Chironomid Larva Density}) \)

\[ x = [(60,670 \text{ LBDO})(10 \text{ days})](13.451/\text{LBDO/day})(1 \text{ m}^2/2.4 \text{ g}) \\
= 3,400,300 \text{ m}^2 = 340.03 \text{ ha} = 840.23 \text{ ac} \\
\]

~840.23 acres habitat required for fall transient LBDO, GCJV region outside BCR 37

Habitat Needed, Over-Wintering LBDO, GCJV region outside BCR 37, \( x = (\text{LBDO-Use-Days})(\text{EMR+2g per LBDO per day})(\text{Chironomid Larva Density}) \)

\[ x = [(130 \text{ LBDO})(114 \text{ days})](13.451/\text{LBDO/day})(1 \text{ m}^2/2.4 \text{ g}) \\
= 83,059 \text{ m}^2 = 8.31 \text{ ha} = 20.52 \text{ ac} \\
\]

~20.52 acres habitat required for over-wintering LBDO, GCJV region outside BCR 37

Total acreage required for LBDO, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~11,335 acres
18) Wilson’s Phalarope – WIPH (significant habitat needs overlap with priority species Stilt Sandpiper and Short-billed Dowitcher)

**North American WIPH population estimate** – 1,500,000

**Maximum proportion of North American WIPH population passing through GCJV region during fall** – ~10% (150,457)

**Proportion of GCJV WIPH population using managed/inland wetlands, agriculture, and grasslands** – ~50% (75,442)

**GCJV WIPH fall population objective (juveniles only), managed/inland wetlands, agriculture, and grasslands** – 75,442

**Estimated length of stay during fall migration, GCJV region** – 10 days

**Grams of chironomid larva (used as representative shorebird food item) required to maintain WIPH existence metabolic rate (EMR= 912 (Body Mass (kg))0.704) and to sustain migration (EMR + 2g) – 9.243**

**Grams of chironomid larva per square meter of managed habitat** – 2.4

**Habitat Needed, Transient WIPH, x = (WIPH-Use-Days)(EMR+2g per WIPH per day)(Chironomid Larva Density)**

\[ x = [(75,442 \text{ WIPH})(10 \text{ days})](9.243\text{g/WIPH/day})(1\text{m}^2/2.4\text{g}) \]

\[ x = 2,905,460 \text{ m}^2 = 290.54 \text{ ha} = 717.95 \text{ ac} \]

**Total acreage required for WIPH, managed/inland wetlands, agriculture, and grasslands fall, GCJV region = ~717 acres**

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2 From unpublished document by Chuck Hunter et al., with revisions per GCJV Shorebird Working Group, based on unpublished research and surveys and expert opinion

3 From analysis and extrapolation of Christmas Bird Count (CBC) data for inland CBCs, GCJV region, 1995 - 2008


5 From International Shorebird Survey protocol, fall period defined as July 15 – November 5


GCJV Shorebird Working Group expert opinion

From: