CONSERVATION PLAN FOR THE MARBLED GODWIT (*LIMOSA FEDOA*)

Version 1.2

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NOTE about Version 1.2:

The only difference between Version 1.2 (February 2010) and Version 1.1 (February 2006) is the addition of a Spanish executive summary.

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Front Cover Photo:

Marbled Godwits resting and foraging at Snake Bight mudflats, Everglades National Park, Florida. Photograph by **Nancy Douglass**, Southwest Region Nongame Biologist, Florida Fish & Wildlife Conservation Commission. Godwits wintering at Snake Bight may include birds of the isolated population that nests along the southwestern coast of James Bay in Ontario, Quebec, and Nunavut.

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EXECUTIVE SUMMARY

The Marbled Godwit (*Limosa fedoa*) nests primarily in temperate grasslands of north-central United States (U.S.) and south-central Canada (i.e., mid-continental population) and winters primarily at coastal sites from central California south to central Sinaloa. There are also two small breeding populations that are highly disjunct from the mid-continental population—one on the Alaska Peninsula (*L. f. beringiae*) and one at James Bay in Ontario, Quebec, and Nunavut. Alaskan birds are thought to winter at coastal sites from Washington south to central California, and James Bay birds are believed to winter at coastal sites of the southeastern U.S. and/or at sites along the U.S. Gulf of Mexico coast.

The Marbled Godwit warrants conservation planning for several reasons: (1) its estimated global population is relatively small (140,000-200,000 birds), (2) its population trends and ecology are poorly understood, and (3) significant habitat loss or degradation appears to be eroding much of its breeding and wintering ranges. Primary mid-continental nesting habitat is native grassland encompassing complexes of relatively unvegetated, shallow wetlands. In these habitats, godwits face a number of threats, the most significant of which is habitat loss/ degradation due to agricultural conversion. Currently, the greatest threats to the two disjunct breeding populations are their small sizes. At wintering and coastal migration stopover sites, the most significant threats are development, recreation-based human disturbance, mariculture, and invasions of exotic plants and aquatic invertebrates. Threats at inland migration stopovers vary regionally, but the primary threat is inadequate water supply, which threatens the habitats themselves and exacerbates contamination, invasions of exotic plants, and disease outbreaks.

A vital tool for protecting godwit grassland/wetland habitats in the U.S. is the U.S. Fish and Wildlife Service's (USFWS) Partners for Wildlife Program (specifically, grassland easements). This program, however, requires non-federal matching funds, the supply of which is too limited to accommodate the number of landowners interested in this program. Identifying and developing sources of non-federal matching funds is a crucial first step towards bringing this program to its full potential. Another need is incentive programs directed at ranching (grazing) and small dairy operations that currently hold important grassland bird habitat. Currently, the U.S. Farm Bill provides too little support to this crucial sector of the agricultural landscape. Although it has yet to receive adequate appropriations, the U.S. Farm Bill's Grassland Reserve Program holds potential for conserving many high-priority grassland bird species. Concomitant

program needs is the need to educate landowners and technicians that work with private lands about state and federal programs that permit income-producing activities on native prairie. Eliminating exotics on private lands could be accomplished through the Partners Program. Securing water rights that ensure adequate deliveries of water to crucial migration stopovers will generally require stakeholder involvement, political support, and legislative action.

Relative to U.S. programs, federal funding for habitat conservation in México and Canada is more limited, which means that protecting habitats in those regions will require even greater funding from non-governmental organizations, private sources, and U.S. federal programs that require non-federal matching funds. In Canada, the two federal programs that hold the greatest promise for godwit habitat conservation are the Green Cover Canada and Best Management Practices programs. In México, PRONATURA (a non-governmental organization) has great potential for protecting critical godwit wintering sites from rapid development if adequate funding is made available in the near future. Other main avenues for habitat protection in Canada and México include Ducks Unlimited Canada and Ducks Unlimited de México, both of which also need additional funding to accomplish needed conservation goals. In many portions of the godwit's winter range, however, relatively small amounts of funding may go a long way towards protecting birds from human disturbance (i.e., for public education, fencing, and enforcement of protected areas—high priorities at many sites).

Aside from actions needed to put conservation on the ground for Marbled Godwits, we also need more information about the species' population ecology, without which it is unclear how or where to focus conservation efforts. A coordinated research effort and a synthesis of existing Marbled Godwit life history data would help answer crucial life history questions that, in concert with habitat protection and improved legislation, would allow maximization of conservation efforts for this species and other grassland birds. Finally, implementation of conservation actions must be accompanied by programs for evaluating their effectiveness. Adjustments to both this plan and actions may be needed as evaluations and research uncover new information. Overall, an adaptive management approach and maximizing information gains through applied research will help strengthen the overall effectiveness of Marbled Godwit conservation efforts.

RESUMEN EJECUTIVO

Limosa fedoa anida principalmente en los pastizales templados del norte-central de los Estados Unidos y en el sur-central de Canadá (la población del centro del continente) y pasa los inviernos principalmente en las zonas costeras desde el centro de California hasta al centro de Sinaloa. En el rango de reproducción, también hay dos pequeñas poblaciones que están altamente aisladas de la población del centro del continente. La primera está en la Península de Alaska (*L. f. beringiae*) y la segunda, en la Bahía de James, en Ontario, Québec, y Nunavut. Se piensa que la población de Alaska pasa el invierno en las zonas costeras desde Washington hasta el centro de California, y que otra población de la Bahía de James pasa el invierno en las zonas costeras del sureste de los Estados Unidos y/o en sitios a lo largo de la Costa del Golfo de los EE.UU.

El *Limosa fedoa* merece el planeamiento de conservación debido a: (1) la población mundial estimada es relativamente pequeña (140.000–200.000 individuos); (2) las tendencias de su población y la ecología son peor conocidas; y (3) la pérdida o degradación significativa de hábitat parece estar erosionando gran parte de sus zonas de reproducción y donde pasan el invierno. El hábitat primario de anidación en el centro del continente es el pastizal nativo que abarca los complejos de humedales poco profundos con poca vegetación. En estos hábitats, *Limosa fedoa* enfrenta a una serie de amenazas, la más significativa es la pérdida/degradación de hábitat debido al cambio para el uso agricultura. En la actualidad, la mayor amenaza para las dos poblaciones aisladas en el rango de reproducción es su tamaño pequeño. En los sitios donde *Limosa fedoa* pasa el invierno y en los sitios de parada costeros en la migración, las amenazas más significativas son el desarrollo, la perturbación de recreación humana, la maricultura, y las invasiones de plantas exóticas y los invertebrados acuáticos. Las amenazas en los sitios de parada interiores en la migración varían según las regiones, pero la amenaza principal es el suministro insuficiente de agua, que amenaza a los hábitats propios y aumenta la contaminación, las invasiones de plantas exóticas, y los brotes de enfermedades.

En los Estados Unidos, una herramienta vital para la protección de los hábitats pastizales y humedales del *Limosa fedoa* es el Programa de Socios para la Vida Silvestre (especialmente, su cervidumbres pastizales), facilitado por el Servicio de Pesca y Vida Silvestre de los EE.UU. (USFWS, por sus siglas en ingles). Este programa, sin embargo, requiere los fondos contrapartes no-federales, y el suministro de éstos es demasiado limitado para servir el número de los propietarios interesados en este programa. Identificar y desarrollar las fuentes de los fondos contrapartes no-federales es un primer paso crucial para llevar el programa a su máximo potencial. Otra necesidad es el desarrollo de programas de incentivos dirigidos a la ganadería (pastoreo) y las operaciones pequeños de productores lecheros que ocupan hábitat importante para las aves de los pastizales. En la actualidad, la Ley Agrícola de los Estados Unidos ofrece muy poco apoyo a este sector fundamental del paisaje agrícola. A pesar de que aún no ha recibido una dotación adecuada, el Programa de Reservas Praderas facilitado por la Ley Agrícola de los Estados Unidos tiene una potencial para la conservación de muchas especies de aves de alta prioridad que usan los pastizales. Este Programa tiene la potencial de favorecer la necesidad de educar a los propietarios y técnicos que trabajan con las tierras privadas sobre programas estatales y federales que permitan actividades productivas en las praderas nativas. La eliminación de especies exóticas en tierras privadas se puede lograr a través del Programa de Socios. Garantizar el acceso al agua, donde se controlen los adecuados suministros de agua a los sitios de paradas cruciales en la migración, generalmente se requiere la participación de los interesados, el apoyo político, y la acción legislativa.

En relación con los programas de Estados Unidos, los fondos federales para la conservación del hábitat en México y Canadá son más limitados; lo que significa que la protección de los hábitats en estas regiones requerirá una mayor financiación por parte de organizaciones no gubernamentales, fuentes privadas, y programas federales de los Estados Unidos que requiere los fondos contrapartes no-federales. En Canadá, los dos programas federales que son muy prometedores para la conservación del hábitat de *Limosa fedoa* son "Green Cover Canada" [Cubierta Verde Canadá] y el Programa de Gestión de Mejores Prácticas. En México, PRONATURA (una organización no gubernamental) tiene un gran potencial proteger los sitios críticos donde *Limosa fedoa* pasa el invierno si la adecuada financiación sea disponible en el futuro próximo. Otras vías para la protección del hábitat en Canadá y México incluyen Ducks Unlimited Canadá y Ducks Unlimited de México (DUMAC), ambos también necesitan fondos adicionales para cumplir los objetivos de conservación necesarios. En muchas partes del rango invierno del *Limosa fedoa*, sin embargo, una pequeña cantidad relativa de financiación lograría una gran cantidad de protección para las aves de la perturbación humana (por ejemplo, para la educación pública; la protección del hábitat con una cerca; y el cumplimiento de las áreas protegidas).

Aparte de las acciones necesarias para la implementación de conservación para el *Limosa fedoa*, también se necesita más información sobre la ecología de las poblaciones de la especie, sin la cual no está claro cómo o dónde se deben concentrar los esfuerzos de conservación. Un esfuerzo coordinado de investigación y una síntesis de los datos históricos existentes de *Limosa fedoa*, podría ayudar a contestar preguntas cruciales sobre la historia de vida. Esto, en combinación con la protección del hábitat y el mejoramiento de la legislación, permitiría la maximización de esfuerzos de conservación para esta especie y otras aves de pastizales. Por último, la aplicación de acciones de conservación debe ir acompañada por programas donde se evalúen la eficacia de los mismos. Los ajustes tanto a este plan como a acciones pueden ser necesarios, como las evaluaciones y las investigaciones descubran nueva información. En general, un enfoque de gestión adaptable y la maximización de información lograda por la investigación aplicada ayudarán a fortalecer la eficacia general de los esfuerzos de conservación para *Limosa fedoa*.

PURPOSE & METHODOLOGY

A number of issues have led to development of this conservation plan for the Marbled Godwit (*Limosa fedoa*). These issues include (1) historical declines and range contractions from which the species never fully recovered; (2) recent rates of habitat loss/degradation; (3) inadequate monitoring data for determining population trends, and (4) gaps in our knowledge regarding the species' ecology and life history. These concerns have prompted a number of organizations and agencies to assign special conservation status to the Marbled Godwit. The United States (U.S.) and Canadian shorebird conservation plans list the Marbled Godwit as a species of 'high concern' and 'high- priority', respectively (Brown et al. 2001, Donaldson et al. 2000). Partners in Flight (2005) has assessed the godwit as a top conservation priority in nearly every physiographic region where it occurs during breeding or non-breeding season, and the National Audubon Society gives it 'yellow status' on its WatchList (National Audubon Society 2005*b*). A group of concerned shorebird scientists resolved to address these concerns by establishing an informal Marbled Godwit working group with a goal of coordinating research and conservation efforts in North America. This conservation plan was subsequently initiated under the auspices of that working group with funding from the USFWS and the Western Hemisphere Shorebird Reserve Network. The first step was to identify wintering/migration[1] sites and breeding regions that support relatively large numbers of godwits and are, therefore, crucial to the species' long-term survival. All site-based data, including site names/locations/descriptions, high counts of Marbled Godwits in the primary season(s) of occurrence, priority habitats used by godwits, level of major threats to godwits or their habitats, and conservation actions needed were entered into a site data matrix and summarized by the shorebird planning regions outlined in the U.S. Shorebird Conservation Plan (Brown et al. 2001). The next step was to provide a brief overview of the species' ecology and status, conservation threats, and the highest-priority conservation actions needed to conserve and protect Marbled Godwits and their habitats at the important sites/regions. (Because targeting breeding habitats for conservation will

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[1] We use 'winter' and 'migration' to specify sites and/or site use during the non-breeding season, as the Marbled Godwit is generally restricted to the Northern Hemisphere.

be a more complex, landscape-scale proposition than it will be for migration and wintering sites, we provide a more in-depth treatment of breeding habitats.) The final step was to compile and synthesize all this information into a working conservation plan for the Marbled Godwit. This document and the associated important site data matrix represent the culmination of those undertakings.

To develop this plan and its associated matrix for important sites, we summarized information from published literature, unpublished data, and personal communications with shorebird scientists, resource managers working with godwits, and amateur field ornithologists knowledgeable about shorebirds. The scope of this document includes most of the godwit's range and its full annual cycle. The accompanying data matrix that summarizes important Marbled Godwit site information includes high counts of godwits in the season(s) of primary occurrence and locations/descriptions of important sites, as well as habitats used, threats, and conservation actions needed to diminish or offset those threats at each site.

This plan was written in accordance with the U.S. and Canadian shorebird conservation plans (Brown et al. 2001, Donaldson 2000), as well as the associated regional and Joint Venture shorebird plans that pertain to the Marbled Godwit's primary range and the accompanying documents that identify research and education/outreach needs[2]. The proximate goal of this conservation plan is to provide natural resource managers, funding agencies, and scientists with information necessary for developing Marbled Godwit conservation strategies. In the early 20th century, Thomas Sadler Roberts took a reconnaissance trip to Grant County, Minnesota, then later remarked that the Marbled Godwit "…was so abundant, so constant and insistent.…" (Roberts, T.S. 1932. *The Birds of Minnesota*. University of Minnesota Press, Minneapolis.). Inspired by Sadler's observation, it is the ultimate goal of this plan to initiate a process of ensuring that the voices of Marbled Godwits will always be as abundant, constant, and insistent throughout North America as they were in Sadler's time.

[2] (Alaska Shorebird Working Group [2000], Drut and Buchanan [2000], Elliott and McKnight [2000], Hunter et al. [2000], Oring et al. [2000*a*], Oring et al. [2000*b*], Shultz et al. [2000], Fellows et al. [2001], Gratto-Trevor at al. 2001], Hickey et al. [2003], de Szalay et al. [2005], U.S. Prairie Pothole Join Venture Implementation Plan (2005), Skagen and Thompson [2005], Prairie Habitat Joint Venture Strategic Plan [in prep.])

MANAGEMENT STATUS & NATURAL HISTORY

TAXONOMY

Authorities recognize two subspecies of Marbled Godwits and three separate populations (Gibson and Kessel 1989, Gratto-Trevor 2000[3]; Fig. 1).

1) *Limosa fedoa fedoa* nests primarily in north-central U.S. and south-central Canada, comprising the 'mid-continental' population. A highly disjunct population of *L. f. fedoa* nests along the southwestern coast and islands of James Bay in Ontario, Quebec, and Nunavut (Akimiski Island), Canada (herein referred to as the "James Bay" population).

2) *L. f. beringiae* nests on the northwestern coast of the Alaska Peninsula (herein referred to as the 'Alaska' population).

[3] To improve this document's readability, we do not repeatedly cite our main source of Marbled Godwit ecology (Gratto-Trevor's 2000). However, we freely used information from this account and, even where other in-text citations are included, readers may assume that we referenced Gratto-Trevor (2000) with respect to general Marbled Godwit ecology.

Overall, *L. f. beringiae* is heavier and its wings, tarsi, and culmen are shorter than those of *L. f. fedoa* (Gibson and Kessel 1989); however, it is not yet known whether these birds are genetically differentiated from the other godwit populations. Likewise, it is not known whether the James Bay population and small, remnant populations on the fringes of the mid-continental breeding range (e.g., in Minnesota) are genetically distinct. Genetics of the Alaska and James Bay populations are currently under investigation by Thomas Braile/Kevin Winker (Alaska), and Kenneth Ross/Kenneth Abraham (James Bay), respectively.

Population Estimates & Trends

Gratto-Trevor (2000) and Morrison et al. (2001) compiled winter, migration, and breeding (for James Bay and Alaskan populations) survey data from numerous sources and estimated the global population of Marbled Godwits to be 140,000-200,000 and 171,500 birds, respectively. The figure calculated by Morrison et al. (2001), which includes an estimated 1500 birds in the James Bay population, 2000 birds in the Alaska population, and 168,000 birds in the mid-continental population, is ranked as moderately accurate. They further indicate that 60% of the population nests in Canada.

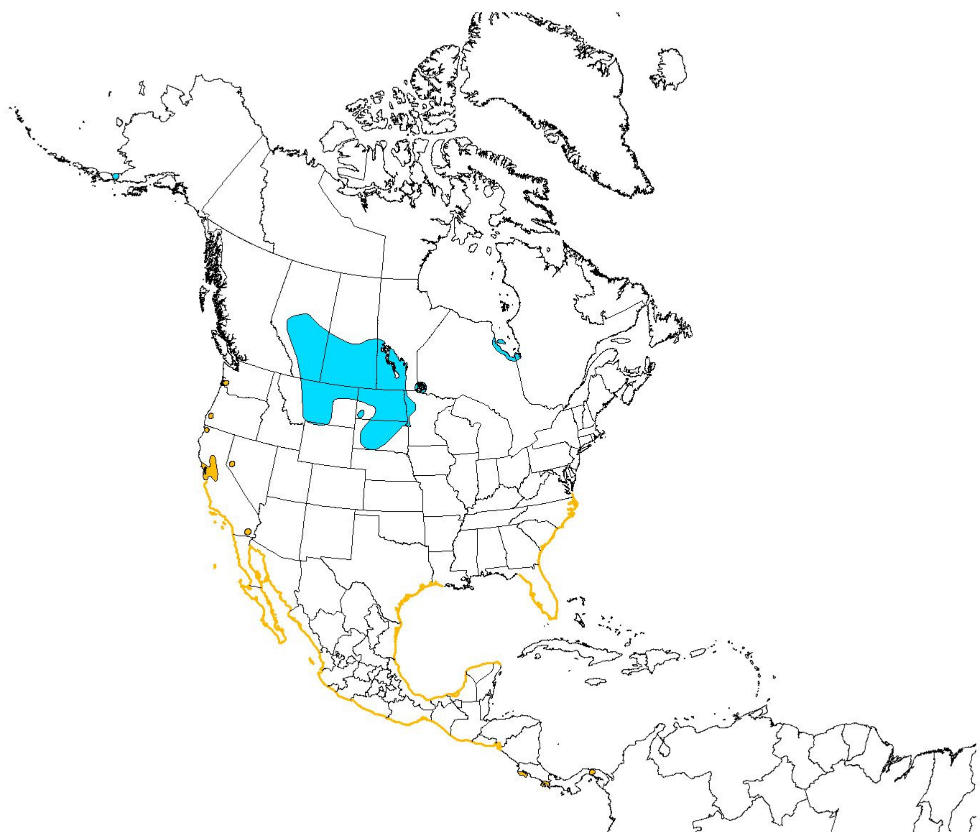

Figure 1. Breeding range (blue) and wintering range (yellow) of the Marbled Godwit. The majority of important stopover sites overlap the wintering range; important exceptions include the Yakutat Forelands in Alaska, Bear River Migratory Bird Refuge and the Great Salt Lake in Utah, and Cheyenne Bottoms Wildlife Management Area in central Kansas. (Map provided courtesy of Gratto-Trevor 2000 and Birds of North America.)

The Partners in Flight species-assessment database currently lists the Marbled Godwit population as stable to possibly increasing in north-central U.S. and south-central Canada (Partners in Flight 2005). However, this assessment is based primarily upon Breeding Bird Survey (BBS) data, which are ranked as deficient (i.e., low numbers of birds/route, annual variation to reveal trends of $\leq$5% per year; Sauer et al. 2004, 2005) for accurately determining Marbled Godwit trends in most of the breeding range—except in Manitoba, Saskatchewan, and the Glaciated Missouri Plateau. With that important caveat in mind, the most current *survey-wide* (i.e., all routes combined) data for Marbled Godwit indicate no significant trend from 1966 to 2000 (Sauer et al. 2005; Appendices 1 and 2). In Manitoba, however, there was a significant ($P = 0.01$) decline of 3.7%/year from 1980-2004, whereas in Saskatchewan and the Glaciated Missouri Plateau there have been no significant trends during the same period (Sauer et al. 2005; Appendices 1 and 2). There are no trend data for either of the two disjunct populations.

Marbled Godwits generally occur at low densities throughout their breeding ranges, and their annual distributions can vary widely. Furthermore, they are very secretive once they begin incubation. These factors make it extremely difficult to obtain adequate sample sizes for determining population trends, productivity, or a comprehensive understanding of breeding habitat requirements (S. Davis, G. Beyersbergen, C. Gratto-Trevor, B. Madden, N. Niemuth, S. Stephens, and K. Tribby, pers. comm.). To address the low statistical power of monitoring data for grassland birds in general, Canadian Wildlife Service (CWS) scientists launched the Grassland Bird Monitoring (GBM) as a pilot program in 1996 (B. Dale, pers. comm.). GBM follows BBS protocol, but it increases sample sizes and focuses effort on grasslands. As a result, godwits have been detected on 93% of the routes, whereas they have been detected on only 64% of BBS routes in the same region (B. Dale, pers. comm.). With full implementation, the GBM program may yield statistically significant trend information for godwits in the future. It should be kept in mind, however, that BBS/GBM programs were designed to track a diversity of grassland bird species—many of which initiate nesting later than the Marbled Godwit. Therefore, it is likely that neither program encompasses the ideal time for detecting godwits on the breeding grounds—before incubation onset (C. Gratto-Trevor and N. Niemuth, pers. comm.). For godwits, perhaps the most important outcome of the GBM/BBS data will be the associated geo-referenced habitat data, which could reveal changes in habitat or landscape characteristics that may help to explain godwit population trends or responses to conservation efforts. In the meantime, godwit population trends remain poorly understood, in all portions of the species' range.

DISTRIBUTION, TIMING, & ABUNDANCE

Breeding

The Marbled Godwit breeds entirely within North America (Fig. 1). The majority of *L. f. fedoa* nests in the prairies of north-central U.S. and south-central Canada (mid-continental population; Fig. 1; Appendix 2). Historically, the mid-continental range also included other portions of Minnesota, as well as parts of Wisconsin, Iowa, and Nebraska (Fig. 2). Today, the core of the breeding range appears to align with the Missouri Coteau/Missouri Coteau Slope of the U.S. and Canada (Figs. 3 and 4). Relative abundance, however, appears to be greatest in southern Alberta (Appendix 2).

Within Minnesota, Manitoba, and Ontario, where populations are at risk of disappearing in the near future, small numbers of breeding godwits still occupy relatively isolated areas (D. Granfors, pers. comm.). The primary area in Minnesota is the Glacial Lake Agassiz Beach Ridge of the Red River Valley—a narrow band of remnant tallgrass prairie and wetlands in northwestern Minnesota. Two other, smaller populations occur along the Minnesota River and in wet prairie areas of central Minnesota. There is also a small, at-risk population that nests north of the Minnesota border in the Rainy River area of Ontario (K. Abraham, pers. comm.).

Historically, much of the agricultural landscape west and south of the Red River Valley consisted of diversified farms and dairy operations that sustained breeding Marbled Godwits, but in recent decades small dairy farms lost economic viability and the native prairie rangelands they maintained are being converted to row crop agriculture. The Red River Valley now represents a gap between Minnesota's godwits and those that nest in the eastern Dakotas. A small area of habitat still connects the Glacial Ridge breeding region to godwit habitat in southern Manitoba, where the godwit population is also small and declining at a rapid rate (Appendices 1 and 2). North of the Minnesota River, there is 30-km gap that separates habitat in that area from the species' range in eastern South Dakota.

The disjunct population of *L. f. fedoa* nests along the southwestern coast of James Bay in Ontario and Québec, and on Akimiski Island, Nunavut (K. Abraham, pers. comm.). *L. f. beringiae* nests on the northeastern coast of the Alaska Peninsula near Ugashik Bay within a narrow strip (80 × 32-48 km) of inland lowlands from just north of Pilot Point south to Cinder-

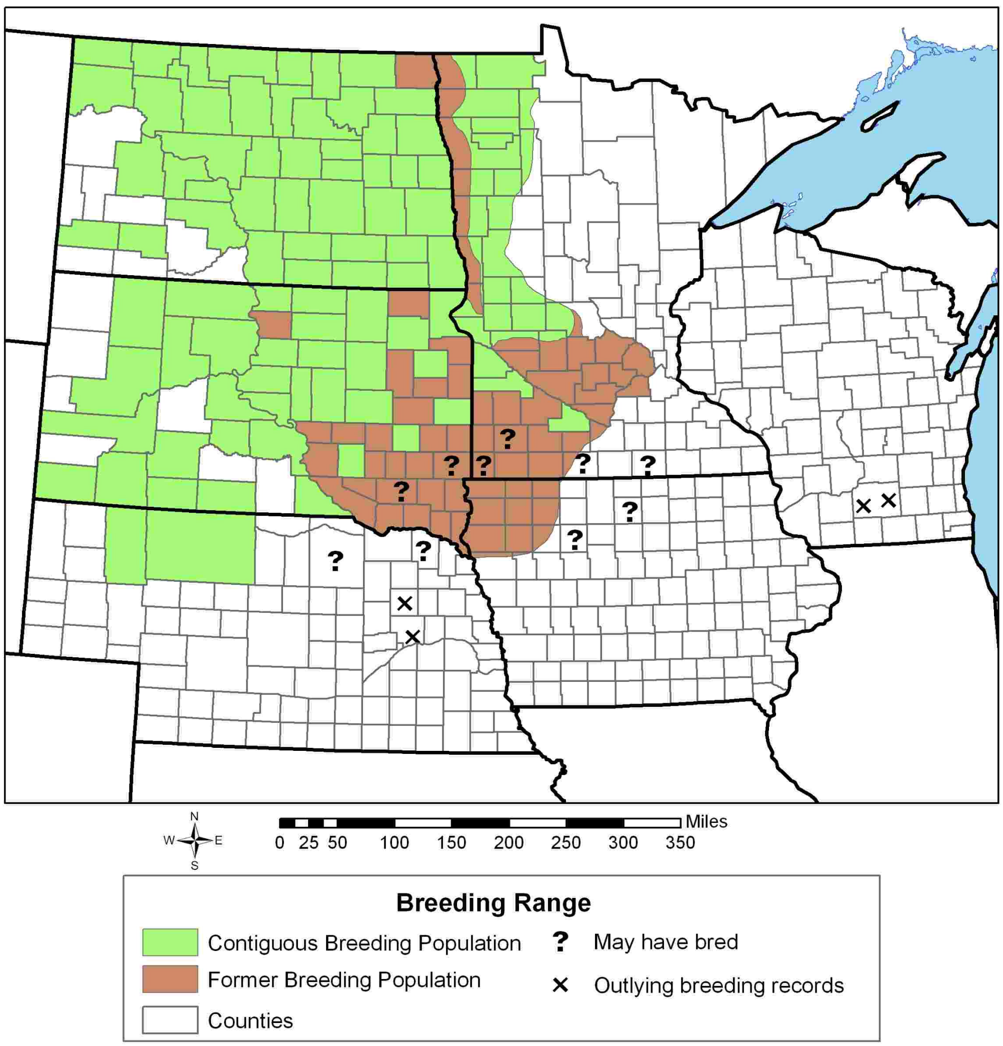

Figure 2. Known historical range of the Marbled Godwit in the U.S. portion of the eastern Great Plains. (Map provided by Mary Balogh, U.S. Fish and Wildlife Service Region 3 Division of Conservation Planning).

Hook Lagoon (Morse and Powell 2003, Gill et al. 2004; L. Tibbitts, pers. comm.; Fig. 1). Overall, the breeding ranges of these two disjunct populations are poorly understood and currently under investigation.

Most of the mid-continental birds arrive in their breeding range from late April to early May and depart from late July through September. Birds of the James Bay and Alaska populations arrive in their breeding range from late April to late May (generally later at James

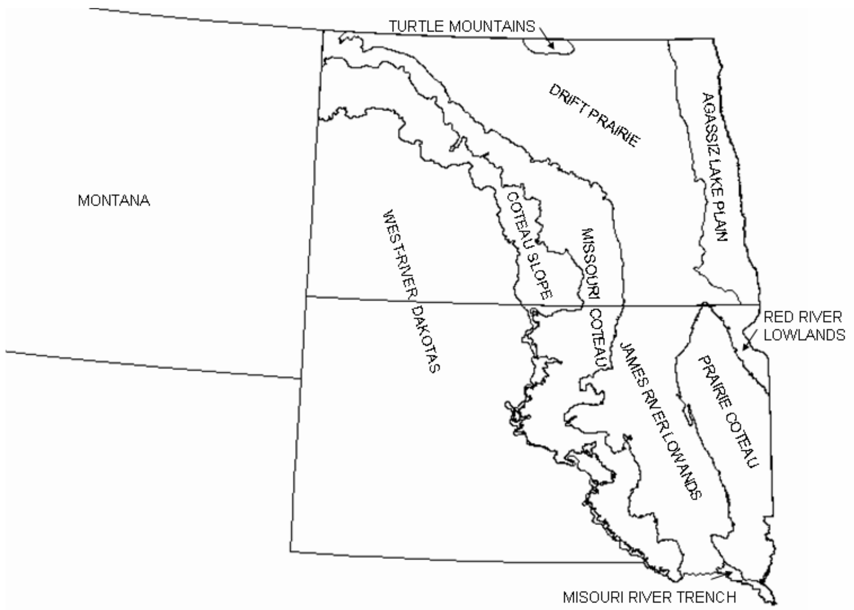

Figure 3. Physiographic strata and sub-strata in the Dakotas region.

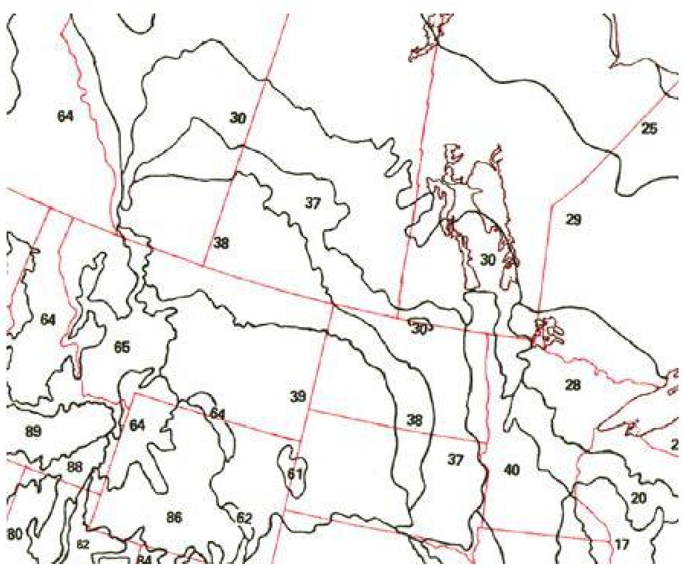

Figure 4. Principal physiographic strata in the Marbled Godwit's mid-continental breeding range (from Sauer et al. 2005). Strata names: 30 = Aspen Parklands, 37 = Drift Prairie, 38 = Glaciated Missouri Coteau (includes the Missouri Coteau Slope), 39 = Great Plains Roughlands, 40 = Black Prairie. The physiographic strata shown are used to identify important breeding *regions* (see below in Conservation Sites section; Table 1).

Bay), and depart between late August and late September (Gibson and Kessel 1989; K. Abraham, pers. comm.). Knowledge of arrivals and departures at these two far-northern breeding sites is limited by access, and may be adjusted as sampling opportunities improve.

Reports of godwit relative abundances/densities vary widely. On GBM routes, the number of godwits detected per route is 8.75 for 1996-2000, whereas on standard BBS routes it was 6.25 in the same region (B. Dale, pers. comm.). This difference is due largely to the greater number of GBM routes in grassland habitat. In North Dakota, Marbled Godwit densities have ranged from 0.2–1.35 pairs per km^2. Within the Medicine Lake National Wildlife Refuge's (NWR) Wetland Management District (WMD) in northeastern Montana, 1998–2000 surveys yielded mean densities of 0.0–1.6 godwit pairs/km^2 at 4–8 Waterfowl Production Areas (WPA) that contained large areas of native prairie habitat (B. Madden, pers. comm.). The greatest densities (7.2–7.4 pairs per km^2) have been recorded in southern Alberta where wetland cover was $\geq$5%; in the same region, densities in dry areas (<5% wetland cover) averaged 1.1–2.0 pairs per km^2. Little is known about breeding densities of Minnesota's Marbled Godwits, although D. Granfors (pers. comm.) obtained an estimate of 0.2 pairs/km^2 in the southern Glacial Lake Agassiz Beach Ridge area during 2003, and along randomly selected roadside transects she detected 0.025 pairs/km. In 2004 researchers at Glacial Ridge NWR obtained an estimate of 0.7 pairs/km^2 (D. Granfros, pers. comm.). Access to Minnesota breeding areas is precluded in a number of places, compounding the difficulty of estimating breeding populations.

Overall, it is not well-known whether, or how, godwit breeding distributions are affected by annual changes in climatic or other conditions. At Bowdoin NWR, however, it is reported that banded individuals come back to the same location in subsequent breeding seasons (B. Madden, pers. comm.). Likewise, adult godwits in southern Alberta exhibit a high degree of nest-site fidelity. If godwits are similarly philopatric throughout their breeding range, variation in annual densities may be more indicative of demographic cycles or trends rather than redistribution.

Wintering

Marbled Godwits generally arrive on their wintering grounds sometime between September and November and depart sometime between March and May—the latter northbound dates generally applicable to wintering sites at higher degrees of latitude. The species winters almost entirely within North America, although small numbers occur irregularly at scattered coastal sites of Central America (Fig. 1) and (rarely) South America. There are no published data to confirm whether age classes segregate geographically, whether males and females of any one population winter together, or the extent to which godwits exhibit site fidelity during the winter.

Overall, the vast majority of godwits winter along the Pacific and Gulf of California coasts from central California to central Sinaloa, where sites typically host 1000–10,000 godwits. At Ojo de Liebre/Guerrero Negro (roughly the mid-point of the Baja California Peninsula's Pacific coast), nearly 70,000 Marbled Godwits (40% of the global population) were counted in January 1994, making it the largest concentration of Marbled Godwits recorded to date. San Francisco Bay Complex, the largest wintering site in the U.S., typically hosts approximately 10% (~17,000 birds) of the global population. Significantly fewer godwits (20–2000 per site) winter along the Pacific from southern Sinaloa to Panama; north of California; at the Salton Sea in California; in the interior valleys of California and western Nevada; on the Gulf of México coast from Texas to the southern tip of Florida, and from Tamaulipas to the Yucatán Peninsula; and along the Atlantic coast from Florida north to Virginia. It is possible that numbers of godwits wintering along the Gulf of Mexico and southeastern U.S. Atlantic coasts are underestimated, as access to godwit habitats in those regions is difficult, at best.

Band returns indicate that godwits nesting in the mid-continental breeding range winter on both the Pacific and Gulf of Mexico coasts, and sightings of banded birds indicate that godwits nesting in Alberta may winter primarily in Baja California. It is not yet known whether Alberta breeding birds also winter on the Mexican mainland. Morphometrics indicate that at least some birds from the Alaska population winter along the Pacific coast from Washington south to San Francisco, California (Gibson and Kessel 1989). Less is known about which non-breeding sites are used by the James Bay breeding population. There is evidence that they may winter along the southeastern U.S. coast (see discussion below; K. Abraham, pers. comm.), but there are reports of late migrants arriving in the Great Lakes region in late May and early June (R. Russell, pers. comm.); these arrival dates (and quick departures) suggest that they may be James Bay birds. If godwits stopping over in the western Great Lakes region are James Bay birds, their most direct route would be from the Gulf of Mexico region (or farther south).

Migration

Currently, all Marbled Godwit populations are believed to be migratory. Some wintering/migration sites host small numbers of godwits year-round (e.g., Texas coast [C. Stinson, pers. comm.], Baja California [Mellink et al. 1997, Danemann et al. 2002]), but it is not known whether these birds migrate from farther south and then discontinue their northward migration or spend the entire year at those sites. There is evidence that godwits delay breeding until their second or third year; thus, it may be that birds remaining at wintering/migration sites are first- or second-year birds.

Migration routes of individual godwit populations are not well known. Based on locations of large godwit concentrations during migration season, however, the mid-continental population appears to follow a relatively direct route through interior North America between wintering sites in northern México/southern California and breeding sites in the prairie regions of north-central U.S./south-central Canada. Along the Pacific and Atlantic coasts, most wintering sites also serve as migration stopovers—the extent of overlap probably being most significant from San Francisco south to central Baja California, the Río Colorado Delta at the northern apex of the Gulf of California, and the Salton Sea in southern California.

Although banded birds that nest in Alberta have been resighted at coastal stopovers in México, it is not yet known whether they use primarily interior or both interior and coastal stopover sites (Gratto-Trevor, pers. comm.). The stopover site used by the largest-known number of southbound migrants in interior North America is Bear River Migratory Bird Refuge (MBR) in northeastern Utah (Shuford et al. 2002), where a high count of ~43,000 Marbled Godwits (25% of the global population) was recorded in July 2000 (B. Olson, pers. comm.). Considerably smaller congregations occur during southbound migration in the Lahontan Valley/Humboldt Sink Complex of western Nevada (~1100 in August 1999; L. Neel, pers.

comm.) and the Salton Sea of southern California (~1200 in November; N. Warnock, pers. comm.). During northbound migration, fewer godwits occur at Bear River MBR (high count was ~27,000 birds in April 1993) and the Lahontan Valley/Humboldt Sink Complex (just over 500 in April 1991; L. Neel, pers. comm.); at the Salton Sea, however, high counts of northbound and southbound migrants are similar (N. Warnock, pers. comm.). Outside the breeding range, the only major stopover site east of Utah is Cheyenne Bottoms Wildlife Management Area (WMA) in central Kansas. At that site, annual godwit use is irregular and occurs almost exclusively during northbound migration (high count was ~3300 in April 1991; H. Hands, pers. comm.).

Overall patterns may vary between northward and southward migration. More godwits are found at important Pacific coast sites during northward migration than during southward migration (see Harrington and Perry 1995), and godwits generally do not use the Kansas site during southbound migration (H. Hands, pers. comm.). On the other hand, more birds appear to use Bear River MBR during southbound migration (B. Olson, pers. comm.), and although southbound migration is notable along the Atlantic coast, godwits are rarely observed there during northbound migration.

Less is known about migration of the two disjunct populations that breed on the Alaska Peninsula and in the James Bay Complex. Post-breeding birds likely make a trans-oceanic trip across the Gulf of Alaska. Observations of godwits at Yakutat Forelands (roughly where the borders of Yukon Territory, Alaska, and British Columbia intersect) indicate that at least some northbound birds follow the coast for at least part of their migration. During southbound migration, James Bay birds may first fly directly east to the Atlantic coast and then travel southward, although this seems unlikely since godwits are rarely observed north of southern Virginia and no large staging areas have been discovered between the James Bay breeding area and the coast (K. Abraham, pers. comm.). A more likely possibility is that James Bay birds fly across the interior between their breeding site and the southeastern coast of the U.S.. There are numerous reports of individual or small flocks of Marbled Godwits—during both northbound and southbound migration—in northwestern Georgia (Digioia 1977), Kentucky (Dever 2000, Palmer-Ball and McNeeley 2003), West Virginia (Igou 1986, Argabrite 1988), southeastern Pennsylvania (Miller 1982, Heller 1991), central Massachusetts (Bradbury 1997), and upstate New York (Cook 1986).

The timing of migration varies regionally, but typically northbound migration occurs from mid-March (in Central America) to early June (in Minnesota; B. Russell, pers. comm.). Overall, northbound migration for the mid-continental population peaks from late April to mid-May, with later peaks generally occurring at more northern latitudes. Small flocks of migrants observed in late May and early June at sites near Lake Superior generally stop for just one day (R. Russell, pers. comm.). The earliest known arrival date for birds at Akimiski Island in James Bay is 19 May (with observations beginning in the first week of May), and the latest departure date is 17 September (constrained by discontinued observations on that date); the highest single counts have been documented in late July and early August (K. Abraham, pers. comm.).

Typical of most shorebirds, the Marbled Godwit's southbound migration is quite protracted. Suspected non-breeders and unsuccessful breeders begin to form large flocks at staging sites within core areas of the breeding range as early as the first week of June (R. Martin, pers. comm.). By late June and early July, successful breeders and, later, juveniles join staging flocks. Godwits may continue moving southward into November, although southbound migration peaks in mid-July to mid-September. The largest post-breeding staging sites within the breeding range are located in southern Saskatchewan, northeastern Montana, and central North Dakota, where single-day counts may vary from ~500-1600 Marbled Godwits (i.e., these numbers do not account for turnover). Bear River MBR in Utah, where as many as 5000 godwits may appear by the end of the first week in June (B. Olson, pers. comm.), also serves as a staging area where the birds undergo a body and wing molt (B. Olson, unpubl. data). Turnover rates at large staging sites have been found to vary from two weeks for juveniles in Saskatchewan (Alexander and Gratto-Trevor 1997) to at least 5- 6 weeks (age class unknown) at Bear River MBR (B. Olson, unpubl. data). Juveniles generally migrate southward about three weeks later than the adults.

MAJOR HABITATS

Breeding

Breeding habitats vary somewhat between regions. Although there is some on-going debate as to what comprises *acceptable* nesting habitat, most authorities agree that Marbled Godwits in the mid-continental breeding range nest *preferentially* in sparse (<75% canopy coverage) to moderately (>75% canopy coverage) vegetated, native shortgrass (<15 cm) habitats—often grazed or recently idled from grazing. They will nest on occasion in tame grass habitats, including hayfields and idle pastures (Ryan et al. 1984), especially if the vegetative structure is similar to that of native, shortgrass habitats. Typically, nesting birds avoid dense grass cover (Grattor-Trevor, pers. comm.) and rarely nest in croplands or stubble fields (Dechant et al. 2003). Adults with broods, however, are often found within close proximity of taller grass (15–60 cm) than that used for nesting, which provides escape cover and protection from exposure (Ryan et al. 1984).

Godwits in the mid-continental breeding range appear to prefer large, contiguous blocks of habitat (C. Gratto-Trevor and N. Niemuth, pers. comm.). Within these grasslands, godwits also require complexes of wetlands that represent a broad diversity of sizes and types—ranging from ephemeral to permanent, although ephemeral and temporary wetlands are used more than expected based on their availability (Ryan et al. 1984). Generally, godwits feed at water depths of 5-13 cm, and in dry years, when ephemeral and temporary wetlands are limiting, the birds will shift to semi-permanent wetlands. Such shifts underscore the need for conserving wetland complexes as opposed to single wetlands.

Early results of habitat studies in the James Bay and Alaska regions indicate that these populations also use primarily open habitats. Nests and young in the James Bay region have been found primarily in open, supratidal graminoid habitats, although some pairs have been observed in wet tundra and taiga with scattered fens and short, woody vegetation, including heath and stunted trees (K. Abraham, pers. comm.). They also commonly feed in coastal marshes vegetated with marsh grasses, rushes (*Scirpus* spp.), sedges (*Carex* spp.), and scattered tall willows (*Salix* spp.). Similar to godwit preferences for grazed grasslands in the interior prairies, James Bay godwits may select areas lightly to moderately grazed by geese (K. Abraham, pers. comm.). In Alaska, nesting godwits are most likely to be found in herb bog meadows, fresh herb meadows, and sedge bog meadows (Mehall-Niswander 1997, Morse and Powell 2003, Gill et al. 2004). Overall, godwits have been observed more often in relatively wet habitats and within close proximity to wetlands in a landscape context of expansive wet-sedge and wet-shrub communities (Morse and Powell 2003), although these findings are based on very small samples. At one site, birds nested and raised broods in open, low shrub habitats characterized by 25-75% shrub cover (Mehall-Niswander 1997).

Modeling Landscape Attributes to Predict Marbled Godwit Presence in the Mid-continental Breeding Range—.Scientists with CWS and USFWS's Habitat and Population Evaluation Team (HAPET) in region 6 are using existing datasets based on GBM/BBS surveys and HAPET shorebird surveys, respectively, to model mid-continental breeding occurrences and habitat associations of Marbled Godwits (Niemuth 2005; S. Davis, pers. comm.). Although the models require further development and validation, they show some general patterns. Based on the first year of data, the HAPET model for the Dakotas region (Fig. 5) illustrates that godwit presence is influenced by geographic location. Specifically, godwits are predicted to use the southern and western portions of the prairie potholes (i.e., primarily the Missouri Coteau/Missouri Coteau Slope) (Niemuth 2005). The model also indicates that the probability of godwit presence increases with greater percentages of native prairie and temporary/seasonal/semi- permanent wetlands in the landscape, and it predicts a decreasing probability of godwit presence as the percentage of forest cover increases.

HAPET scientists have conducted two additional projects that provide greater detail regarding Marbled Godwit habitat use during breeding season in the Dakotas (Niemuth 2005). One project consisted of wetland-based shorebird surveys conducted mid-May to late July in 2002 to determine factors affecting godwit distributions and habitat use. Results of this study corroborated HAPET's graphical model (Fig. 5) in that Marbled Godwits were more likely to occur in the western portion of the prairie pothole region. It also indicated that godwits were more likely to use wetlands with extensive shorelines, brackish or saline water, and little emergent vegetation, as well as wetlands surrounded by a grassland buffer and/or large percentages of grassland in the surrounding landscape. Small groups of godwits were seen throughout the survey period, although flock size increased as the season progressed and was positively associated with wetland area and brackish/saline water (i.e., post-breeding birds flocked up at large basins with no external drainage). Overall, these results appear to emphasize habitat associations of godwits at staging areas. The other project consisted of repeated point counts conducted mid-May to late June 2003 to evaluate shorebird detection and habitat use

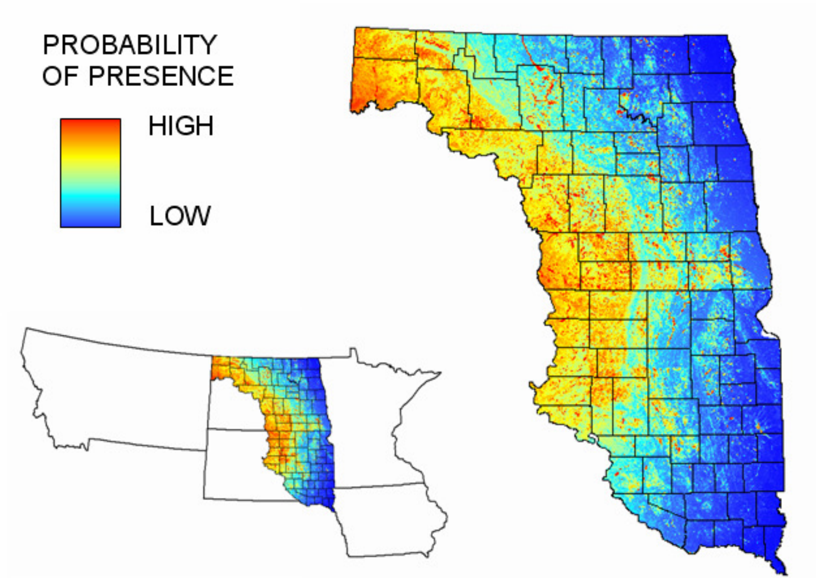

Figure 5. Predicted landscape suitability for Marbled Godwit during nesting season in the Prairie Pothole region of North and South Dakota. The model was based on 2004 Breeding Shorebird Survey data. Resolution of landcover data was 30 m × 30 m.

(Niemuth 2005). The results of this work indicated that godwits were more likely to be found in uplands earlier in the season; as the season progressed, the number of birds found in uplands declined and numbers of birds observed flying or in wetlands increased.

The Canadian model for Marbled Godwit occurrence in the Prairie Habitat Joint Venture region reveals habitat associations similar to those illustrated by the HAPET model. The model needs further refinement, however, because it over-emphasizes the importance of large, open water wetlands, due, in part, to the lack of a digitized inventory for all Canada's wetlands (i.e., temporary/seasonal and semi-permanent wetlands are poorly represented in the GIS layers). In addition, the model was extrapolated to regions beyond those from which the data used to build the model were collected (S. David, pers. comm.). With these caveats in mind, godwits were found to associate positively with grassland and wetland area in the landscape (at a scale of 1200 m^2), and were negatively associated with roads and trees (S. Davis, unpubl. data). Overall, the CWS model revealed that godwits, Sprague's Pipits, Baird's Sparrows, and Chestnut-collared Longspurs (*Calcarius ornatus*) all responded similarly to landscape composition and other environmental factors. In addition, Marbled Godwit occurrence was positively associated with all classes of Waterfowl Capability (class definitions of Waterfowl Capability may be found at <http://geogratis.cgdi.gc.ca/download/peterborough/readme.w>). Specifically, the model indicates substantial overlap between godwit occurrence and areas that support high densities of Northern Pintails (*Anas acuta*) (S. David, unpubl. data).

Nesting Parameters—Ultimately, productivity data are needed to improve our understanding of important habitat associations of breeding godwits. There have been several studies designed to evaluate nesting success in various habitat types, although low densities of godwit territories have severely limited sample sizes and results must be considered preliminary. Using maximum likelihood estimates based on exposure days (an improvement on the Mayfield method), overall nest-survival rate of Marbled Godwits in a Ducks Unlimited (DU) study was 0.30. For all grassland-nesting shorebirds combined (i.e., Willet [*Catoptrophorus semipalmatus*], Upland Sandpiper [*Bartramia longicauda*], Marbled Godwit, Wilson's Phalarope [*Phalaropus tricolor*], and Wilson's Snipe [*Gallinago delicata*]), nesting success was greater in native grasslands (0.37) than in other grassland types (0.23 in hayland, 0.16 in Conservation Reserve Program/planted cover; Stephens 2004). In a study at Benton Lake NWR, 14 of the 22 nests were successful, and the fate of 2 nests remains uncertain (B. Johnson, pers. comm.). Causes of nesting failure included predation and accidental destruction of eggs or nests during field work. All nests were first found between 10 May and 17 June, and estimated hatching dates ranged from 4 June to 1 July, supporting speculations that birds using staging sites by early June are probably unsuccessful breeders.

Migration

Migration stopover habitats vary by region and, to some extent, by season. Within the mid-continental breeding range, northbound flocks frequent small marshes vegetated with bulrush (*Scirpus* spp.) and other aquatic emergents that provide the tubers upon which Marbled Godwits frequently feed, as well as shallow, relatively unvegetated wetlands (ranging in size from small [<8 ha] to large [>8 ha]; H. Hands and B. Olson, pers. comm.) that provide abundances of invertebrates. During northbound migration, moderate numbers of godwits also forage at rice fields (especially in Calhoun County of the central Texas coast and in the Imperial Valley of California) during stages of flooding or draw-down (B. Ortego, pers. comm.), but it is not well understood how heavily these habitats are used and under what conditions. Modeling of shorebird habitat use during two years of northbound migration in the U.S. prairie pothole region indicates that Marbled Godwit presence is best predicted by percent cover of grasslands and palustrine wetlands within the landscape. The proportion of wetlands classified as temporary/seasonal was also important (S. Skagen, pers. comm.).

During southbound migration, interior stopover habitats include shorelines and mudflats exposed by dropping water levels in lakes and reservoirs. Coastal migration sites used by Marbled Godwits consist of extensive mudflats, tidal marshes, brackish estuaries, lagoons, beaches, and shoals. Within the mid-continental breeding range, large flocks of non-breeding, unsuccessful, post-breeding, and juvenile godwits also use certain sites for staging prior to southbound migration. These sites include large complexes of unvegetated freshwater wetlands in a context of native grasslands, hayfields, and other grassland types, as well as large, alkaline lakes. Salinities in these systems vary widely according to natural background levels; however, fluctuations in salinities are largely a function of drought cycles and, in many cases, agricultural practices. In the early 1990s after a period of drought, salinities within the Quill Lakes Complex in Saskatchewan ranged from 1521-111,009 ppm and the pH ranged from 6.7-9.2 (Alexander and Gratto-Trevor 1997). At Cheyenne Bottoms WMA in Kansas, salinities range from 30-7568 ppm due to large fluctuations in water levels that alternately dilute and concentrate salts in the water (Helmers 1991). Outside of the breeding range, salinities at inland sites also fluctuate significantly according to freshwater inflows. At Bear River MBR, the typical salinity range is 3000-3300 ppm (B. Olson, pers. comm.).

Wintering

Nearly all sites used by Marbled Godwits during winter are located on or near marine coastlines and river deltas; the few exceptions are large wetlands at inland sites. Juxtaposition of extensive foraging habitats and suitable roosting sites appears crucial. The birds forage primarily on expansive intertidal mudflats or sandflats of consolidated to unconsolidated substrates inhabited by benthic prey (especially polychaetes). They also forage in nearby estuaries and brackish marshes with emergent vegetation, brackish mudflats, along muddy edges of mangrove-lined channels, on beaches and shoals, and in the shallows of relatively unvegetated inland wetlands. Foraging birds at marine sites tend to follow receding tides. When high tide renders a site unsuitable for foraging, the birds will seek nearby sites where the tide is still receding or go to roosting sites until the tide begins to recede again. Flooded pastures and agricultural fields (e.g., irrigated alfalfa) and wet meadows are visited when conditions are suitable (or when unsuitable elsewhere); prey commonly taken at these sites include earthworms. Roosting godwits are known to use scrublands, fallow fields, pastures, salt ponds, lagoons, estuaries, edges of mangrove channels, marshes, and, in a number of sites, docks, jetties, and/or rooftops. Sightings of marked godwits indicate that the birds show at least some fidelity to roosting and feeding areas (B. Winn, pers. comm. to R. Russell and W. C. Hunter 9/18/2002).

CONSERVATION SITES

This section identifies important sites used by Marbled Godwits and elaborates briefly on the location and seasonal abundance data provided in the data matrix for important Marbled Godwit sites. With Gratto-Trevor's (2000) global population estimate being 140,000-200,000 birds, important sites were defined as those used by ≥1400 birds in any one season (i.e., ≥1% of the lower half of the estimated range of the global population). In some cases, this section also serves to justify the inclusion (in the plan and matrix) of certain sites that currently do not appear to meet minimum criteria for inclusion. Whereas it was a relatively straightforward process to define an important migration or wintering site comprising a discrete wetland, bay, or intertidal flat where ≥1400 godwits occur regularly, defining other sites was complicated by a variety of factors, including incompletely surveyed coastal areas with large expanses of relatively convoluted and inaccessible estuarine shoreline, unknown effects of variation in detectability, and unknown turnover rates within local populations. Also confounding the process of identifying important migration and wintering sites was the unknown extent to which migration and wintering flocks shift within and among sites as climatic (short and long term), diurnal length, tidal, and lunar conditions change (Skagen and Knopf 1993, 1994; Colwell and Dodd 1997; Dodd and Colwell 1996, 1998; Skagen et al. 2005).

Another factor affecting the identification of important sites is the fact that shorebirds migrating across the mid-continent require a broad diversity of wetlands to ensure that habitat will exist as long- and short-term shifts in climatic conditions occur (Skagen and Knopf 1993, 1994; Dechant et al. 2003). Therefore, it seemed reasonable at this stage of conservation planning for the Marbled Godwit to include complexes of adjacent or nearby sites, even if the number of godwits thought to use any one part of the complex is <1400 birds. In many cases, these complexes are also used by concentrations of other high-priority shorebirds, including American Oystercatchers (*Haematopus palliatus*), Snowy (*Charadrius alexandrinus*) and Piping (*Charadrius melodus*) plovers, and Red Knots (*Calidris canutus*), which further elevates their overall importance.

Not knowing with any certainty which migration and wintering sites host birds from the James Bay and Alaska populations, we also included a number of sites hosting much smaller numbers of godwits in the suspected winter ranges of these two populations. Although it did not seem reasonable at this time to include all sites that host as little as 1% of their estimated populations, we did include sites where ≥100 godwits occur regularly. In a few cases, we also included sites that appear to host <100 godwits, but where better access to remote areas and/or more survey across seasons of occurrence may reveal larger godwit numbers. Overall, we took a conservative approach when identifying sites of questionable importance, taking into account the factors mentioned above. Basic inventory, monitoring, and population- and habitat-centered research will help determine with greater certainty the relative importance of all sites.

This section of the plan—as well as subsequent sections on threats and conservation actions needed at important godwit sites—is organized by region (generally from breeding to migration and wintering, and from regions hosting more to fewer godwits) and, to the extent possible, by season within region. For the most part, the organization in this section aligns with the regional plans associated with the U.S. and Canadian shorebird plans and/or Joint Venture plans. Where it made sense to organize sites somewhat differently on the basis of Marbled Godwit ecology, distribution, or threats/actions, we make that explicit in the regional headings. México sites are included in two regions: (1) Pacific and Gulf of California coasts and (2) Gulf of Mexico.

We begin with breeding *regions*, for which identification/description was generally quite different than it was for migration and wintering *sites*. Marbled Godwits are so widely dispersed throughout most of their breeding range that the concept of breeding sites is less meaningful than it is for migration and wintering sites. Because, the James Bay and Alaska breeding sites are relatively discrete and small areas, however, we treated them as *sites*.

CANADA & U.S.—PRAIRIE HABITAT, NORTHERN PLAINS/PRAIRIE POTHOLES, & UPPER MISSISSIPPI VALLEY/GREAT LAKES REGION REGIONS

Breeding Regions

Important regions within the Marbled Godwit's mid-continental breeding range are best identified according to the species' distribution and relative abundance within physiographic strata (Table 1; also see Figs. 3 and 4, Appendices 1 and 2) of the Northern Plains. Overall, the Missouri Coteau and the Missouri Coteau Slope (stratum 38) in Alberta, Saskatchewan, Montana, North Dakota, and the northern half of South Dakota comprise the present-day geographic core of the breeding range (Table 1, Appendices 1 and 2), although southeastern Alberta (in strata 37 and 38) appears to host the greatest densities over the largest area (Appendix 2). Where habitat is suitable (i.e., relatively high densities of temporary/seasonal wetlands within a context of large, unbroken landscapes of native prairie) and is still relatively intact, godwits also occur regularly on the Prairie Coteau in eastern South Dakota; in the James River lowlands; in the Aspen Parklands of Alberta, Saskatchewan and Manitoba; in the Drift Prairie/Glaciated Plains of Alberta Saskatchewan, Manitoba, and North Dakota; and in the Black Prairie of Manitoba and Minnesota (Table 1).

HAPET in U.S. Fish and Wildlife Service region 3 developed a conceptual model for identifying priority conservation areas for Marbled Godwits in Minnesota (D. Granfors, pers. comm.). HAPET scientists led a group of Marbled Godwit experts from state and federal agencies in Minnesota on a tour of habitats ranging from suitable to unsuitable to identify essential landscape elements (concepts) for breeding godwits. The concepts were formalized into parameters (Table 2) and applied to spatially explicit data (including landcover, National Elevation, and National Wetlands Inventory data). From there, HAPET was able to identify the areas of Minnesota most likely to support breeding godwits, including (1) the Glacial Lake Agassiz Beach Ridge of the Red River Prairie, (2) along the Minnesota River in southwestern Minnesota, and (3) scattered locations in prairie areas of central Minnesota (Fig. 6). The model also identifies priority areas for restoration, enhancement, and protection (Fig. 6).

Migration Sites

Embedded within the continental breeding range are a number of important staging sites used prior to southward migration (G. Beyersbergen and Ron Martin, pers. comm.; Fig. 7).

Although these sites are also used as stopovers during northward migration, the numbers are significantly smaller, probably because godwits disperse to their nesting territories as soon as they arrive within the breeding range. In Canada, the most important staging sites are the Quill Lakes Complex, and Kutawagen, Pelican, Luck, and Porter lakes in south-central Saskatchewan (Morrison et al. 1995, Beyersbergen and Norton 2005; G. Beyersbergen, pers. comm.; Table 3). In the U.S., the most important staging areas are the McKenzie-Horsehead Lake Complex in central North Dakota (G. Knutsen, R. Martin, and C. Talkington, pers. comm.), Medicine Lake NWR and WMD in northeastern Montana (B. Madden, pers. comm.), and Benton Lake NWR just north of Great Falls, Montana (S. Dinsmore and V. Fields, pers. comm.) (Table 3). Birds stage as early as the first week in June and remain through late July or early August. The extent to which counts in early June represent late northbound migrants, non-breeders/ unsuccessful breeders, and/or southbound migrants is uncertain, although they are most likely non-breeding/unsuccessful breeders (R. Martin and C. Talkington, pers. comm.). High counts of godwits at some of these sites have ranged from ~200-2500 birds, and there is undoubtedly considerable turnover from the beginning to the end of the staging period (average residency of juvenile Marbled Godwits from early July to September in Saskatchewan was 14 days; Alexander and Gratto-Trevor 1997); thus, one-day counts do not reflect the overall importance of these sites to the species.

Table 1. Important breeding *regions* of the mid-continental Marbled Godwit population, sorted by Breeding Bird Survey strata.

Region[a]	State(s)/ Provinces(s)	Breeding Status	Preferred Habitat	Issues & Threats	Highest-Priority Needs
Missouri Coteau and Missouri Coteau Slope (stratum 38)	Alberta, Saskatchewan, North Dakota, South Dakota	Common except in southern-most portion	Large grassland/wetland complexes, relatively flat, few trees, short upland & wetland vegetation; wetland density high Missouri Coteau, relatively high but lower on the Slope	Many wetlands & grasslands remain, largely because rolling topography was not as conducive to cultivation as flatter areas; conversion of wetlands & grasslands is ongoing	Protect existing grassland/wetland complexes, particularly in areas of low relief
Montana Prairie Potholes (stratum 38)	Northern Montana	Common	Large grassland/wetland complexes, few trees, short upland & wetland vegetation; ewer wetlands than on the Missouri Coteau, but largely intact landscape	Agricultural conversion is ongoing	Protect existing grassland/wetland complexes
Drift Prairie/ Glaciated Plains (stratum 37)	Alberta, Saskatchewan, North Dakota, South Dakota	Regular where habitat exists	Large grassland/wetland complexes, few trees, short upland & wetland vegetation	Many wetlands & grasslands converted to agriculture; conversion ongoing; region previously dominated by shallow wetlands & mixed grass; was likely an important breeding region	Protect existing grassland/wetland complexes; restoration potential high
James River Lowlands (stratum 37)	South Dakota	Regular where habitat exists, absent in s. part of region	Large grassland/wetland complexes with few trees and short upland & wetland vegetation	Most wetlands & grasslands converted to agriculture; region previously dominated by shallow wetlands & mixed grass; was likely an important breeding region	Protect existing grassland/wetland complexes; restoration potential high in northern part of the region, but the southern part is at the limit of the breeding range
Prairie Coteau (stratum 37)	South Dakota	Regular where habitat exists	Large grassland/wetland complexes, relatively flat, few trees, short upland & wetland vegetation	Many wetlands & grasslands remain, largely due to rolling topography was (not as conducive to cultivation as flatter areas), but conversion ongoing	Protect existing grassland/wetland complexes, particularly in areas of low relief
Agassiz Lake Plain/Red River Valley (stratum 40)	North Dakota, Manitoba, Minnesota	Uncommon	Large grassland/wetland complexes; few trees, short upland & wetland vegetation	Most wetlands & grasslands have been converted to agriculture	Protect existing grassland/ wetland complexes; restoration potential high but hampered by high land values

[a] Physiographic regions are depicted in Figure 4.

Table 2. Parameters for a conceptual model of Marbled Godwit habitat and high-priority areas that warrant protection in Minnesota (D. Granfors, unpubl. data).

Patch size $\geq$130 ha
a) $\geq$400 m wide (okay)
b) $\geq$800 m wide (better)
Wetlands $\geq$1.6 ha of temporary and saturated wetlands within 130-ha patch
Trees[a] – patch must be >100 m from trees
Percent grass in 3.2-km radius
a) 10-30% (okay)
b) >30% (better)
Topography – average slope within a circular 90 ha area of $\leq$3% considered good; areas with average slope $\geq$4% considered less than ideal.

[a]Scores were later adjusted to address an over-emphasis on woody vegetation.

The only migration stopovers (i.e., not used as staging sites) we identified as important in this region are located in the Upper Mississippi Valley/Great Lakes Region. They include Long Island in Apostle Islands National Lakeshore Park (located in Lake Superior just north of mainland Wisconsin) and Interstate Island at St. Louis River Estuary (on the Minnesota/ Wisconsin border near Duluth). Although the numbers of godwits known to stop at these sites are quite small (Table 3), they were considered important because the godwits using these sites may be James Bay birds (R. Russell, pers. comm.).

U.S.—ALASKA REGION

The Alaska Peninsula breeding site (Table 3; Fig. 8) hosts the world's only known population of *L. f. beringiae* (Gibson and Kessell 1989). The estimate of 1000–3000 breeding birds that use this site is based primarily on counts of Marbled Godwits in Ugashik Bay and Cinder/Hook Lagoon during breeding and post-breeding (staging) seasons (L. Tibbitts and R Gill, pers. comm.). At Ugashik Bay proper, 562 and 450 staging birds were counted during aerial surveys on 22 September 2005 (R. Gill, pers. comm.) and 3 September 1997 (Gill and Sarvis 1997), respectively. These totals represent up to 56% of the Alaska breeding population;

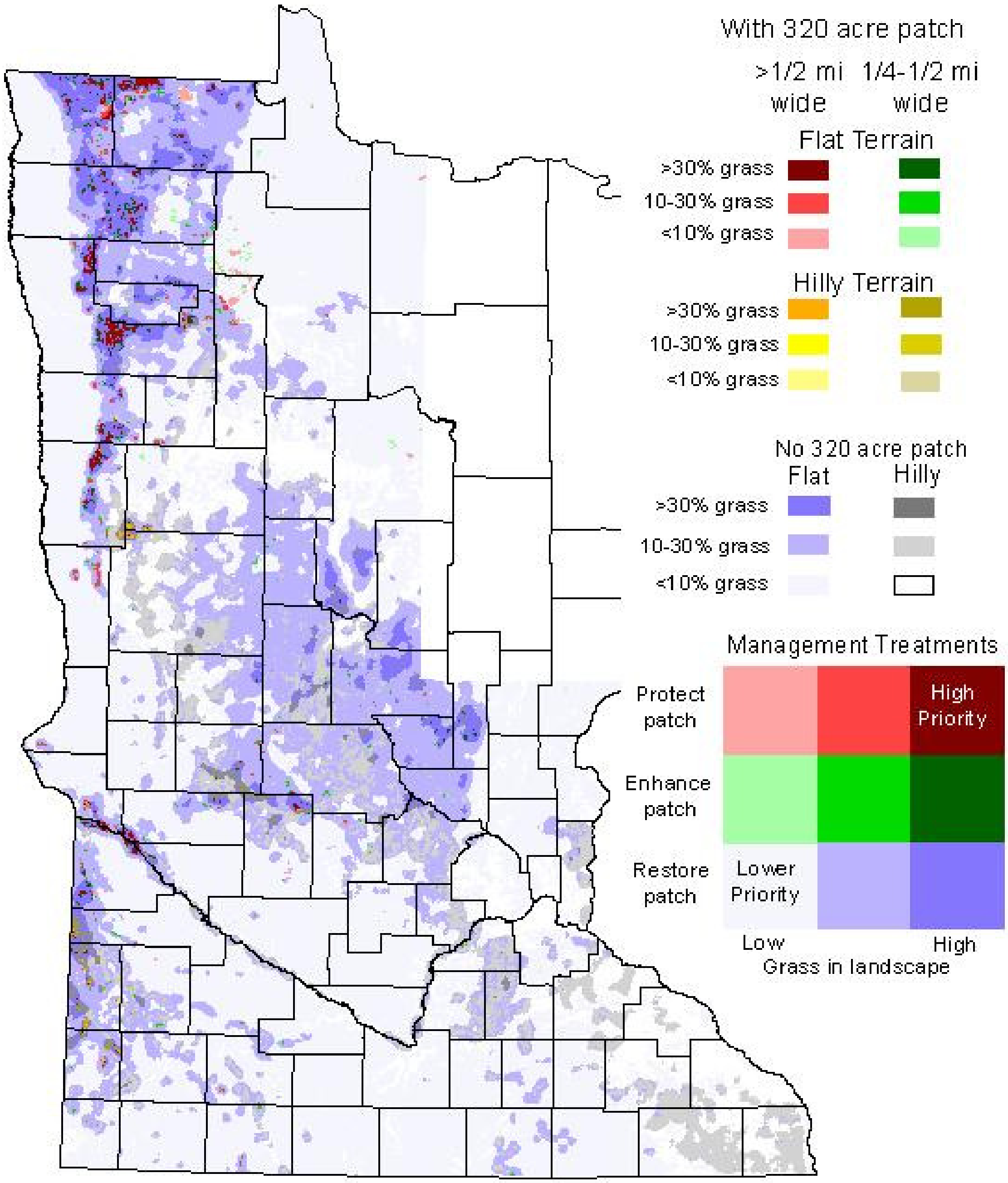

Figure 6. High-priority landscapes for Marbled Godwit conservation in Minnesota derived from parameters described in Table 3.

Table 3. Important migration/winter *sites* (and two breeding *sites* disjunct from the mid-continental breeding range), sorted by region and greatest abundance within region, listed in the Marbled Godwit site data matrix. Seasons of primary Marbled Godwit occurrence: W = wintering, N = northbound migration, S = southbound migration, B = breeding.

Country -- Region	State/Province	Site	Count/Estimate	Season
U.S. – Alaska	Alaska	Alaska Peninsula Complex (Ugashik, Cinder/Hook Lagoons)	1000-3000	B
U.S. – Alaska	Alaska	Alaska Peninsula Complex	500-1000	N
U.S. – Alaska	Alaska	Alaska Peninsula Complex	1410	S
U.S. – Alaska	Alaska	Yakutat Forelands	358	N
CA – James Bay	Ontario/Quebec/ Nunavut	James Bay Complex	1000-2000	B
CA – James Bay	Ontario	James Bay Complex (Chickney Channel, n. of Ft. Albany)	300-400	S
CA – James Bay	Nunavut	James Bay Complex (Akimiski Island n. & s. shores)	176	S
CA – James Bay	Nunavut	James Bay Complex (Akimiski Island, n. shore near Stitt River	140	S
CA – Prairie Habitat	Saskatchewan	Luck Lake	1510	S
CA – Prairie Habitat	Saskatchewan	Quill Lakes Complex	1200	S
CA – Prairie Habitat	Saskatchewan	Last Mountain Lake, n. end	1125	S
CA – Prairie Habitat	Saskatchewan	Pelican Lake	1000	S
CA – Prairie Habitat	Saskatchewan	Porter lake	700	S
CA – Prairie Habitat	Saskatchewan	Kutawagan Lake Complex	538	N
U.S. – Northern Plains/Prairie Potholes	Montana	Medicine Lake NWR Complex	>1700	B
U.S. – Northern Plains/Prairie Potholes	Montana	Medicine Lake NWR Complex	176	S
U.S. – Northern Plains/Prairie Potholes	Montana	Bowdoin NWR/Nelson Lake Complex	1610	S
U.S. – Northern Plains/Prairie Potholes	Montana	Benton Lake NWR Complex	1138-1625	S
U.S. – Northern Plains/Prairie Potholes	North Dakota	McKenzie Slough/Horsehead Lake Complex	2500	S
U.S. – Upper Miss. Valley/Great Lakes	Wisconsin	Long Island in Apostle Island Lakeshore NP	43	N
U.S. – Upper Miss. Valley/Great Lakes	Wisconsin	Long Island in Apostle Island Lakeshore NP	30	S
U.S. – Upper Miss. Valley/Great Lakes	Wisconsin/Minnesota	Interstate Island at St. Louis River Estuary	70	N
U.S. – Intermountain West	Utah	Bear River Migratory Bird Refuge	43056	S
U.S. – Intermountain West	Utah	Bear River Migratory Bird Refuge	26855	N
U.S. – Intermountain West	Utah	Great Salt Lake	22326	S
U.S. – Intermountain West	Utah	Great Salt Lake	15482	N
U.S. – Intermountain West	California	Salton Sea	3190	S
U.S. – Intermountain West	California	Salton Sea	3170	N
U.S. – Intermountain West	California	Salton Sea	1381	W
Country—Region	**State/Province**	**Site**	**Count/Estimate**	**Season**
U.S. – Intermountain West	Nevada	Lahontan Valley/Humboldt Sink Complex	1100	S

U.S. – Intermountain West	Nevada	Lahontan Valley/Humboldt Sink Complex	518	N
U.S. – Central Plains	Kansas	Cheyenne Bottoms WMA	3276	N
U.S. – Northern Pacific Coast	Washington	Northern Willapa Bay	1500	W
U.S. – Northern Pacific Coast	Washington	Grays Harbor	157	W
U.S. – Northern Pacific Coast	Washington	Grays Harbor	271	N
U.S. – Southern Pacific Coast	California	San Francisco Bay Complex	32353	N
U.S. – Southern Pacific	California	San Francisco Bay Complex	28831	S
U.S. – Southern Pacific	California	San Francisco Bay Complex	16944	W
U.S. – Southern Pacific	California	Humboldt Bay	9282	N
U.S. – Southern Pacific	California	Humboldt Bay	8997	W
U.S. – Southern Pacific	California	Humboldt Bay	8244	S
U.S. – Southern Pacific	California	Elkhorn Slough (Monterey Bay)	9000	W
U.S. – Southern Pacific	California	Elkhorn Slough (Monterey Bay)	1180	S
U.S. – Southern Pacific	California	Elkhorn Slough (Monterey Bay)	1044	N
U.S. – Southern Pacific	California	Morro Bay	4045	W
U.S. – Southern Pacific	California	Morro Bay	2955	S
U.S. – Southern Pacific	California	Morro Bay	1495	N
U.S. – Southern Pacific	California	Bodega Bay	2676	W
U.S. – Southern Pacific	California	Bodega Bay	1241	N
U.S. – Southern Pacific	California	Bodega Bay	1382	S
U.S. – Southern Pacific	California	Tomales Bay	2278	S
U.S. – Southern Pacific	California	Tomales Bay	2201	N
U.S. – Southern Pacific	California	Tomales Bay	1564	W
U.S. – Southern Pacific	California	San Diego Bay	1982	S
U.S. – Southern Pacific	California	San Diego Bay	1818	W
U.S. – Southern Pacific	California	San Diego Bay	1167	N
U.S. – Southern Pacific	California	Bolinas Lagoon/Point Reyes Estero Complex	1617	W
U.S. – Southern Pacific	California	Bolinas Lagoon/Point Reyes Estero Complex	1527	N
U.S. – Southern Pacific	California	Bolinas Lagoon/Point Reyes Estero Complex	1499	S
MX – Pacific & Gulf of California	Baja California Sur	Ojo de Liebre/Guerrero Negro	68942	W
MX – Pacific & Gulf of California	Baja California Sur	Laguna San Ignacio	10261	W
MX – Pacific & Gulf of California	Baja California/ Sonora	Delta of the Rio Colorado	9105	W
MX – Pacific & Gulf of California	Baja California/ Sonora	Delta of the Rio Colorado	6057	N
MX – Pacific & Gulf of California	Baja California	Bahia San Quintin	7800	W
MX – Pacific & Gulf of California	Baja California Sur	Bahia Magdalena	7210	S
Country--Region	**State/Province**	**Site**	**Count/Estimate**	**Season**
MX – Pacific & Gulf of California	Baja California Sur	Bahia Magdalena	5859	W
MX – Pacific & Gulf of California	Nayarit/Sinaloa	Marismas Nacionales	3988	W
MX – Pacific & Gulf of California	Sinaloa	Bahia Santa Maria	3438	W

MX – Pacific & Gulf of California	Sinaloa	Ensenada Pabellones	1906	W
MX – Pacific & Gulf of California	Sinaloa	Bahia Adair	1517	W
MX – Pacific & Gulf of California	Sinaloa	Bahia Lechuguilla/Topolobampo	1543	W
MX – Pacific & Gulf of California	Sinaloa	Caimanero-Huizache	1100	W
MX – Gulf of Mexico Coast	Tamaulipas	Laguna Madre	1550	W
U.S. – Gulf of Mexico Coast	Texas	San Antonio Bay/Aransas Matagorda Island NWR Complex	1000	N
U.S. – Gulf of Mexico Coast	Texas	Copano Bay/Aransas Bay	2100	W
U.S. – Gulf of Mexico Coast	Texas	Copano Bay/Aransas Bay	2800	N
U.S. – Gulf of Mexico Coast	Texas	Nueces Bay/Corpus Christi Complex	1000	N
U.S. – Gulf of Mexico Coast	Texas	Baffin Bay/Land Cut Complex	1000	W
U.S. – Gulf of Mexico Coast	Texas	Bolivar Flats/Galveston Bay Complex	695	N
U.S. – Gulf of Mexico Coast	Texas	Bolivar Flats/Galveston Bay Complex	355	W
U.S. – Gulf of Mexico Coast	Texas	Bolivar Flats/Galveston Bay Complex	157	S
U.S. – Gulf of Mexico Coast	Texas	Oso Bay/Upper Laguna Madre Complex	500	N
U.S. – Gulf of Mexico Coast	Texas	Calhoun County Rice Fields Landscape	400	N
U.S. – Gulf of Mexico Coast	Florida	Snake Bight Channel/Cape Sable Complex	200	W
U.S. – Gulf of Mexico Coast	Florida	Lanark Reef/Carabelle Beach/Bald Point/Bay North Pier Complex	376	W
U.S. – Gulf of Mexico Coast	Florida	Honeymoon Island Barrier Is. Complex	200	N
U.S. – Gulf of Mexico Coast	Florida	Point Pinellas/North Shore Beach Complex	176	W
U.S. – Gulf of Mexico Coast	Florida	Fort De Soto County Park/Shell Key Complex	146	W
U.S. – Gulf of Mexico Coast	Florida	Cape Romano/Marco Island/Caxambas Pass/Tigertail Beach Complex	120	W
U.S. – Gulf of Mexico Coast	Louisiana	Breton NWR/Chandeleur Islands	?	W?
U.S. – Gulf of Mexico Coast	Louisiana	Delta NWR	55	W
U.S. – Gulf of Mexico Coast	Louisiana	Grand Isle/Port Fourchon/Grand Terre Complex	?	W?
U.S. – Gulf of Mexico Coast	Louisiana	Southwest Louisiana NWR Complex	45	W
U.S. – Southeastern Coastal Plains	South Carolina	Cape Romain NWR	960	S
U.S. – Southeastern Coastal Plains	South Carolina	Cape Romain NWR	626	W
U.S. – Southeastern Coastal Plains	North Carolina	Clam Shoal Area	363	S
U.S. – Southeastern Coastal Plains	North Carolina	Clam Shoal Area	324	W

Country—Region	State/Province	Site	Count/Estimate	Season
U.S. – Southeastern Coastal Plains	South Carolina	Hilton Head	355	W
U.S. – Southeastern Coastal Plains	North Carolina	Ocracoke Island/Portsmouth Island Complex	312	W
U.S. – Southeastern Coastal Plains	North Carolina	Rachel Carson/Howland Rock/Shackleford Banks Complex (Moorehead City region)	266	W
U.S. – Southeastern Coastal Plains	North Carolina	Rachel Carson/Howland Rock/Shackleford Banks Complex (Moorehead City region)	40	S
U.S. – Southeastern Coastal Plains	Georgia	St. Catherines Island Sound	229	W
U.S. – Southeastern Coastal Plains	Georgia	Altamaha River Delta	222	W
U.S. – Southeastern Coastal Plains	North Carolina	Masonboro Island/north end Carolina Beach	158	W
U.S. – Southeastern Coastal Plains	North Carolina	Lower Cape Fear River Region	141	W
U.S. – Southeastern Coastal Plains	Virginia	Fisherman Island NWR	110	S
U.S. – Southeastern Coastal Plains	North Carolina	Pea Island NWR/Bodie Island Lighthouse Pond	84	S
U.S. – Southeastern Coastal Plains	North Carolina	Pea Island NWR/Bodie Island Lighthouse Pond	61	W
U.S. – Southeastern Coastal Plains	North Carolina	Pea Island NWR/Bodie Island Lighthouse Pond	26	N
U.S. – Southeastern Coastal Plains	North Carolina	New Drum Inlet Shoals	15	S

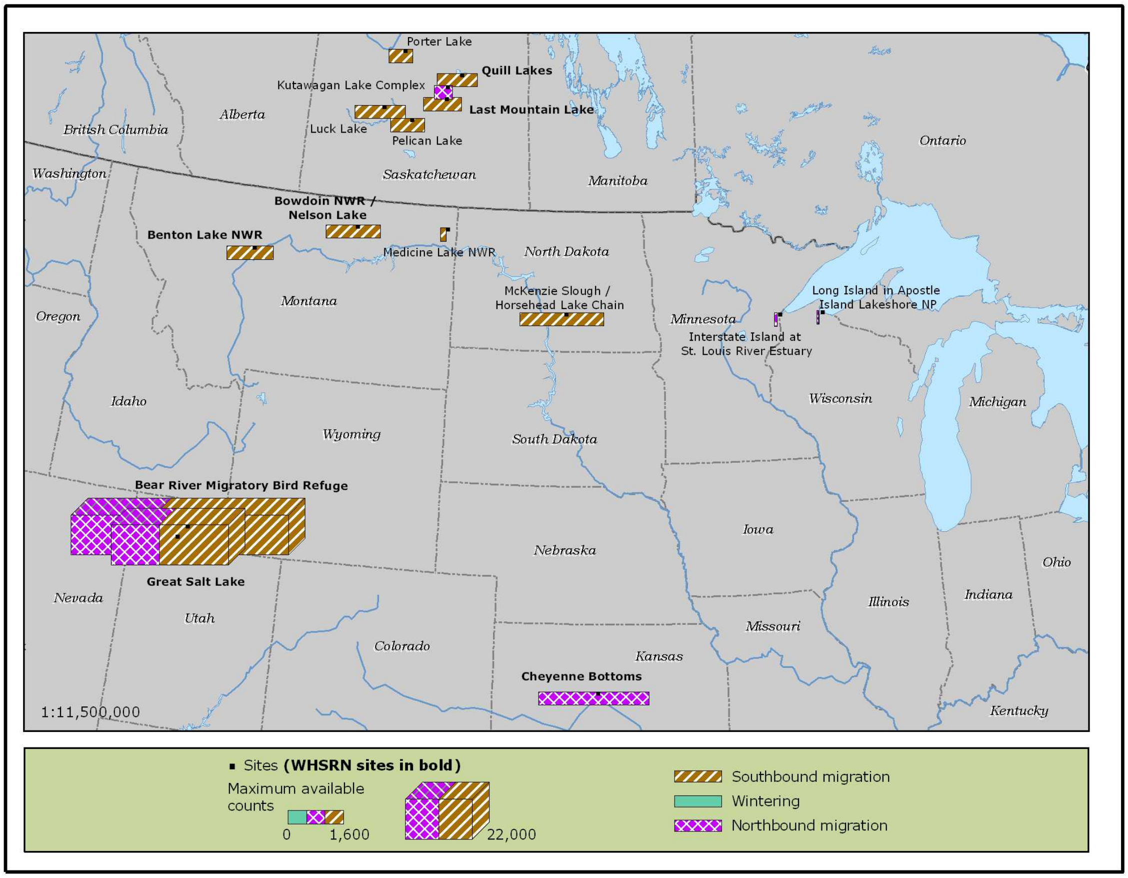

Figure 7. Migration sites used by Marbled Godwits in mid-continental North America.

however, as for all counts in late fall, these flocks were likely composed mainly of juveniles. Finally, high counts from the Cinder/Hook Lagoon system include a maximum count of 360 Marbled Godwits on 28 April 1988 (Gibson and Kessel) and an estimate of 500–1,000 birds on 6 May 1995 (Mehall-Niswander 1997), which represent up to 100% of the Alaska breeding population. At Cinder/Hook Lagoon, ~1000 staging or migrating godwits were seen daily 22–26 September 1991, and 1410 were counted during an aerial survey on 3 September 1997 (Gill and Sarvis 1997). Juveniles were likely present in the southbound flocks.

The only other important site identified in the Alaska region was a portion of the largest estuary in the Yakutat Forelands, used during northbound migration (Andres and Browne 1998). The site is situated where the Alaska, Yukon, and British Columbia borders intersect on the Gulf of Alaska coast (Fig. 8). The number of godwits that use this site is relatively low (Table 3), although they may represent up to 35% of the Alaska breeding population (Alaska Shorebird Working Group 2000) and it is the only known stopover south of the peninsula used by these birds.

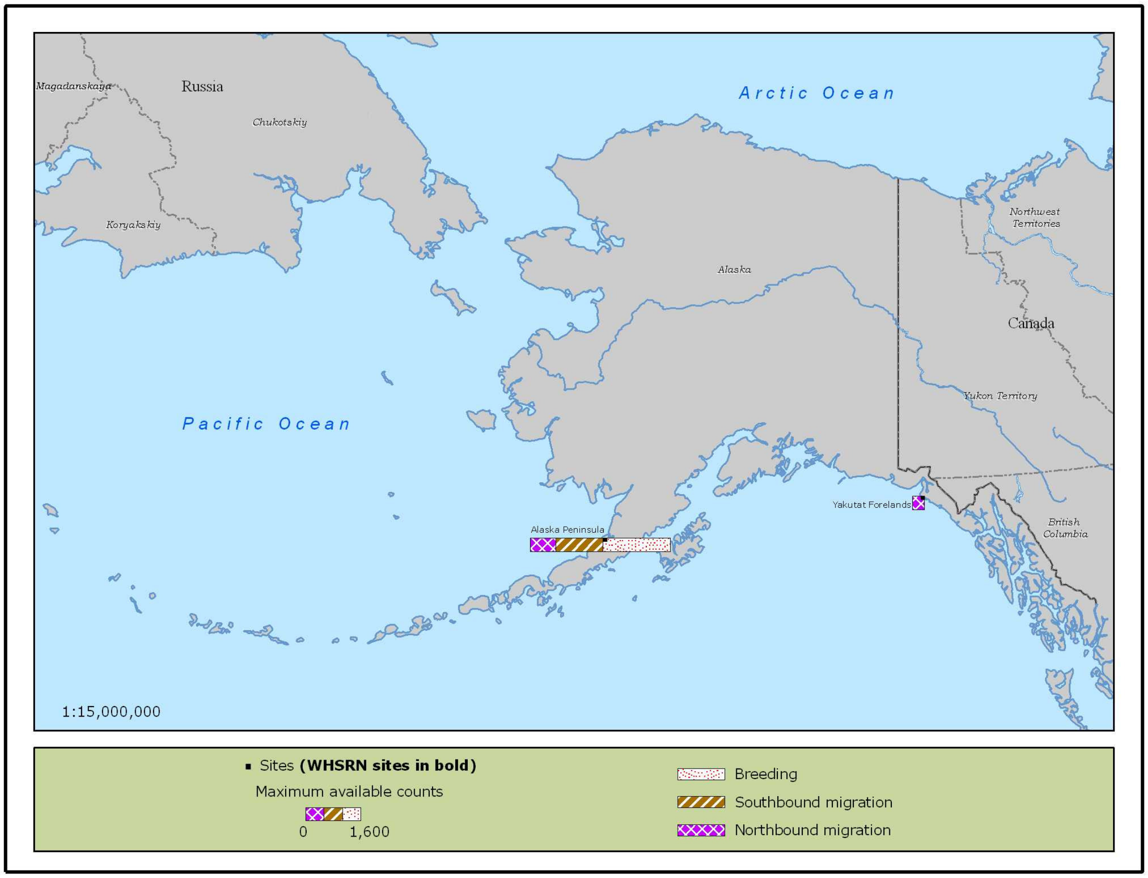

Figure 8. Breeding and migration sites used by Marbled Godwits in Alaska, United States.

CANADA—JAMES BAY REGION

The breeding site known as James Bay (James Bay Complex) occurs in three political jurisdictions: two provinces (Ontario, Quebec) and one territory (Nunavut; Table 3; Fig. 9). Historical and current records of Marbled Godwits at James Bay indicate that the population is probably concentrated in the western half of the basin, including Akimiski Island (which comes under the jurisdiction of Nunavut, even though it is considerably south of mainland Nunavut), and the western shores of Ontario. Less is known about godwit distribution in Quebec, but the southern-most shore of the east James Bay coast in Quebec is similar to the other two areas (Morrison et al. 1976; also see Ontario Breeding Bird Atlas: <http://www.birdsontario.org/atlas/map.jsp?ts=1127746625540>); the coast of northeastern James Bay in Quebec is rockier and less marshy, thus probably not suitable habitat (K. Abraham, pers. comm.). There has been no quantitative assessment of godwit density or abundance at the James Bay site, nor has there been a comprehensive survey on the breeding grounds. The estimate of 1000-2000 birds in this population was derived by Ken Ross and Ken Abraham (pers. comm.) on the basis of site visits, field observations, and crude calculations from what is known about James Bay godwit ecology and habitat use.

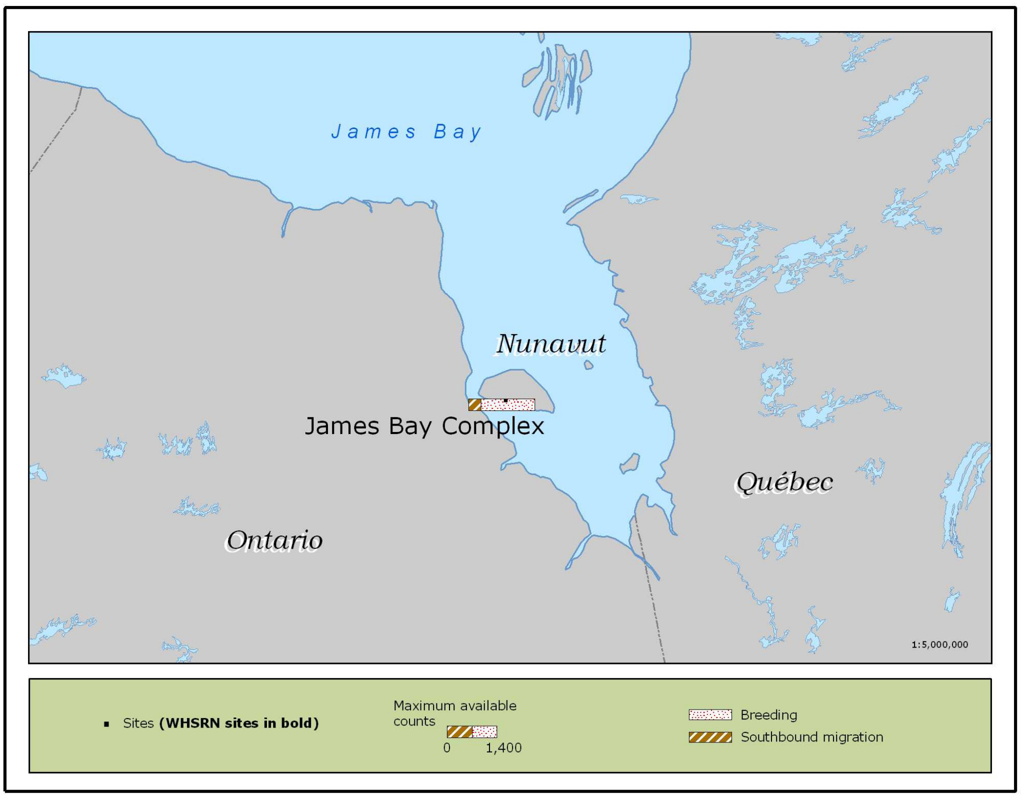

Figure 9. Breeding and migration sites used by Marbled Godwits at James Bay in Ontario, Nunavut, and Québec, Canada.

U.S.—INTERMOUNTAIN WEST REGION

In terms of inland sites, the GSL (Bear River MBR in particular) hosts the greatest number of northbound (~27,000) and southbound (~43,000) migrants (Table 3; Fig. 10; Olson, pers. comm.). In fact, it hosts the largest-known congregations of godwits in the entire U.S. and

Canada. The sheer numbers of godwits—as much as 1/3 of the global population—at this site make the GSL area a crucial link between the mid-continental breeding grounds and the wintering grounds. Furthermore, recent evidence from birds captured in mid-August 2005 for radio-tagging indicate that they undergo a body and wing molt while staging at this site for perhaps as many as six or more weeks (A. Farmer, pers. comm.). A mid-June high count of 5000 Marbled Godwits at Bear River MBR (B. Olson, pers. comm.) indicates that non-breeders and/or unsuccessful breeders also may use this site.

The two other important sites identified in the Intermountain West include the Lahontan Valley/Humboldt Sink Complex in western Nevada and the Salton Sea of southern California (Table 3; Fig.10). The Nevada site hosts >500 northbound migrants, although more birds appear to use the site during southbound migration (L. Neel, pers. comm.). The Salton Sea is used during three seasons: winter, and southbound/northbound migrations, when the numbers peak (~1300 [Nils Warnock, pers. comm.]).

U.S.—Central Plains Region

Cheyenne Bottoms WMA in central Kansas is the only important site identified in the Central Plains/Playa Lakes Region (Table 3, Fig. 7). High counts have exceeded 3200 northbound godwits (Skagen et al. 1999; ISS data). The high count during southbound migration, however, is <100 (H. Hands, pers. comm.). Overall, the abundance of godwits in northward migration at this site varies widely from year to year—typical of shorebird occurrences at wetlands throughout the mid-continental region. At this time, it is not clear what precipitates large numbers of godwits at this site (when numbers are low, there is not a corresponding increase in numbers at other Kansas or Oklahoma sites), but it likely depends on overall climatic effects on the availability of suitable wetlands throughout the Playa Lakes and Central Plains regions (H. Hands, D. Haukos, and S. Skagen, pers. comm.).

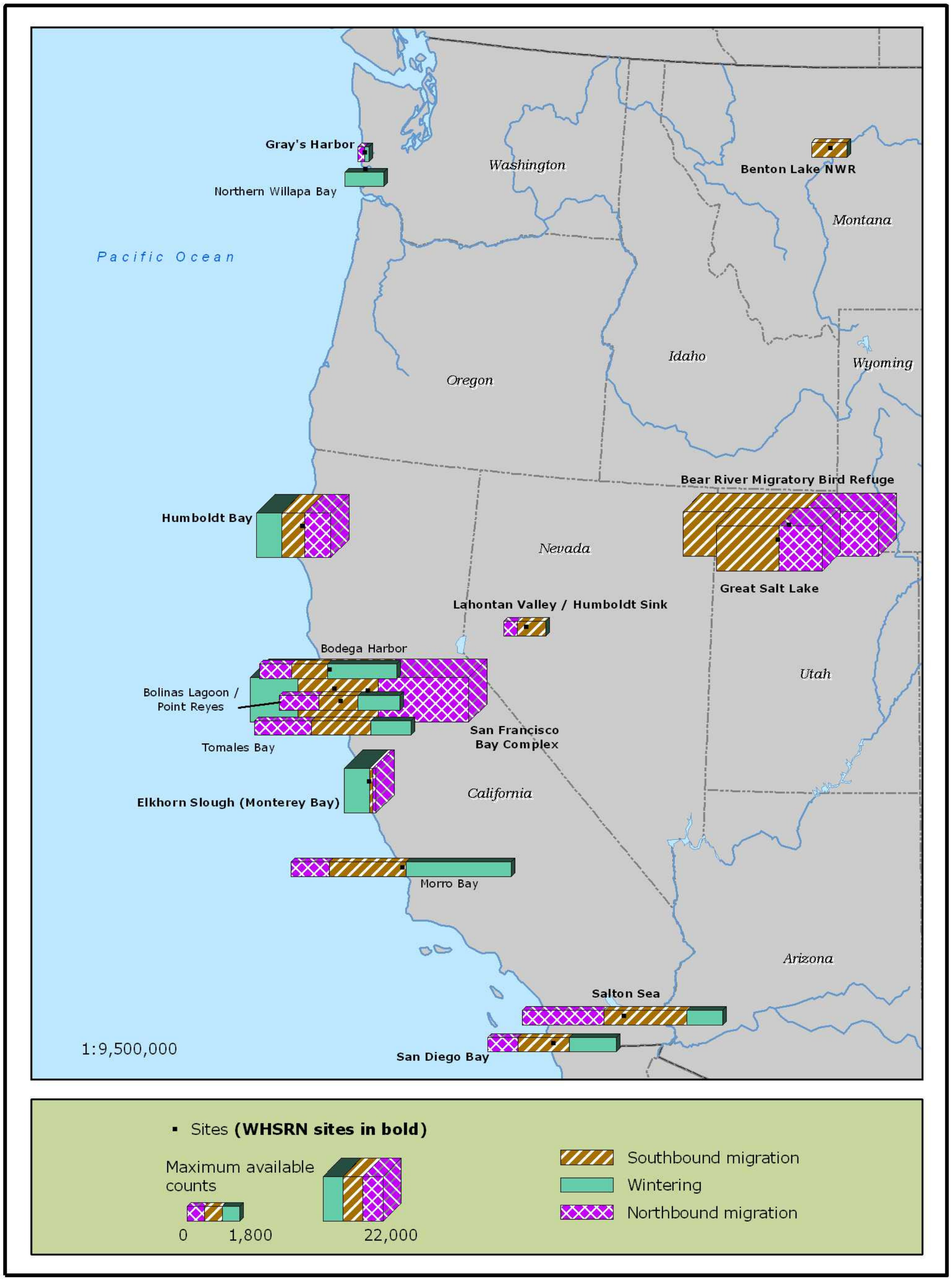

Figure 10. Migration and wintering sites used by Marbled Godwits in western United States.

U.S.—NORTHERN PACIFIC COAST REGION

Few sites are used by notable numbers of godwits in the Northern Pacific Region. One important exception is Northern Willapa Bay (primarily between Tokeland and the mouth of the Willapa River) on the south coast of Washington (Fig. 10). Grays Harbor, just north of Willapa Bay, hosts significantly fewer godwits, but we included it because it may serve as an alternative or secondary site for Willapa Bay birds (Buchanan and Evenson 1997; Buchanan 2000, 2005; M. Bailey, pers. comm.; Table 3; Fig. 10). At the Willapa Bay site, godwits habitually roost on a floating dock at Tokeland and regularly move back and forth across the northern part of the harbor to forage, although small flocks occasionally move from Willapa Bay to the outer beaches or to adjacent Ocean Shores. These movements, however, are infrequent and short-term.

Counts of wintering Marbled Godwits at Willapa Bay have recently been as high as 1500 (>250 during northbound migration at Grays Harbor, including Grays Harbor NWR), which is remarkable in that they are suspected of being primarily *L. f. beringiae* (Gibson and Kessell 1989). If true, this wintering population may represent 50-100% of the Alaska breeding population. What is also remarkable about Willapa Bay is that godwit numbers have been increasing there since the 1960s, when <20 godwits were thought to winter there (J. Buchanan, pers. comm.). At this time, there is no information on why the population at Willapa Bay may be increasing. This site is one of numerous coastal sites where godwits frequently roost on a wooden docks; here they also roost on a rooftop near the dock and on rock jetty (J. Buchanan, pers. comm.). At this time, the extent of migration use at Willapa Bay is limited primarily to the northern part of the bay and the numbers of migrants are small (J. Buchanan, pers. comm.).

U.S.—SOUTHERN PACIFIC REGION

The U.S. Southern Pacific Shorebird Conservation Plan (Hickey et al. 2003) describes the Southern Pacific Region as the most important U.S. region for several shorebird species, including Marbled Godwits. A majority of the world's Marbled Godwit population either winters in, and/or migrates through, the region. It is not yet clearly understood whether a given site is used primarily by southbound migrants, wintering birds, and/or northbound migrants.

In winter, the San Francisco Bay Complex, the largest site in the region, easily hosts 10% of the mid-continental Marbled Godwit population, and it may host as much as 20% of the population for brief periods during northward and southward migrations (Harrington and Perry

1995, Page et al. 1999, Takekawa et al. 2001, Stenzel et al. 2002; J. Takekawa, pers. comm.) (Table 3; Fig. 10). High counts of Marbled Godwits recorded during southbound and northbound migration have been greater than the number recorded in winter (Point Reyes Bird Observatory [PRBO] Conservation Science data; J. Takekawa, pers. comm.). Also important to godwits are Humboldt Bay on the northern California coast and Elkhorn Slough (part of Monterey Bay) just south of San Francisco Bay Complex (Fig. 10). At Humboldt Bay, 8000-9000 godwits may occur in either migration season and similar numbers winter there (PRBO Conservation Science data; Table 3)). Monterey Bay (Elkhorn Slough) has hosted as many birds as Humboldt Bay in winter, although significantly fewer godwits have been recorded there during either migration season (Harrington and Perry 1995, Hickey et al. 2003; PRBO Conservation Science data; Table 3; Fig. 10).

Other important godwit sites in the region include Bodega Harbor, Tomales Bay, and Bolinas Lagoon/Point Reyes Estero Complex (all within close proximity of one another just north of San Francisco Bay), and San Diego Bay (Harrington and Perry 1995, Hickey et al. 2003; B. Collins, pers. comm.; Table 3; Fig. 10). Whereas numbers at these sites do not approach those found at San Francisco, Humboldt, and Monterey bays, they are nonetheless significant. Counts during the season(s) of greatest abundance at these sites range from ~1100-4000, and the high counts occur during all three non-breeding seasons.

MÉXICO—PACIFIC & GULF OF CALIFORNIA REGION

Sites along the Baja California Peninsula coast host the largest concentrations of wintering Marbled Godwits, and combined they are believed to host ~65% of the mid-continental population in winter. Survey data from important sites indicate that they are primarily wintering sites (Morrison et al. 1992; Mellink et al. 1997; Page et al. 1997; Carmona and Danenmann 1998, Engilis at al 1998). To a certain extent, however, this may be an artifact of limited funding and opportunities to survey the region adequately during migration—the majority of surveys have taken place in winter. The only two sites where migration surveys have been conducted are Bahia Magdalena and the Río Colorado Delta (Fig. 11).

Figure 11. Migration and wintering sites used by Marbled Godwits in northwestern México.

By far the most important site—not only in this region, but in the world—is Ojo de Liebre/Guerrero Negro (at the northern tip of the Pacific coast of Baja California Sur; Fig. 11), where the winter high count of nearly 70,000 (Table 3) could represent up to 50% of the global population. Laguna San Ignacio in the northern portion of Baja California Sur (Fig. 11) hosts the second-highest number of godwits (>10,000 in winter), followed by the Río Colorado Delta (at the apex of the Gulf of California; winter), Bahía San Quintín (at the mid-point of Baja California state; winter), and Bahía Magdalena (in the southern portion of Baja California Sur; winter) (Page et al. 1997; Table 3; Fig. 11). Numbers of godwits recorded at the Río Colorado Delta indicate that it is an important wintering site as well as a significant migration stopover (Mellink et al. 1997; Table 3; Fig. 11).

Although godwit numbers at sites south of the Baja California Peninsula and along the eastern coast of the Gulf of California are smaller than those found elsewhere in the region, they are, nonetheless, important winter sites. Wintering numbers range from ~4000 birds at Marismas Nacionales (on the Nayarit/Sinaloa border) and ~3500 at Bahia Santa Maria (in Sinaloa), to 1100-1900 at Ensenada Pabellones, Bahia Adair, Bahia Lechuguilla/Topolobampo, Caimanero-Huizache, all in Sinaloa (Morrison et al. 1992; Morrison et al. 1994; Engilis et al. 1998; Table 3; Fig. 11).

U.S. & MÉXICO—GULF OF MEXICO COAST (INCLUDING LOUISIANA & FLORIDA)

Currently, the only important site known on the Gulf of Mexico in México is Laguna Madre in extreme northern Tamaulipas (high count of >1500; Morrison et al. 1993; Table 3; Fig. 12). Much smaller numbers of godwits are generally believed to winter at the U.S. portion of Laguna Madre. Overall, important godwit sites are difficult to identify in this region due to the fact that godwits likely use tidal flats that become exposed at significant distances from shore (due to off-shore winter winds), a lack of staff to adequately survey such a large extent of convoluted coastline, and the relatively contiguous nature of sites all along the lower and mid-coastal regions of Texas. However, we felt it was important to include the larger sites/complexes known to host godwits in this region if there and possibility that they host James Bay or other isolated breeding populations in the extreme northeastern portion of the mid- continental breeding range—all of which are small enough to warrant conservation prioritization of their winter sites.

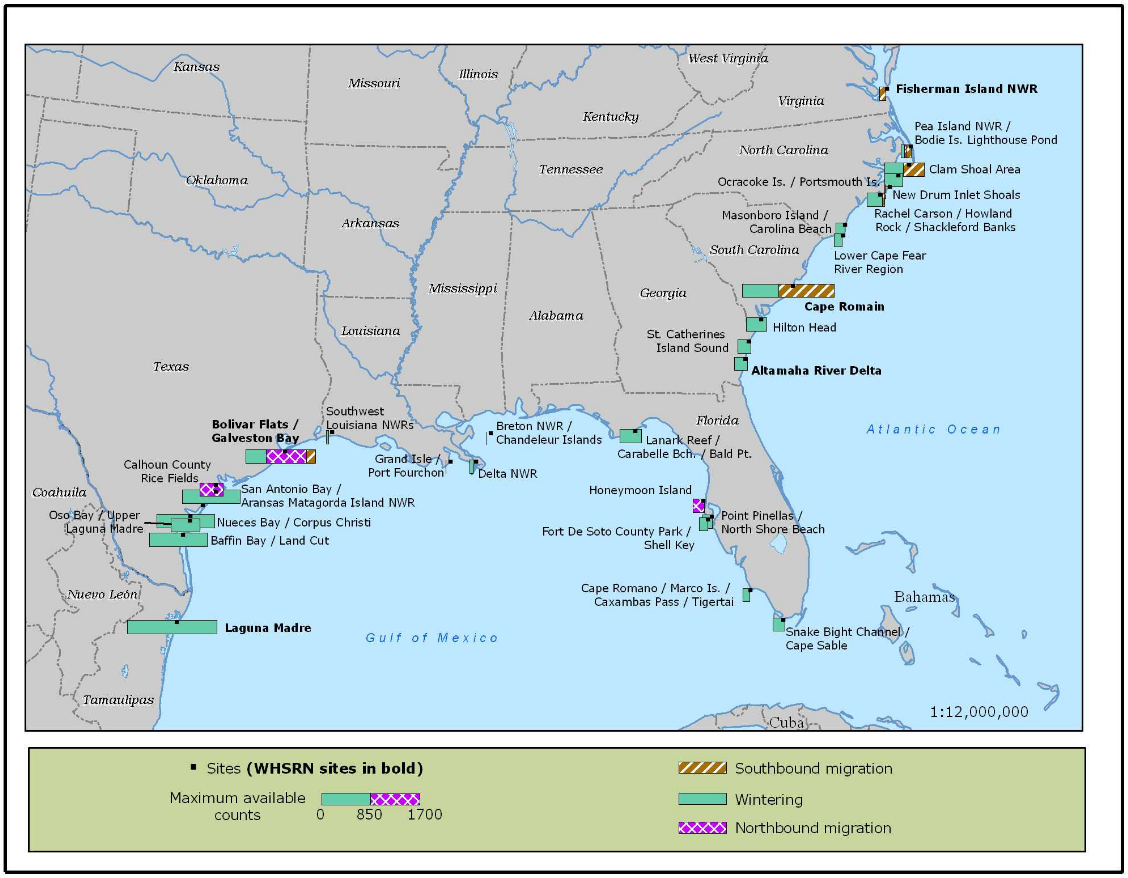

Figure 12. Migration and wintering sites used by Marbled Godwits in northeastern México and southeastern United States.

In general, Gulf coast sites from the extreme southern tip of Texas to the Breton NWR/Chandeleur Islands of Louisiana are not thought to host more than several hundred godwits at any one site, although in Texas complexes of contiguous sites over 50-100+ km may host as many as 500-2000+ birds (Skagen et al. 1999; G. Blacklock, W. Burquette, D. Newstead, B. Ortego, S. Reagan, C. Stinson, and R. Russell, pers. comm.). These complexes include the Baffin Bay/Land Cut Complex, Oso Bay/Upper Laguna Madre Complex, Nueces Bay/Corpus Christi Bay Complex, Copano Bay/Aransas Bay/Rockport Area Complex , San Antonio

Bay/Aransas Matagorda Island NWR Complex, (G. Blacklock, W. Howe, D. Newstead, and Chad Stinson, pers. comm.), Calhoun County Rice Fields Landscape (B. Ortego, pers. comm.), and the Bolivar Flats/Galveston Bay area (<http://www.crystalbeach.com/boliva~1.htm>; John Whittle, pers. comm.) (Table 3; Fig. 12). Winter high counts at these complexes range from 235-800 (mostly based on Christmas Bird Count [CBC] data; National Audubon Society 2005*a*); however, estimates provided by the Coastal Bend Bays and Estuaries Program, which has conducted some aerial surveys of the coastal bend region, are much higher (500-2800; G. Blacklock and D. Newstead, pers. comm.).

Only small numbers of godwits (45-55) have been recorded at the Louisiana sites (Southwest Louisiana NWR Complex, Grand Isle/Port Fourchon/Grand Terre Complex, Delta NWR, Breton NWR/Chandeleur Islands; Table 3; Fig. 12); however, they were included in this plan for now, as our efforts to gather additional information about them were hampered by the heavy impacts of hurricanes Katrina and Rita in that region. (Aerial photographs indicate that all shorebird habitat at the Chandeleur Islands disappeared in Hurricane Katrina, and the other sites were badly damaged.) For now, we left these sites in the matrix and plan as a reminder that they will represent important sites if research reveals that birds using these sites belong to any of the small, isolated, at-risk breeding populations.

We also identified complexes of important coastal sites ranging from the Florida panhandle to Everglades National Park. From north to south, important complexes included the Lanark Reef/Carabelle Beach/Bald Point/Bay North Pier Complex on the panhandle; the Honeymoon Island Barrier Island Complex, Fort De Soto County Park/Shell Key Complex, and Point Pinellas/North Shore Beach Complex (all in the greater Tampa Bay region); Cape Romano/Marco Island/Caxambas Pass/Tigertail Beach Complex between Ft. Meyers and the Everglades; and Snake Bight Channel/Cape Sable Complex (southern tip of the Everglades) (Sprandel et al. 1997, National Audubon Society 2005*a*; S. Bass, T. Below, N. Douglass, K. Penny-Sommers, R. Russell, B. Smith, and R. Zambrano, pers. comm.; Table 3; Fig. 12).

U.S.—Southeastern Coastal Plains Region

Included in this section are coastal sites ranging northward from Georgia to Virginia (including South and North Carolina), as any one of the sites may host birds from the James Bay breeding populations. The most important site is Cape Romain NWR in South Carolina, where the high count was 960 during southbound migration (South Atlantic Migratory Bird Initiative 2005; Table 3; Fig. 12). Godwits also winter at the site, frequently roosting on a certain wooden dock (F. Sanders, pers. comm.). Hundreds (~200-350) of wintering godwits also use the Altamaha River Delta and St. Catherines Island Sound in Georgia; Hilton Head in South Carolina; and the Clam Shoal Area, Ocracoke Is./Portsmouth Is. Complex, and the Rachel Carson/Howland Rock/Shackleford Banks Complex (Moorehead City region) in North Carolina (National Audubon Society 2005*a*; South Atlantic Migratory Bird Inventory website; S. Cameron, R. Russell, F. Saunders, and B. Winn, pers. comm.; Table 3; Fig. 12). Significantly fewer numbers (~15-160) of godwits also use Masonboro Island/N. end Carolina Beach, Lower Cape Fear River Region, Pea Island NWR/Bodie Island Lighthouse Pond, and Drum Inlet Shoals in North Carolina (National Audubon Society 2005; R. Russell, pers. comm.; Table 3; Fig. 12). One last site, Fisherman Island NWR in Virginia, hosts >100 godwits during southbound migration, although these birds may remain at the site through mild winters (S. Cameron, pers. comm.; Table 3; Fig. 12).

CONSERVATION THREATS

Overall, the greatest threat facing Marbled Godwits on the mid-continental breeding grounds is loss and fragmentation of native grasslands and wetlands. At major mid-continental migration stopover sites, the principal threat is inadequate rights to, and/or availability of, water. This problem is further exacerbated by drought (G. Beyersbergen and H. Hands, pers. comm.). At coastal stopovers and in the winter range, Marbled Godwits face a host of major threats, principally residential development, industrial and petroleum contaminants, mariculture, and human disturbance, all of which contribute to habitat loss and degradation. These issues and region-specific threats are discussed in greater detail in the sections below. However, a universal threat identified, either explicitly or implicitly, in all shorebird plans and through discussions we had with collaborators in the development of this plan is the overall lack of coordination and communication required to realize effective, integrated shorebird management and conservation throughout the entire ranges of these species. Rising sea levels resulting from global climate change is also a threat at every coastal site, although the problem may threaten certain sites sooner than others—particularly the Alaska site and low-lying coastal areas of the Gulf of

Mexico and the U.S. Southeastern coastal plains (Lynch et al. 2004). Appendix 3 provides regional summaries of principal threats.

CANADA & U.S.—PRAIRIE HABITAT, NORTHERN PLAINS/PRAIRIE POTHOLES, & UPPER MISSISSIPPI VALLEY/GREAT LAKES REGION REGIONS

Breeding Regions

The greatest known threat to Marbled Godwit populations in their mid-continental breeding range is habitat loss due to agricultural conversion of native prairie (G. Beyersbergen, C. Gratto-Trevor, B. Madden, N. Niemuth, and S. Stephens, pers. comm.). The rolling topography of the Missouri Coteau has helped to discourage cultivation in that region (N. Niemuth and S. Davis, pers. comm.), but elsewhere losses have been significant. In some regions, especially western portions of the godwit's breeding range, conversion rates may be accelerating (e.g., northeastern Montana; B. Madden, pers. comm.). Potato crops are now being planted in Canadian sectors of the Missouri Coteau (G. Beyersbergen and C. Gratto-Trevor, pers. comm.), which encompasses the greatest known population and nesting densities of Marbled Godwits (Sauer et al. 2005, Gratto-Trevor, unpubl. data). In both the U.S. and Canada, the promotion of genetically modified (i.e., Round-up Ready) soybeans is further accelerating the westward conversion of native grasslands to row crops (N. Niemuth, pers. comm.).
Almost everyone that we worked with in development of this plan felt that the lack of government subsidies for ranchers and small dairy operations, and the many subsidies for farming operations, contributes to agricultural conversion in the godwit's breeding range by making the economics of growing crops appear more attractive than those of raising cattle. Of particular note is the funding shortage that results in a 1- to 2-year wait for ranchers to enroll in the USFWS's Partners for Wildlife (Partners) Program (N. Niemuth, pers. comm.). In the ensuing time, many farmers give up and convert their grasslands to croplands. In addition, the Grassland Reserve Program, a CRP-like program for untilled grasslands, has received virtually no funding; this problem is predicted to continue in the next Farm Bill update (which may be delayed until 2008 due to Hurricane Katrina-related funding reallocations) (A. Allen, pers. comm.).

Although certain conservation programs (e.g., the U.S. Farm Bill's Conservation Reserve Program [CRP]) and the planting of Dense Nesting Cover [DNC] for enhancing duck-nesting success) have resulted in some farmed lands being reverted to grasslands, there is on-going debate as to whether the structure of these habitats is suitable for nesting godwits. At least in southern Alberta, godwits were found to nest almost exclusively in the shorter, less-densely vegetated cover of native mixed-grass prairie and rarely in densely planted cover (C. Gratto-Trevor pers. comm.). In North Dakota, godwits are occasionally found nesting in CRP (N. Niemuth, pers. comm.). CRP cover at least maintains large blocks of grassland within the landscape—an important factor in models that predict godwit occurrence (D. Granfors and N. Niemuth, pers. comm.), although native grass mixes in CRP likely provide more suitable habitat than non-native species that form dense stands. It appears that the observed differences are regional, possibly due to differences in grassland structure affected by precipitation and other factors and/or where researchers have focused their efforts. In either case, the debate over grassland structure clearly points out the need for additional studies to strengthen the effectiveness of habitat conservation efforts in the region.

Associated with agricultural conversion are additional threats that result from habitat fragmentation, including invasions of non-native plants, altered predator communities, and the presence of woody vegetation, fencing, and powerlines or other tall infrastructures related to the energy and communications industries. As we know from the models presented earlier, breeding godwits appear to avoid roads, trees, and small tracts of grassland—all inevitable outcomes of agricultural habitat conversion and fragmentation. In addition, godwit injury and mortality have been observed where powerlines bisect shallow wetlands, and there is growing concern about proliferations of wind turbines in godwit habitats. Agricultural conversion also leads to wetland sedimentation and, possibly, greater frequencies/ intensities of botulism (*Clostridium botulinum*) outbreaks if excessive nutrient concentrations build up in wetlands (Irwin et al. 1996, Hall et al. 1999, Rocke and Samuel 1999).

It is not known to what extent predators may be affecting mid-continental godwit populations, but previous studies have shown that altered mammalian predator communities can influence duck populations (e.g., Garrettson et al. 1996, Day 1998), and it is possible that such changes also affect godwits. Throughout the mid-continental breeding range, leafy spurge (*Euphorbia esula*), crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), Canada thistle (*Cirsium arvense*) and Russian olive (*Elaeagnus angustifolia*) threaten the integrity of native grasslands, and cattails (*Typha* spp.) threaten wetlands. Although no one we spoke with believes that sedimentation is a major threat in most existing godwit breeding habitat, sedimentation has damaged or completely filled in wetlands in regions (Gleason and Euliss 1998) of the godwit's historical range. Although current Marbled Godwit breeding habitat in the mid-continental range is dominated by rangeland, overgrazing can precipitate sedimentation problems even in rangelands (Luo et al. 1997). Moreover, if cultivation in the breeding range core does increase, sedimentation is also likely to increase there.

Additional threats on the mid-continental breeding grounds include habitat loss and degradation due to oil/gas extraction, strip-mining for coal, and an unknown level of threat due to agricultural chemicals. Oil/gas exploration and drilling are on the increase in mid-continental regions, including the Williston Basin where Medicine Lake NWR and WMD are located (B. Madden, pers. comm.). In southern Alberta, oil and gas extraction are compounding the effects of strip mining for coal (Gratto-Trevor, pers. comm.). Godwit collisions with powerlines will likely increase as increasing extraction activities for both coal and petroleum result in additional utility infrastructures being installed (R. Harness—EDM International, pers. comm.). Also likely to increase is the dumping of petroleum contaminants into/onto above-ground areas (B. Madden, pers. comm.). In at least some aquatic taxa, herbicides are known to interfere with reproduction (e.g., herbicides are suspected of causing demasculinization among male frogs; Hayes et al 2002), but the extent to which these chemicals threaten shorebirds remains unknown.

The extent to which diseases affect godwit populations in the mid-continental breeding range is also unknown. However, botulism has been known to kill thousands of other birds at wetlands that godwits use, and at least 32 botulism-infected godwits were found at a single site in Alberta in the early 1900s; smaller numbers have been recorded elsewhere in the Canadian prairie provinces. To date, West Nile Virus has not been reported in the Marbled Godwit, although it has been reported in four other shorebird species: Piping Plover (*Charadrius melodus*), Killdeer (*Charadrius vociferous*), Ruddy Turnstone (*Arenaria interpres*), and Western Sandpiper (*Calidris mauri*) (Center for Disease Control 2005).

Finally, there is some concern as to whether haying, mowing, and other land-management operations result in direct or indirect godwit mortality. Currently, however, this problem is thought to be minimal because godwits are not known to make frequent use of habitats likely to be mowed during the nesting season (Gratto-Trevor, pers. comm.). However, more information is needed to determine whether these activities do or do not represent a significant source of godwit nest failure or chick mortality.

In Minnesota ‘s Red River valley, loss of grassland and wetland habitat is also a major threat, but the mechanisms are somewhat different from those elsewhere, as large-scale conversion to cropland has already occurred there. Gravel and rock mining threatens remnants of godwit habitat that are not suitable for cultivation (i.e., the Minnesota River area and the Beach Ridge area in Clay County; D. Granfors, pers. comm.), and conversion to cropland threatens small dairy and ranching operations that still provide habitat for godwits. Perhaps more than in other portions of the mid-continental breeding range, godwit habitats in Minnesota are also threatened by suburban and exurban development (primarily in central Minnesota; D. Granfors, pers. comm.). Finally, invasive species threatening godwit wetland habitats in Minnesota include reed canary grass (*Phalaris arundinace*), purple loosestrife (*Lythrum salicaria*), and cattails (*Typha* spp.), all of which can completely alter the vegetative structure of wetlands (Whitson et al. 1996) and render them unsuitable for most shorebirds. Species that threaten grasslands include leafy spurge and spotted knapweed (*Centaurea maculosa*).

Migration Sites

The two migration sites in Wisconsin and on the Wisconsin/Minnesota border appear to be under no immediate or obvious long-term threat, although monitoring at either site has been infrequent and sporadic. Because the migration period at this latitude (usually 2 weeks at most) is narrow, survey efforts easily miss the birds’ arrivals and departures, making it difficult to gain a full understanding of the way in which they use the sites. Long Island in particular appears secure, as human disturbance is rare in spring when most northbound godwits stopover (R. Russell, pers. comm.). Interstate Island encompasses some private land, including that owned by the Burlington Santa Fe Railroad, but plans to develop the site are not known to exist (R. Russell, pers. comm.). Within a mile of the island, there is the ‘40th Street dredge-disposal site’ (owned and used by the Army Corps of Engineers and the Duluth-Superior Harbor Authority for the St. Louis River estuary and Duluth Harbor) that has occasionally attracted numerous shorebirds, including a few godwits in both migration seasons. Currently, there is no means of maintaining or enhancing godwit habitat at this site (i.e., water-control structures; R. Russell, pers comm.). The presence of invasive invertebrates in the Great Lakes is not thought to be a threat to shorebird populations. This is particularly true for Marbled Godwits, as they use these sites primarily as short-term roosting sites during northbound migration (R. Russell, pers. comm.).

Primary threats to important mid-continental staging sites are basically the same as threats listed above for regions in the mid-continental breeding range. However, there are some threats more specific to the staging sites themselves. Perhaps the greatest threat is the lack of adequate water rights, which is greatly exacerbated by cycles of drought and dewatering/draining due irrigation and development in this relatively arid region. In Canada, drought can severely limit foraging habitat, although generally suitable habitat is available on the larger lakes even in drier years (G. Beyersbergen, pers. comm.). The alkali influences on lakebeds and much of the shoreline habitat at these sites discourages agricultural activities, even when the sites become dry for a number of years. Legislation for Species at Risk (e.g., Piping Plover) and public support for conserving these areas for listed species also helps protect a number of important Canadian staging sites (e.g., Quill Lakes Complex; G. Beyersbergen, pers. comm.).

Often associated with wetlands in arid regions such as the Great and Northern plains—especially where agricultural irrigation runoff is returned to wetlands—is selenium contamination. At this time, it is not known to what extent this contaminant threatens Marbled Godwit populations. Benton Lake NWR in central Montana has a history of selenium levels outside the 'normal' range. Studies there in the late 1990s revealed selenium levels of 4-5 ppm in the livers and embryos of waterfowl, and even greater levels were detected in agricultural return water and natural runoff that enters the site's wetlands (V. Fields, pers. comm.). (The site is almost entirely surrounded by row-crop agriculture.) Current selenium levels are unknown (there is no monitoring program), although it is likely that they remain high because there has been no significant remediation program and land-use practices within the watershed have not changed.

Botulism and contamination due to agricultural runoff, sedimentation, and the by-products of oil/gas extraction may be particularly acute at staging sites, especially in the more southern reaches of the breeding range. G. Beyersbergen (pers. comm.) believes that most Marbled Godwits have migrated south before botulism outbreaks normally occur in Canada; thus, any loss is not likely to be catastrophic in that area. In U.S. the situation may be different, as B. Madden (pers. comm.) reports that botulism outbreaks have occurred at Medicine Lake NWR, and 18 dead godwits were found during an outbreak in 2001. More information is needed to elucidate this potential threat and the interactive effects of excess nutrients that enter wetlands from agricultural lands (Irwin et al. 1996). In the Williston basin and sectors of the Alberta range, oil/gas extraction are accelerating, thus the threat of wetland (and terrestrial) contamination from petroleum waste and salt brine used in extraction activities within those areas is particularly acute. Also significant at eastern Montana sites is the invasion of crested wheatgrass, leafy spurge, Canada thistle, and Russian olive, which threaten to further degrade godwit habitats.

U.S.—ALASKA REGION

In Alaska, the Marbled Godwit (i.e., the Alaska subspecies) is a priority species for conservation (Alaska Shorebird Working Group 2000), due primarily to its small size, and our lack of knowledge about their overall ecology, including where they winter. It is important to understand their genetics and migratory connectivity, however, as they could elucidate the probability of extinction due to stochastic events (e.g., Avian Flu, due to successive years of poor production, oil spills) and what conservation actions might be needed to mitigate these risks. Marbled Godwits in Alaska are also at risk due to the lack of a monitoring program capable of identifying a population decline before the population's viability is severely compromised; if such a program existed, it might be possible to identify the causes of a decline and attempt to reverse it.

Principal threats to the breeding grounds and nearby foraging/staging areas are different from those of the mid-continental population. The region is not suitable for cultivation; therefore, habitat loss at this site is more likely to result from global climate change (Lynch et al. 2004) and/or the effects of oil/gas extraction and spills. Godwits nest very close to coastal shorelines from Ugashik Bay to Cinder Lagoon, thus even small rises in sea level may cause inundation of major portions of their nesting and foraging areas (S. Savage and L. Tibbits, pers. comm.). Future petroleum development and large-scale mining projects are a possibility in the Bristol Bay area, as leases for these projects have been offered recently. At this time, however, it may be cost prohibitive to develop the infrastructure required for transporting extracted products from that region (S. Savage, pers. comm.). If these projects do come to fruition, however, potential negative impacts could be direct (e.g., loss of breeding habitat to road building) and/or indirect (e.g., increased predation, collisions with power lines) (L. Tibbitts, pers. comm.). Oil spills are a more likely threat, although Ugashik is relatively remote from the nearest drilling operations and most shipping lanes, making it somewhat less vulnerable than other areas of the Alaskan coastline.

Other threats to the Alaska breeding site are unknown levels of subsistence harvest and predation due to altered predator communities (both avian and mammalian). Marbled Godwits are not legal game in Alaska, but subsistence hunters are permitted to hunt Bar-tailed (*L. lapponica*) and Hudsonian (*L. haemastica*) godwits, which can easily be mistaken by an untrained eye for Marbled Godwits (S. Savage, pers. comm.); all three species co-occur at Egegik Bay, Ugashik Bay, Cinder/Hook Lagoon, and Port Heiden (L. Tibbitts, pers. comm.). Even a small annual subsistence take of Marbled Godwits could negatively affect the population size of this long-lived species. Also, the extent to which predator communities may have been altered due to human settlement on the Alaska Peninsula is known, but mammalian predators attracted to human settlements are suspected of negatively impacting nesting birds on the Arctic coastal plain of Alaska (Day 1998). On the Alaska Peninsula, Common Ravens (*Corvus corax*) and various gull species also occur, although it is not known whether their populations have changed in response to human activities, and, if so, whether they are now affecting godwit productivity. However, there is a low probability that predators are having a population-level effect on Marbled Godwits at this time due to the small number and wide dispersal of villages in the region (R. Lanctot and L. Tibbitts, pers. comm.). If oil and gas operations are eventually developed in the Ugashik region, predation from ravens and arctic foxes may increase as it has elsewhere in Alaska where oil and gas development has occurred.

Threats at the Yakutat Foreland migration stopover are very similar to those at the Alaska breeding site. Due to its location on the Gulf of Alaska and the relative proximity to major oil-shipping routes, however, it may be significantly more susceptible to oil spills.

CANADA—JAMES BAY REGION

Similar to the Alaska breeding site, the James Bay site is not suitable for cultivation; therefore, habitat loss at this site is more likely to result from global climate change and/or the effects of increasing goose populations. Godwits nest very close to the shorelines of James Bay and on islands within the bay, thus rising sea levels threaten both nesting and foraging areas (K. Abraham, pers. comm.). Given the overlap of godwit habitats and habitats known to be negatively affected by the rapidly expanding populations of Snow (*Chen caertulescens*) and Canada (*Branta canadensis*) geese in James Bay through a destructive foraging strategy (grubbing; Jefferies et al. 2003), it is possible (though untested) that habitat alteration is affecting the long-term sustainability of the godwit population (K. Abraham, pers. comm.). However, because Marbled Godwits appear to prefer grazed grasslands in the mid-continental breeding range, the possibility that goose grazing at a more moderate level could be less deleterious (or even beneficial) should be considered (K. Abraham, pers. comm.).

Also similar to the Alaska population, this population is at risk due to its small size and the paucity of information about their migratory connectivity and/or dispersal among godwit populations from elsewhere. Without this information, the probability of extirpation for this population due to stochastic events remains unknown. This threat is heightened by the fact that there is no comprehensive, long-term monitoring program to detect declines before the population's viability drops to dangerously low levels. Subsistence harvest of godwits also takes place in this region, although unlike the situation in Alaska, harvesting Marbled Godwits is legal in the James Bay area. However, the population size of godwits at James Bay is even smaller than that in Alaska, thus the potential for population-level effects due to hunting could be significant at even relatively low levels. At this time, the magnitude of harvest seems limited to a few families for which the Hudsonian Godwit is the focus of a cultural tradition involving shorebird hunting (K. Abraham, pers. comm.), although harvest data are lacking.

U.S.—INTERMOUNTAIN WEST REGION

The principal threats to mid-continental migration sites are dewatering and inadequate water rights (exacerbated by drought and development), the associated water quality problems, and the lack of interagency regional planning and integrated management for determining water-use priorities in this arid region. The Intermountain West Regional Shorebird plan (Oring et al 2000) indicates that, "Finding ample high quality fresh water will be the greatest challenge faced by future shorebird conservation interests. . . ." Not only does a lack of fresh water diminish the ability to ensure that shorebird habitat is available when needed, it also causes significant, often highly detrimental, swings in salinity levels. At times, salinity levels can even exceed the tolerances of brine flies and shrimp. In the GSL area, mineral extraction/contamination and associated industries have also resulted in direct loss of habitats used by feeding and roosting shorebirds (B. Olson, pers. comm.).

Other important threats in the Intermountain West include sedimentation, as well as by-products of energy and mineral extraction—especially in the GSL system. Collisions with powerlines, fences, and other infrastructures, as well as botulism (*Clostridium botulinum*) can cause direct mortality. In the past, botulism has been reported in freshwater bays of the GSL, including Bear River MBR (Wilson 1973), where a large outbreak of the disease could affect up to 25% of the world's population of godwits. Another possible threat is mosquito control, which is currently significant in the GSL system; the only site in this system not being sprayed for mosquitoes is Bear River MBR. The extent to which this practice will increase with additional threats of West Nile Virus is not difficult to predict, but the effect of such programs on godwit prey bases or physiology remains unknown and warrants investigation.

The Salton Sea exists by virtue of irrigation return flows from agricultural lands of the Imperial Valley. Increasingly, portions of that water supply are being diverted to meet water demands in the heavily populated urban southwest, slowly eroding the quantity and quality of shorebird habitat at the site. Indeed, the site has been one of historic avian die-offs, due primarily to botulism, avian cholera (*Pasturella multocida*), heavy metals, selenium, and unknown contaminants (N. Warnock, pers. comm.). Additional threats to the Salton Sea's water quality include sewage flows from México (although this threat is presumed to be decreasing) and rising salinity levels believed to be impacting prey bases for shorebirds (N. Warnock, pers. comm.). Although the California Department of Water Resources (CDWR) and other agencies are studying the water-quantity issue in the Imperial Valley, it is not clear that wildlife values will be part of long-range planning for water demand in the desert southwest.

Shifts in agriculture and land use in the uplands that surround the Salton Sea also threaten godwit habitat. Rice fields are used by foraging shorebirds more than other croplands, but many rice fields are undergoing conversion to crops that require less water and/or they are threatened with housing development (N. Warnock, pers. comm.). With residential development, the threat of increased recreation development on the sea's shores is likely to increase as well. Overall, the Salton Sea's future as a viable godwit wintering site and migration stopover appears precarious.

The Lahontan Valley/Humboldt Sink site is also threatened by dewatering and water quality issues. Historically, contamination, including selenium, boron, and arsenic, as well as botulism, have led to large-scale avian die-offs at this site. After a five-year process, however, area resource managers recently succeeded in wining legislation for purchasing water rights for the site (L. Neel, pers. comm.). Today a conservation program that entails diluting the contaminants by increasing water flow into the wetlands is slowly undergoing implementation (L. Neel, pers comm.).

U.S.—Central Plains Region

The principal threat at the one important stopover site we identified in the Central Plains region—Cheyenne Bottoms WMA—is similar to that in the Intermountain West: inadequate water supplies. Water volume in streams to which Cheyenne Bottoms has surface water rights have been diminished by virtue of increasing upstream use for center pivot irrigation (H. Hands, pers. comm.). Cutbacks in water rights and damming have also occurred in this hydrologically and politically complex watershed. Thus, supplemental water for managing shorebird habitats has declined. Additional issues that lead to diminished surface flows include terracing and other agricultural conservation practices.

Another important threat—directly due to diminished water availability—is sedimentation. In the past, when stream flows were adequate, water quality in the Cheyenne Bottoms basin was good. In the last ~30 years, however, it has become necessary to divert precipitation runoff into the basin to ensure that water enters the basin. It is these diversions of runoff that carry significant sediment loads. Sediments from agricultural areas often carry contaminants, although tests during the last 15 years have not detected any contaminants in the watershed.

In the past few years, phragmites (common reed; *Phragmites australis*) has become a problem in the wetlands, despite earlier efforts to eradicate it when it was still relatively rare at the site. Today, managers are finding more, bigger clumps of this invasive. Cattail infestation, which often chokes up to 90% of a given pool, has been a major problem at the site for the past 30 years. Today, cattail control is a major driving force behind management decisions and is a major focus of management activity. Currently, the main goal is to prevent cattail infestation from returning to historical levels.

U.S.—NORTHERN PACIFIC COAST REGION

The principal potential threat to Marbled Godwits at Willapa Bay is the invasion of spartina (*Spartina alterniflora*) (J. Buchanan, pers. comm.), a very aggressive species of cordgrass that invades mudflat habitats (see website for San Francisco Bay Estuary Invasive Spartina Project at: <http://www.spartina.org/>)—critical foraging habitats used by shorebirds (Hickey et al. 2003). Spartina control has been a significant focus of management efforts for several years, including northern Willapa Bay. Currently, it appears that those efforts have been effective, and, given the continued increase in godwit abundance at the site, neither spartina nor the protocols used to control it have impacted godwit populations. Continued spread of spartina, however, in the primary foraging area used by godwits represents an on-going threat.

Changes in the prey base for shorebirds due to exotic/invasive invertebrates and oil spills also pose potential threats at Willapa Bay and Grays Harbor (J. Buchanan, pers comm.). The spread of exotic invertebrates has been well documented in many estuaries of western North America, and there is a strong likelihood that exotic invertebrates will become established in Willapa Bay and Grays Harbor. European green crabs (*Carcinus maenas*) have already been found at both sites (<www.wsg.washington.edu/outreach/mas/aquaculture/crab.html>), but whether they have the potential to negatively impact godwits is unknown. Currently, no problems are suspected (J. Buchanan, pers. comm.). Without a special monitoring program to elucidate this relationship, however, it will be difficult to determine whether this becomes a conservation issue for godwits. The Washington coast is also an important shipping lane for oil, making the threat of a spill near either site a real possibility. At Willapa Bay, the birds regularly use the northern sector, where a spill would threaten the entire population. Although somewhat smaller, the same threat applies to Grays Harbor.

Finally, although human activity is not known to affect godwits adversely at the Willapa Bay roosting site, the potential exists. At high tide, roosting godwits frequently use a floating dock in the bay and the roof of an old building nearby, as well as the remnants of a rock jetty. Although all three roost sites are in areas of regular human activity (i.e., a small fishing fleet operates from the dock) to which the godwits appear habituated, damage to or removal of the roost structures would certainly limit roost-site options (J. Buchanan, pers. comm.).

U.S.—SOUTHERN PACIFIC REGION

California is home to more people than any other state in the U.S. (12% of the total U.S. population), and a large proportion of that population is concentrated along the coast near important Marbled Godwit habitats. Consequently, potential threats to godwits, or godwit habitats, in this region are numerous. The principal threat is habitat loss and degradation, due primarily to residential and industrial development—including the possible expansion of the San Francisco airport into San Francisco Bay. However, sedimentation in coastal bays due to runoff from surrounding watersheds, contamination from non-point and known sources, invasive species, mariculture activities, disturbance from recreational activities (boating, fishing), diminishing supplies of fresh water for wetlands, and agriculture are problems that, to one degree or another, threaten virtually all the important Marbled Godwit sites in the region. The Southern Pacific Shorebird Conservation Plan (Hickey et al. 2003) clearly summarizes the extent to which these issues have been, and continue to be, a source of concern within individual sites of the region. Furthermore, many of these problems have long been recognized and actions have been taken to further protect important wetland habitats through acquisition, management, and (in some cases) restoration.

At Humboldt Bay, oil spills have occurred twice in the recent past, and the potential for future spills there and other California sites is significant. Mariculture is a particular threat to Bodega Harbor and Tomales and Humboldt bays (oyster culture), and contaminant and sediment runoff from croplands is a problem in Morro Bay and Bolinas Lagoon, respectively. Invasive plants and invertebrates threaten nearly every site in the region. Species of greatest concern include spartina and European beach grass (*Ammophila arenaria*) at most sites, European green crabs (*Carcinus maenas*) at Bolinas Lagoon and Tomales Bay, Canada Geese (displacing birds at important foraging areas) at Bolinas Lagoon, and an invasive isopod (*Sphaeroma quoyamum*) at San Diego Bay. San Diego Bay's water is also threatened by warm discharges from a power plant (B. Collins, pers. comm.). Powerlines are a potential threat at the San Francisco and Humboldt bays, but again the extent to which they affect godwit populations is not known. At Elkhorn Slough, a major threat is contamination from the rail system (e.g., oil spills) that runs along the slough. In each case, however, the level of threat that these issues pose to Marbled Godwits is unknown. Finally, nearly every site in the region is threatened at some level by recreation activities, including jet-skiing, kayaking, surfing and windsurfing, claming, and para-sailing (Hickey et al. 2003).

A threat that may be unique to sites around and north of San Francisco Bay Complex (i.e., Humboldt and Tomales bays) is the increasing loss of livestock pastures and seasonally flooded agricultural areas—the latter also typically characterized as grazed grassland. These habitats can be very valuable, especially when nearby wetland habitats are less suitable or unavailable due to fluctuating water levels. However, changing agricultural patterns—including loss due to bulb farming and/or encroaching urban development—are threatening these grassland systems.

MÉXICO—PACIFIC & GULF OF CALIFORNIA REGION

Various relatively new threats are cropping up at Marbled Godwit sites in México. In Baja California, major threats include habitat loss and/or degradation due to mariculture and dams, and land and water pollution from agricultural activities. The recent, rapid expansion of tourism, with the associated development of coastal resorts and human disturbance, also pose major threats to this region. Mariculture operations, including shrimp farming and small, subsistence fisheries, threaten godwit populations by altering the hydrology, habitat structure, and biota of sites where these activities occur. Saltworks are also a threat to Baja California sites—largely through the loss of native habitats—although they also provide habitats that godwits will use (E. Palacios-Castro and X. Vega-Picos, pers. comm.), and the extent to which saltworks provide reasonable substitutes needs investigation.

Along the Sinaloa and Nayarit coasts, major threats are similar to those listed for Baja California. Recent utility development (water and electricity) along Sinaloa's coast may encourage extensive development in that region, further degrading and destroying shorebird habitat. Shrimp farming in Sinaloa has already led to drainage and serious degradation of coastal wetlands, and agricultural development is resulting in decreased salinities in brackish wetlands. In addition, tidal flats used by foraging shorebirds are becoming invaded by vegetation, perhaps due to increased inflows of agricultural nutrients and sewage.

On the Río Colorado Delta, which historically served as one of the most important shorebird sites on the Pacific Coast of North America, dewatering has all but destroyed the ecosystem. However, the site still hosts thousands of Marbled Godwits in winter and in migration, which makes it worthwhile to mitigate further water loss and restore both water quantity and quality.

U.S. & MÉXICO—GULF OF MEXICO COAST REGION (INCLUDING LOUISIANA & FLORIDA)

Coastal development, including residential, resort, and industrial, is a major threat at all sites from Texas to Florida (W. Howe, N. Douglass, D. Newstead, B. Smith, K. Penny-Sommers, R. Zambrano, and C. Stinson, pers. comm.). In many regions, development has already eliminated significant sectors of habitat (e.g., Galveston Bay in Texas and Tampa Bay in Florida), and time is running out for protecting other important sites from development (e.g., Lanarck Reef in Florida, Rockport in Texas). Currently, development around the Copano Bay/Aransas Bay/Rockport /Port Aransas Area Complex area is especially acute, and although land trusts/conservation organizations are working to purchase and conserve coastal wetlands there, funding limits have precluded significant success (C. Stinson, pers. comm.). The owner of Lanarck Reef also plans to sell the land for development, and the Florida Fish and Wildlife Conservation Commission is exploring avenues for purchasing the site (B. Smith, pers. comm.). Of course, one of the major threats that accompanies residential and resort development is recreation-based disturbance—particularly in this sub-tropical sector of the godwit's range, where intense recreation takes place year-round. At Honeymoon Island and the Marco Island/Caxambas Pass/Cape Romano Complex in Florida, unleashed dogs and boaters entering protected areas disturb shorebirds, especially during winter (K. Penny-Sommers and R. Zambrano, pers. comm.).

Another principal threat along the Gulf of Mexico coast is spills of petroleum products and chemicals, as well as non-point source pollution from both industry and agricultural activities. In the early 1990s, there was a significant oil spill on Florida's Gulf coast, and although an oil spill-contingency plan was in place, a large quantity of oil was spilled, many sections of coast were impacted, and many birds were oiled (R. Zambrano, pers. comm.). The long-term impacts of that spill and similar threats are unknown. As we have seen during recent severe hurricane events in the gulf, spill risks may become greater if global climate change spawns more frequent, intense storms. In addition, the increasing demand for domestic oil reserves is promoting continued oil/gas development in the Gulf. Associated with oil/gas and groundwater extraction in the region is subsidence of estuary habitats. Dewatering of rivers and wetlands is not only leading to loss of freshwater habitats, it is also resulting in saltwater intrusions along the coast. Because godwits are believed to spend much of their time foraging on tidal flats, it is not known to what extent changes in estuary habitats are affecting them, although in other regions of the godwit's range the birds make significant use of estuaries for both foraging and roosting.

A potential threat to Texas coastal sites is habitat damage caused by feral hogs. These animals are abundant on the coast and their impacts on godwit feeding and roosting sites remain unknown (W. Howe, pers. comm.). At Laguna Madre, shrimp farming and the associated effluent is suspected of contributing to toxic algal blooms (brown tide), which compromise the site's water quality and other aspects of the system's integrity. Large-scale fisheries also threaten the Rockport area. At some Florida sites, a potential threat is beach modification (generally beach nourishment), especially near areas used most heavily by people (e.g., Tampa Bay area). At this time, no one is certain how this activity is impacting or will impact godwits.

One of the greatest threats to godwits along the Texas and Louisiana coasts is not knowing their level of importance due to a lack of data to point out important godwit sites, how the birds are distributed across the region, and the extent to which they move between sites. Florida, where comprehensive aerial winter surveys have been conducted, may have the best godwit survey data of any state in the region (Sparandel et al. 1997). Those surveys have been very useful for identifying which sites are truly important to Marbled Godwits in Florida.

U.S.—Southeastern Coastal Plains Region

Because Fisherman Island NWR—the only important godwit site that we identified in Virginia—is an inviolate sanctuary closed to the public and largely accessible only by water, the site is relatively secure (R. Russell, pers. comm.). However, the extent to which the site may be threatened by petroleum spills from shipping traffic or invasive species is not known.

At North Carolina sites, there is an unknown level of threat from harvest of horseshoe crab (*Limulus polyphemus*) eggs (R. Russell, pers comm.). The other major threat to most of these coastal sites is development, recreation, and tourism. In addition, the Ocracoke Island/Portsmouth Island Complex, Pea Island NWR/Bodie Island Lighthouse Pond, and Clam Shoal Area sites are threatened by the development of wind energy, which again produces an unknown level of threat to shorebirds, regardless of the habitat or region (R. Russell, pers.

comm.). Invasive species also threaten the Pea Island NWR/Bodie Island Lighthouse Pond site, and all sites are threatened to an unknown extent by recreation (R. Russell, pers comm.).

The four sites that receive the greatest Marbled Godwit use in the region—all in South Carolina and Georgia—are somewhat more threatened than the sites in North Carolina and Virginia. Currently, one of the greatest known threats to godwits in both states is disturbance from recreation activities, including boating, pedestrians, and unleashed dogs. In coastal counties, where annual human population growth rates of 2-3%, fertilizer runoff from lawns along coastal sites and upstream of important delta sites, as well as contamination from pet excrement, are merging as major threats to coastal site water quality (N. Dias, pers. comm.). However, much of the South Carolina coast is protected by public ownership and conservation easements (F. Sanders, pers. comm.); thus, there are few opportunities to increase the amount of protected coastal land. Pollution is also thought to have precipitated declines in invertebrate populations. Little is known about godwit prey selection in this region, or which habitats they use for foraging and roosting.

CONSERVATION STRATEGIES & ACTIONS

General Overview

Region- and site-specific conservation actions needed for Marbled Godwit conservation are discussed in the regional sections below (see Appendix 3 for regional summaries of priority conservation strategies and actions). First, however, we present a general overview to encapsulate the highest-priority—and relatively universal—actions needed throughout the godwit's range.

Habitat Protection & Potential Funding Strategies

Overall, the highest-priority conservation action identified for almost every site within the Marbled Godwit's range is habitat protection, particularly in the mid-continental breeding range and unprotected lands within and immediately surrounding wintering sites. In the mid-continental breeding range, large, contiguous blocks of native grasslands, particularly those encompassing a diversity of wetland types/sizes, should be prioritized. High-priority habitats in the winter range include estuaries where mariculture and other extractive activities are taking place, as well as nearby uplands used for roosting and as alternative habitats during stormy weather. Coupled with protection is the need for habitat management, particularly where invasive plants and/or woody vegetation (including planted and encroaching woody vegetation) are encroaching and where wetlands have been damaged or destroyed by sedimentation. In portions of Canada and in Minnesota, where Marbled Godwits are at greater risk of extirpation in the short-term, wetland and grassland restoration are also a priority; elsewhere, restoration may be important but second to protection of intact habitats.

Although methods of habitat protection will undoubtedly vary by political climates, opportunities, and programs available at various jurisdictional levels, the primary limiting factor for habitat protection is the lack of funding. Thus, a crucial first step is to develop fundraising strategies that earmark funds specifically for habitat protection. This will require understanding what motivates the landowners and other major stakeholders and then seeking at least their passive—if not active—support, and garnering the support of local organizations, businesses, and individuals interested in shorebird conservation. It also requires strengthening or developing relationships with existing or potential partners, respectively, that have the same interests potentially realized through Marbled Godwit conservation.

In Canada, the primary federal vehicle for habitat conservation is its Agricultural Policy Framework (APF; see <http://www.agr.gc.ca/cb/apf/index_e.php>), under which there are two conservation programs potentially useful for conserving or enhancing godwit habitat. One program is Green Cover Canada (GCC), to which farmers may apply for 10-year agreements that fund them to convert marginal croplands to permanent grass cover (pasture or hayland; K. Guyn, pers. comm.). At this time, funds for GCC applicants are not limiting, due, in part, to a lack of education about the program and its benefits. Canada's APF also provides a Best Management Practices (BMP) program (see <http://www.agr.gc.ca/pfra/water/agribtm_e.htm>) that aims to improve wetland water quality (including reductions in fertilizer, pesticide, and sediment runoff) within farmlands, which entails cost sharing with farmers to implement beneficial farming practices. However, additional BMPs, such as wetland restoration, improved stewardship of riparian/wetland and grassland areas (e.g., removing cattle from wetlands, rotational grazing regimes), buffer development, and plugging ditches that drain wetlands, are being sought for renegotiation of the APF in 2007-2008 (K. Guyn, pers. comm.).

In the U.S. and Canada, the Joint Ventures will likely have a major role in both habitat protection and fundraising. Likely funding partners include The Nature Conservancy, as well as Ducks Unlimited, Pheasants Forever, and other sportsmen's associations that promote grassland and wetland habitat conservation. In addition, the Cattlemen's Association may become an important partner in efforts to conserve ranchlands and water sources. The association also may be a crucial partner in campaigning for Farm Bill amendments/appropriations that benefit ranchers and small dairy operations within the godwit's breeding and (to some extent) wintering ranges. Such groups could work toward changes in Federal law that would provide additional appropriation for the Grassland Reserve Program and remove disincentives for converting native grassland to cropland. For example, the provision in the Farm Bill's Sodbuster program that precludes disaster payments, crop insurance, or loan-deficiency payments for native grasslands converted to croplands has not precipitated significant declines in losses of native grassland in previously untilled regions, such as the Missouri Coteau (S. Stephens, pers. comm.). Finally, if the Wetlands Reserve Program were to allow for habitat management—specifically late-season haying, grazing, and/or prescribed burning, depending on the region—that could lead to improvements in shorebird habitat. Marbled Godwits cannot use wetlands vegetated with dense stands of cattails (or any other plants that invade the shallow sections of wetlands used for foraging).

Community awareness-raising workshops are also needed—not only to promote the benefits of conserving native grasslands and wetlands, but to inform landowners about incentive programs for which they may be eligible. Programs could be developed to inspire landowners and other stakeholders to work with their political representatives for policies and legislation that would further promote and fund grassland and wetland conservation (e.g., complete, appropriate, and implement programs that emerge from Canada's Value of Natural Capital policy currently under development; improving the U.S. Farm Bill; developing similar federal policies and legislation in México). Land trusts, birdwatchers, and members of nature conservation organizations within any given portion of the godwit's range also need to be targeted for educational programs and campaigns that encourage the purchase of Duck Stamps and donations ear-marked for habitat conservation.

There is also the need to develop habitat-conservation funds through organizations and corporations, including (but not limited to) energy-extraction/generation and mining companies (particularly those with a presence in regions of conservation interest). For example, Rio Tinto's Kennecott Minerals division is headquartered in Salt Lake City—the backyard of the largest godwit concentration site north of México—and at least Rio Tinto's Luzenac division has a history of supporting the Important Bird Areas [IBA] program. Many such companies are seeking to turn around reputations of poor land stewardship through habitat-based conservation and other public relations programs. Full advantage should be taken of these potential win-win situations.

Another crucial need is a better understanding of how to manage grassland and wetland habitats for Marbled Godwits. As more lands are protected, this need will grow. Thus, applied research to determine best practices and methods for attracting and sustaining healthy godwit populations is needed. Follow-up in the form of habitat management training for resource managers will be essential.

Securing Water Rights for Migration Sites

Another high-priority action specified for a number of sites—especially interior staging and stopover sites—is to ensure adequate water supplies in wetlands targeted for Marbled Godwit use. Because this long-legged species generally forages in water 5-13 cm deep, it requires significantly more water than that needed by shorter-legged shorebirds. The overlap in water-depth preferences between the Northern Pintail—a species of high conservation priority throughout the Marbled Godwit's range—and the Marbled Godwit may be helpful in leveraging water rights for godwits. Securing additional water rights and protecting current water rights will require coordinated, region-wide strategies among agencies and organizations, as well as legislative and policy-based actions. To a great extent, enhancing water availability will also help diminish the deleterious effects of contaminants at most of the inland migration sites, but monitoring and remediation programs designed to track levels, and mitigate the effects, of contaminants will be needed as well.

Protection from Human Disturbance & Contaminants at Coastal Sites

Another set of high-priority actions called for at most coastal sites is protection from recreation-based disturbance and public education as to the effects of disturbance (dogs included). Specific actions to help diminish the threats of human disturbance and contaminant spills include law enforcement, increased signage and 'bird-friendly' fencing, more closure areas and longer periods of closure for avian high-use areas, and programs that target organizations and individuals most likely to include users of these sites or shipping operators whose actions could impact sites (e.g., boating associations, birdwatching groups, local homeowner's associations and the schools attended by children that live there, harbor masters and shipping regulation agencies). Sites not already designated as WHSRN and/or IBA sites could benefit significantly from the public focus and resulting education brought about by these programs.

Enhancing Protocols for Inventory & Monitoring

On the more practical side of conservation action, the Program for Regional and International Shorebird Monitoring (PRISM) calls for estimating the Marbled Godwit's population size and trends within the temperate region. PRISM specifically calls for methods that provide population estimates that have an 80% probability of being within 15% of the actual size, and monitoring methods that have 80% power to detect a 50% decline in 20 years (using a two-tailed test set at a significance level of 0.15 and accounting for potential bias; see <http://www.waterbirds.org/shorebirds.htm#prism>). In the temperate region, where Marbled Godwits breed, existing comprehensive avian surveys (e.g., BBS, GBM) likely do not occur at the optimal time for monitoring godwits. Furthermore, small sample sizes result from the low densities at which godwits occur on comprehensive surveys. Therefore, researchers and resource managers need adequate funding for implementing a region-wide, godwit-specific monitoring program (i.e., to take place prior to incubation onset and with intensified, stratified efforts in targeted grassland types) (B. Dale, C. Gratto-Trevor, and N. Niemuth, pers. comm.). Increased efforts and funding are also needed to achieve PRISM goals for estimating and monitoring godwit populations at wintering and migration sites. A crucial tool needed for enhancing landscape modeling, planning, and protection in Canada is a complete, digitized inventory of all the temporary/seasonal and semi-permanent wetlands, at least in the southern half of the prairie provinces.

Intra- & Inter-Regional Communication & Coordination

A common concern expressed in regional shorebird plans is the widespread lack of communication and coordination that results in diminished conservation efficiency and competing interests. At a meeting on Marbled Godwit conservation in Minnesota 17-18 August 2005, a step taken towards this need was to develop a Marbled Godwit 'network,' and a commitment from some of its members to set up a Marbled Godwit listserver and website. Other recommendations made at that meeting included planning of management-oriented workshops for managers and planners responsible for important Marbled Godwit sites, as well as web-based provisioning of GIS layers of potential godwit habitat and other databases that pertain to godwit conservation. At some point, it may be very beneficial for the network to meet with (or at least involve) the Northern Pintail Action Group to discuss strategies/actions that would benefit both pintails and godwits (see discussion below).

Population & Habitat Research Needs

There is a universal call from nearly every scientist, resource specialist, and site-based manager we spoke with for basic, habitat- and population-centered research, inventory, and monitoring for the Marbled Godwit. Without this basic information, we are handicapped by not knowing which sites to target first, which populations are most at risk, and how to best manage habitats for godwits. For example, existing survey data do not show unequivocally that godwits are declining, and if so, which populations are declining most. Any research efforts along these lines should be conducted at the landscape or regional scale, and should also include development of a meta-database that centralizes/syntheses existing and future data on vital parameters and other information specific to godwits. Currently, existing knowledge is scattered in a few peer-reviewed publications, a number of unpublished reports, in a variety of gray literature, and in unpublished data. Making such a meta-database available (on the Marbled Godwit listserver) would help enhance the value of past studies, standardize data collection in future studies, and help focus research needs and reduce unnecessary or repetitious studies.

Godwit declines are strongly suspected at least in the fringes/isolated regions of the species' range, and, depending on their genetics and dispersal capabilities, there may be a need to prioritize those populations for conservation. Targeting sites for conservation for genetic diversity will be feasible once the genetics and dispersal capabilities are better understood. At sites along the Gulf of Mexico and U.S. southeastern coastal plains, shorebird inventory and monitoring is needed to determine which sites are most crucial to godwits and which populations they serve. Aerial survey work and long-term monitoring programs would potentially fill a number of information gaps. A detailed list of potential research and monitoring questions is provided in the section that follows the regional discussions of conservation actions.

CANADA & U.S.—PRAIRIE HABITAT, NORTHERN PLAINS/PRAIRIE POTHOLES, & UPPER MISSISSIPPI VALLEY/GREAT LAKES REGIONS

Breeding Regions

Within the mid-continental breeding grounds, habitat protection is crucial within physiographic regions where godwits are still common (i.e., BBS stratum 38; Table 1) and in regions where remnants of habitat are still used by godwits (i.e., BBS stratum 37; Table1). Large, contiguous blocks of native grassland >130 ha in size—preferably at least 800 m wide—that encompass a diversity of wetland types and sizes should be prioritized. A potentially useful strategy for implementing the necessary landscape-scale approach to protecting breeding habitat would be to employ GIS layers for identifying important habitat components of other high-priority bird species with habitat needs (this may vary by region) similar to those of the Marbled Godwit. Then, maps of overlapping areas can be generated and used in leveraging partnerships and funding for Marbled Godwit conservation. Overlapping species to consider in the mid-continental breeding range include Northern Pintail, Baird's Sparrow, Sprague's Pipit, and Greater Prairie-Chicken (B. Dale and S. Davis, pers. comm.). Because pintails are already the focus of major conservation efforts, it may be best to focus initial efforts on the pintail-godwit relationship. Some key breeding areas of these two species overlap. Furthermore, protecting large blocks of native grasslands that encompass complexes of diverse wetland types—especially shallow, ephemeral/temporary wetlands—would benefit both species. In Canada, cropland conversions to pastureland under the GCC also may benefit godwits and pintails. Northern Pintail and Marbled Godwit corollaries that point out the potential for shared habitat protection are listed in Table 4.

Strategies for protecting habitat in the breeding range could include funding for the USFWS's Partners Program. In Canada, the current lack of federal programs for protecting native grassland places a greater funding burden on non-governmental organizations, as well as funding from the U.S earmarked for international migratory bird conservation. Developing sources of non-federal matching funds will be crucial. Most shorebird species, including Marbled Godwits, do not benefit from the tradition of excluding grazing or other habitat-management pactices from public and/or privately owned set-aside lands. Increasingly, grazing is accepted by wildlife managers in the Northern Plains as an important habitat management tool for maintaining healthy plant communities and providing habitat structure for the endemic prairie birds (including Marbled Godwit, Northern Pintail, Sharp-tailed Grouse, Ferruginous Hawk, Sprague's Pipit, Chestnut-collared Longspur, and Baird's Sparrow) that evolved with grazing by large ungulates (B. Madden, pers. comm.). All these species are of high conservation concern, and management actions that benefit any one species will likely benefit the others.

Table 4. Certain habitat characteristics and life history traits shared by Marbled Godwits and Northern Pintails may warrant consideration when leveraging partnerships and funding for habitat protection and enhancement. Primary sources of information (explicit and implicit) were: Gratto-Trevor (2000) for godwits, and Fredrickson & Heitmeyer (1991), the Northern Pintail Action Group (2003), and J. Devries and K. Guyn (pers. comm.) for pintails.

Habitat or Life History Trait	**Marbled Godwit**	**Northern Pintail**
Nesting habitat	Short-stature grasslands with moderately sparse cover encompassing complexes of shallow, open, temp/seasonal – semi-permanent wetlands; in some areas will nest in taller cover	Will nest in short, sparse grass, as well as thicker cover (e.g., idle pasture, buckbrush), encompassing complexes of shallow, open, temp/seasonal – semi-permanent wetlands
Water depth in wetland foraging habitats	5-13 cm	<1-30 cm
Important foods	Aquatic tubers, aquatic invertebrates	Aquatic tubers, aquatic invertebrates, seeds
Croplands used as alternative foraging sites	Flooded rice fields during northbound migration	Flooded rice fields during winter; will also forage in wheat and corn stubble (grains); during northbound migration frequently forages in previously cultivated wetlands

In Minnesota, the problem of godwit habitat loss due to rock and gravel mining needs special consideration. These habitats are rare and widely scattered, and they represent the state's remaining remnants of grassland. Because they are being converted at a rapid rate, outright purchase of these lands may be necessary, even if more costly than easement programs. Another option is to educate landowners and private lands technicians about alternative sources of income on native grasslands (including state-based programs: Prairie Bank Program, Native Prairie Tax Exemption program). Rather than linking godwit conservation to pintails, in Minnesota it may be appropriate to tie them to Greater Prairie-Chickens. Because the prairie-chickens require patches of grassland at least 130-245 ha, a great extent of grassland in the overall landscape, low topographical relief, an emphasis on native prairie and/or other grassland types characterized by short, low-density structure, both godwits and prairie-chickens could benefit from similar conservation measures. To the extent possible, habitat protection in Minnesota should emphasize existing and potential linkages (as illustrated in Fig. 5) between isolated godwit populations. A specific investigation is needed to reveal which alternatives to mining would motivate the majority of landowners to conserve habitat, and those factors should be incorporated into development of conservation-incentive programs. Legislation that makes this type of land conversion less profitable also needs to be initiated.

Minnesota portions of the godwit's breeding range also need better protection from sedimentation and contamination of intact wetlands. Restoration of wetlands that no longer function ecologically (largely due to sedimentation) is needed as well. Overall, there is an urgent need for applied research to determine the best methods for restoring specific wetlands in all regions (i.e., it will vary regionally). Coupled with wetland enhancement is the need to control invasive plants, including reed canary grass, cattail, purple loosestrife, leafy spurge, spotted knapweed, and woody vegetation—especially on saturated soils in core breeding areas.

Migration Sites

Conservation actions already undertaken at Canadian staging sites include WHSRN designation for two of the sites (Quill Lakes Complex and at Last Mountain Lake). In addition, some limited, long-term conservation actions (e.g., raising local public awareness) have been implemented for numerous shorebird species (e.g., Piping Plover) that use these sites.

Additional partnerships, however, are needed to expand public awareness programs to the other sites. Another priority need is to determine whether there are important staging sites in Alberta and what, if any, conservation actions are needed at those sites. Currently, it is believed that there are no significant congregation sites, but surveys are needed to verify this one way or another.

At Benton Lake NWR, there is a critical need for godwit-specific research and monitoring to maximize the refuge's contribution to overall marbled godwit conservation. Specifically, refuge managers need information on population status/trends, habitat utilization, and effects of contaminants (selenium). There is a critical need for remediation, a monitoring program to track selenium levels, and a study to determine at what level selenium may harm Marbled Godwits and other birds that use the site. Benton Lake NWR will be initiating development of its 15-year Comprehensive Conservation Plan in 2007, and because these plans generally take 2-4 years to complete, the need to ascertain selenium effects is urgent, as the results may significantly affect the way in which water management is planned. The refuge is entirely surrounded by row-crop agriculture; thus, the extent of contamination and effects of agrochemicals on refuge wetlands and wetland-inhabiting birds also needs to be incorporated with the selenium research.

Throughout the Dakotas and Montana, current habitat-based actions include an active program of restoring and protecting private lands through the USFWS's Partners Program, (<http://montanapartners.fws.gov/>). Most refuge complexes employ a full-time Partners Program biologist and are continually implementing projects. However, more funding would be needed to significantly slow the rapid rate of grassland conversion to croplands in the region. Also new legislation and more stringent guidelines could help protect wetlands and shallow aquifers from the impacts associated with oil/gas production. Montana and many other states have few, if any, regulations restricting well pad construction or drilling in wetland basins. Such legislation might focus on replacing the practice of burying drilling wastes on site with closed drilling systems and alternative disposal methods (reinjection) at approved facilities. Developing criteria for site placement that prohibit drilling in, or immediately adjacent, to wetland basins would greatly reduce the chances of crude oil, well-produced water, drilling wastes, and other contaminants from degrading wetland quality and function. Finally, refuge wildlife managers need to be able to answer population- and habitat-based questions regarding Marbled Godwit conservation in their breeding range.

Within the McKenzie Slough-Horsehead Lake Complex site in North Dakota, current actions entail management of state and federal lands that promote shorebird habitat (G. Knutsen, pers. comm.). In addition, a variety of organizations and agencies are supporting or implementing restoration of critical wetland areas at certain locations within the complex. However, expanded restoration efforts are needed. At McKenzie Slough, the areas plowed intermittently are those typically used by godwits; the remaining area is infested with cattails and needs cattail management (D. Svingen, pers. comm.). The USFWS's Partners Program now protects thousands of acres of important godwit habitat within the complex, but the need for funding to enroll many additional easement acres of wetlands and grasslands is the highest priority for conservation within and around this site. The acquisition of land in 'fee title' (in the form of WPAs and NWRs) is also a very important conservation action for this area, although in general fee title land purchases are more cost-prohibitive than easement programs and should be used primarily for supplementing other land-conservation programs. Lastly, although there are management actions in place to control botulism outbreaks, there is a need for improved understanding of management-action impacts on the prevalence and severity of botulism. Additionally, research is needed to reveal potential impacts of West Nile Virus on Marbled Godwits in this (or any other) area.

At the two sites in Wisconsin and Wisconsin/Minnesota, additional and intensive monitoring the last two weeks of May is needed to measure the population of godwits utilizing the site; genetics work would also reveal which population uses these sites, and thus, the level of importance these represent to the species. The USFWS (Fishery Resources Office, Ashland, Wisconsin) and the National Park Service in Bayfield, Wisconsin, have offered transportation for a short-term monitoring project if funds were allocated for staffing. At the Long Island site, there is no water management capability; however, a water control structure could provide foraging habitat for Marbled Godwits using this site and, possibly, nearby Interstate Island.

U.S. —Alaska Region

Alaska biologists that we contacted thought that a high-priority need in Alaska is protected status/designation for the entire area used by breeding, foraging, and staging Marbled

Godwits. Concomitant to this is the need to identify and protect the primary winter sites (possibly identified through genetic markers) that this population uses. Improved protocol and more research for gaining a better understanding the population's ecology and status are also urgently needed. Specifically, development of a reliable method for censusing and monitoring the breeding population (e.g., spring aerial surveys of Ugashik Bay and Cinder/Hook Lagoon, and summer line transects in breeding areas) is needed. In addition, recruitment and survivorship information is needed. Because there is a high risk of petroleum spills in the Alaska region overall, especially at the Yakutat Forelands stopover site, simply having an oil spill contingency plan for each site is not enough; those plans need ongoing re-evaluation and updating to keep abreast with technology and protocol development, new oil/gas developments (e.g., potential in the Ugashik Bay region) and potentially increasing storm intensities in the Gulf of Alaska due to rising sea temperatures (Lynch et al. 2004). The other important need for the two Alaskan godwit sites is a public education campaign to help subsistence hunters differentiate the three species of godwits, and development of a reliable method for measuring the take of godwits.

CANADA—JAMES BAY REGION

A comprehensive survey of Marbled Godwit distribution is needed. Coupled with that is the need for an improved population estimate, a long-term monitoring program to determine the population status/trend, and more information on the population's nesting productivity, survivorship, and habitat relationships. At the very least, a quantitative assessment of habitat use and availability is needed, from which it may be possible to assess the potential habitat threats resulting from the dramatic increases in local Snow and Canada goose populations. A program of capturing godwits and fitting them with satellite or radio transmitters, as well as color bands, is needed for answering questions regarding site use, dispersal, and migratory connectivity. Genetics work is underway to determine the taxonomic status of these birds, but it will be haphazard without a capture program (CWS researchers are reluctant to resort to a collection program for this small population until/unless capture programs do not work). Finally, a survey program is needed to identify the level of subsistence hunting for godwits by the members of the Cree Nation.

U.S.—Intermountain West Region

A priority in this region is to identify important Marbled Godwit sites most in need of protection and assemble the collective godwit expertise to identify the highest-priority, practical conservation action that could be implemented immediately to promote the long-term sustainability of this species. To a great extent, that goal has been accomplished by virtue of this document, but completion of the GSL Shorebird Management Plan is needed to further this goal (B. Olson, pers. comm.). Another priority need identified for the Intermountain West (but with coordination and implementation of the same across the godwit's entire range) is development of practical protocols and tools for assessing the status and trends of populations.

Because the important godwit sites within this region are largely migration and staging sites, water rights/access and wetland management are crucial needs. A potential means of providing additional water to Bear River MBR in the critical months of June-August (when 1000s of Marbled Godwits arrive to stage/feed/molt at the Refuge—during the lowest water-supply months) is to develop a reservoir on Bear River upstream of the refuge. Although this would take considerable political/legislative maneuvering and funding, the sheer numbers of godwits that use the refuge make this action a very practical action. In addition, there is a need for re-evaluation and applied research to enhance and/or develop best management practices for improving habitat quality at managed sites used by godwits. This work should assess the benefits of various water depths within a variety of wetland types/sizes during various times of year, as well as assessments of human disturbance effects on godwit foraging.

At the Lahontan Valley/Humboldt Sink site, the only important need identified at this time is to continue recognizing and supporting the on-going conservation program currently in place to authorize purchase, and implement use, of recently acquired water rights. The program is working to dilute levels of contaminants and promote shorebird use.

For the Salton Sea, an existing management plan (a cooperative venture between the CDWR, U.S. Geological Survey, and the Bureau of Reclamation) includes analysis of restoration scenarios to address the diminishing flow of water into the basin. There has also been some legislation authorizing protection for, and restoration of, the site, as well as public education campaigns to highlight the importance of this site to birds (via California Audubon Society, Sierra Club, CDWR). Currently, some portions of the site are protected by virtue of NWRs and other protected areas, but most of the site is still in need of protection. There has also been some general (i.e., not godwit-specific) avian research at the site to determine population status/ distribution/ecology of bird species that use the site, as well as studies to improve our understanding of how harvest levels and certain conservation measures are affecting populations. In particular, PRBO Conservation Science is modeling changes at the site to understand the effects of water diversions (N. Warnock, pers. comm.). Actions still needed at this site include a full evaluation of water use in the Imperial Valley (the CDWR, with other agencies, has initiated some of this work). The process must include major stakeholders in finding common ground between human need and wildlife values in the region so that suitable conservation approaches can be developed for their mutual benefit. For example, much of the land in the valley is cropland and/or undergoing development, and much of the development is taking place where rice fields used to be; moreover, rice is falling out of favor among farmers in the U.S., which results in even more habitat loss. Of the row-crops known to be used by foraging godwits, rice fields appear to be among the most suitable, which makes it imperative to encourage the viability of rice farming. Due to these and other changing conditions, additional restoration is urgently needed for the Salton Sea and surrounding landscape. Modeling efforts should continue to provide landscape-scale conservation planning and implementation within the valley.

U.S.—CENTRAL PLAINS REGION

Within the next five years, additional money and personnel are needed to maintain habitat for Marbled Godwits at Cheyenne Bottoms WMA. In particular, funds are urgently needed for herbicides, staff for monitoring and spraying, and fuel and maintenance for equipment used in controlling phragmites and cattails and further reducing their distribution. The extent to which the problem is exacerbated by landscape-level infestation is not clear at this time, but evaluation is needed to identify control measures needed at that scale to help protect this and other nearby important waterbird sites. Funding is also needed to continue disking at the level needed to preclude cattail coverage from increasing again.

Longer-term conservation actions needed for Marbled Godwits and other birds that depend on Cheyenne Bottoms WMA are legislation and policies necessary for restoring adequate base flow to the Arkansas River and Walnut Creek, for which Cheyenne Bottoms holds surface-water rights. Cheyenne Bottoms' water right is senior to that of most local farmers, but the majority of farmers have groundwater rights; thus, the diminishing surface flows (which may exacerbated by groundwater mining) have not seriously affected local farmers. Restoring base flows would provide supplemental water needed for godwit habitat, controlling invasive vegetation, and diminishing the sedimentation that threatens the site from diverting precipitation runoff into Cheyenne Bottoms as a means of putting at least some water into the basin.

U.S.—Northern Pacific Coast Region

Research is urgently needed to determine whether godwits using this region are from the small population that breeds in Alaska. In turn, thus will allow assessment of the priority that these sites represent in the overall conservation planning for Marbled Godwits. Whereas spartina control has been relatively successful at Willapa Bay, ongoing management is needed to preclude it from infesting the godwit's principle foraging area. There is also an immediate need for research that elucidates the realized and potential impacts of invasive invertebrates (e.g., green crabs) already occurring at these two sites.

Also needed for these two sites is a careful evaluation and possible update of local and regional oil-spill contingency plans. Both Willapa Bay and Grays Harbor are at risk of a spill due to the presence of major off-shore shipping channels and high levels of local marine vessel traffic. Finally, although godwits do not appear to be negatively influenced by human disturbance at their Tokeland roost site, the apparently compatible coexistence between humans and birds should be maintained. The godwits appear to have become habituated to the regular activities associated with the local fishing fleet and the marina. Members of the local community, however, may not realize the economic and social value of the "watchable wildlife" present at their local dock. Perhaps the most valuable means of maintaining the current balance of humans and godwits at this site is to encourage birders to conduct business at local establishments and to specify to merchants that the purpose of their visit (no matter how brief) is to view the godwits at their roost. This should help raise or reinforce public awareness in a gentle and non-threatening way to a small community that has already lived with godwits for four decades.

U.S.—Southern Pacific Region

At many of the Southern Pacific sites, actions have already taken place to protect important wetland habitats through acquisition, management, and, in some cases, restoration. In addition, NWRs protect habitats at a number of the important sites in this region. At Humboldt

Bay, ongoing management planning is being conducted for the site through the City of Eureka and the Army Corps of Engineers, and significant, damaging oil spills that occurred in the late 1990s resulted in significantly improved and on-going oil-spill contingency planning in the Humboldt Bay region. California is also well endowed with populations of activist groups working to protect important shorebird sites (many used by godwits) and promote appropriate resource stewardship. For example Audubon conducts a monitoring program at a number of sites (e.g., Tomales Bay). Finally, there have been organized federal/state efforts to control invasive species and enforce protection at designated conservation areas. However, in most cases, ongoing—potentially greater—funding is needed to continue and intensify efforts to control invasive species and protect sites from recreation-based disturbance. At Tomales Bay in particular, a wildlife component is urgently needed in the management plan for Lawson's Landing Campground. The campground property is a known godwit roosting site, but the plan does not address this. Planning and public education as to the effects of small boat/kayak disturbance on these birds is crucial to the long-term viability of this site.

Site-based experts have identified some unique and relatively cost-effective regional conservation opportunities for Marbled Godwits that would involve conserving agricultural lands, especially north of San Francisco. At several sites within this region, including Humboldt and Tomales bays, Marbled Godwits use seasonally flooded agricultural areas (typically characterized as coastal pasturelands [Colwell and Dodd 1997] or grazed grassland habitats [Colwell, pers. comm.]). These habitats are valuable to shorebirds (godwits included), especially when nearby wetland habitats are less abundant due to flood tides and coastal storms. As global climate change threatens to increase sea levels and inundate coastal habitats, habitats like these may become even more crucial to godwit conservation. However, changing agricultural patterns and encroaching urban development threaten these grasslands. Thus, it is imperative that these habitats undergo protection through community-based initiatives to cooperate with the livestock industry in preserving these habitats. Vehicles for acquisition, including easement programs, Land Trusts, and others, need to be identified and pursued immediately.

Other priority needs identified for sites in the region include research to elucidate the migratory connectivity of godwits that occur in this region, the relative importance of the nearby seasonal wetlands described above, and the effects of aquaculture, mercury mining (e.g., Tomales Bay), invasive invertebrates, and sedimentation. Wintering sites north of San Francisco were identified by Gibson and Kessell (1989) as possible wintering sites of the Alaska population, but to date there is no further information available to determine where these birds really do spend the winter. A coordinated effort throughout the Pacific portion of the godwit's range would not require significant expense or time to finally answer this question.

MÉXICO—PACIFIC & GULF OF CALIFORNIA REGION

In the Baja California Peninsula, major conservation actions needed include establishing new protected areas (e.g., Bahia San Quintin and Bahia Magdalena). Because the vast majority of godwits that winter in México are found in this region, it is a priority area. The primary vehicle for conservation of habitats in México at this time is conservation easements with local ejidotarios (owners of common land). PRONATURA, the main organization promoting and arranging these easements, is in dire need of funding for implementing easement programs as soon as possible while these sites are still relatively intact.

Although other important sites along the Baja California coast (e.g., Ojo de Liebre-Guerrero Negro, Laguna San Ignacio, and the Río Colorado Delta) are designated as protected areas and are represented by conservation plans, in every case the plans need implementation to secure critical habitats for Marbled Godwits and the myriad of other shorebird species that use these sites. Furthermore, existing conservation plans at sites in this region (including the three sites that host the largest godwit numbers in all of México: Ojo de Liebre/Guerrero Negro, Laguna San Ignacio, and the Río Colorado Delta) do not consider shorebirds among their priority actions. An immediate need is to highlight and address this omission by nominating any eligible sites that still do not have WHSRN and/or RAMSAR status.

Another crucial need at these sites is adequate monitoring and research programs to assess the godwit population status/trends/distributions/habitat use that use these sites (e.g., Ojo de Liebre-Guerrero Negro, Laguna San Ignacio, Río Colorado Delta, Bahia San Quintin, Bahia Magdalena, and Marismas Nacionales, and Bahia Santa Maria, where the largest numbers occur). Almost no work has been conducted on Marbled Godwits in this portion of their winter range, despite the fact that by far the greatest proportion of the species' global population winters at these sites. Compared to survey difficulties encountered on the breeding grounds, it would be relatively easy and cost-effective to plan and implement a bi-national (México and U.S.) winter monitoring program to track the overall global godwit population at these sites in coordination with similar monitoring programs at crucial sites to the south in Sinaloa and to the north in California (i.e., a total of only 10-15 sites from Sinaloa to northern California may host up to 90% of the world population).

In Sinaloa and Nayarit, major conservation actions—including protection, research/monitoring—needed are similar to those needed on the Baja California Peninsula. In addition, Ensenada Pabellones and Huizache-Caimanero need protection and WNSRN and/or RAMSAR nomination, and the conservation plan for Marismas Nacionales needs implementation. The main difference between Baja California and Sinaloa/Nayarit is that Baja California sites primarily require protection, whereas habitat restoration is a priority at sites in Sinaloa/Nayarit, where large-scale agriculture—including mining of ground and surface water—has degraded or destroyed habitat. In addition, research is needed to determine the level of threat posed by agricultural pesticides, sewage, mariculture and the dams constructed for that industry. An education and outreach program is needed to (1) increase public awareness of the importance of these sites to all shorebirds, (2) teach the importance of ecosystem function and sustainability of coastal wetlands that sustain people as well as shorebirds, and (3) implement better stewardship of the region's coastal wetlands. Part of an education campaign—in both Baja California and Sinaloa/Nayarit—should target the tourism industry that is expanding at a rapid rate throughout much of the region.

U.S. & MÉXICO—GULF OF MEXICO COAST REGION (INCLUDING LOUISIANA & FLORIDA)

The tremendous variation in responses we received from sources in the Texas Gulf Coast region as to whether or which sites are important to Marbled Godwits (and how many of the birds use those sites in any one season) strongly indicates the need for region-wide inventory and monitoring work. To some extent, the same thing is true for Louisiana sites, although generally it seems that numbers wintering and migrating through there are small. This lack of basic information makes it extremely difficult to determine where to start in terms of godwit conservation in the region. Furthermore, if it turns out that northern gulf sites serve as wintering or migration stopover sites for small, isolated populations of godwits, the region's importance at the meta-population level will increase. Thus, a top priority is to conduct a region-wide survey program (probably aerial surveys with on-the-ground verification) and studies to determine the migratory connectivity of birds using this region to fill these significant information gaps.

Pending results of those efforts, more specific conservation actions can be identified for important sites.

Despite the information gaps, there are some sites in this region generally believed by most sources to be relatively important, and most of these sites are in urgent need of protection from development and recreation-based disturbance (including unleashed dogs). In the Copano Bay/Aransas Bay/Rockport/Port Aransas Area Complex, where development is occurring at an especially rapid rate, local land trusts and conservation organizations actively trying to buy and conserve wetlands and coastal marshes—for hundreds of species—urgently need funding. Also needed where agriculture and development is already significant or accelerating is protection of freshwater inflows—both surface water and ground water—to coastal estuaries. Groundwater extraction is also contributing to the region's land subsidence problem and the associated stunningly rapid loss of coastal wetlands that result. Thus, a top need in the region is funding for habitat easements and acquisitions, and legislation and other means of protecting bases flows of freshwater into coastal systems.

Also needed is research to determine the level of impact generated by feral hogs and mariculture—especially in the Rockport area. Establishing high-quality contingency plans for oil and industrial chemical spills is also priority. Even where good plans are in place, there should be a process of on-going evaluation and updating as conditions change and technologies improve. The predicted additions of oil/gas development in the gulf, as well as the recent advent of Hurricanes Katrina, Rita, and Wilma have served to highlight and intensify this need.

In Florida, knowledge of Marbled Godwit distribution and numbers is significantly better than it is elsewhere in the region, although some areas lack the funding needed to acquire more accurate counts throughout expansive habitats (e.g., Everglades National Park). For the most part, conservation actions that would benefit Marbled Godwits in Florida are similar to those that would help the species farther west along the Gulf of Mexico coast. Except at the Snake Bight/Cape Sable site in the Everglades, site protection, both legislative and otherwise, is a top priority (B. Smith, pers. comm.). The Lanarck Reef site in particular is not currently protected and the landowner is planning to sell that site for development. Most sites would benefit from closures (or longer periods of closure over greater areas) and additional law enforcement to keep pedestrians, boaters, and dogs out of protected areas; the problems are especially acute at Honeymoon Island. The emergent sandbars at Caxambas Pass and Cape Romano are only posted during spring and summer to protect breeding species of waterbirds; the rest of the year those are open to recreation, but their habitat value is compromised without year-round closure (R. Zambrano, pers. comm.). The Florida Fish and Wildlife Conservation Commission (FWC) has legal authority under its Critical Wildlife Area (CWA) program to close areas to the public, but concurrence from the landowner (State Land) and the Department of Environmental Protection is required. The FWC commissioners would then need to approve the CWA designation during a public hearing.

Coupled with stronger protection from recreation and other forms of coastal disturbance is a strong need for passive forms of education (raising awareness via brochures, signage, and other means). In addition, operators of watercraft, boat-rental operations, and eco-tour operators need to be educated as to the importance of avoiding these areas and respecting signage. In many cases, signage may suffice in areas of high pedestrian traffic (e.g., Marco Island). Two other major needs for this region are a better oil-spill contingency plan, and research on the effects of beach management, especially renourishment. The major oil spill that damaged much of the south-central Florida gulf coast this region in the early 1990s pointed out major flaws in the existing plan. Beach renourishment has taken place at least at sites in the Tampa Bay area (Point Pinellas, Shell Key), but the effects of this activity on godwits and other shorebirds that use the sites are not known.

U.S.—SOUTHEAST ATLANTIC COASTAL PLAINS REGION

At the Fisherman Island NWR site in Virginia, refuge personnel indicate that no habitat improvements or other actions are needed at this time. However, there is an unstated need to assess the effects of region-wide declines in important prey bases (e.g., horseshoe crab eggs). The extent to which this issue has affected godwits within any portion of this region is not known and needs immediate assessment.

Marbled Godwits occurring within the region are treated by Hunter et al. (2000) at the species level (i.e., not as the James Bay sub-population), which hampers the region's ability to evaluate its importance to godwit conservation (especially in the Carolinas; in Georgia, it is assumed that godwits there belong to the James Bay population; B. Winn, pers. comm.). If research reveals that the region's godwits belong to James Bay and/or Minnesota breeding populations, the priority that godwit conservation has within the region would likely change substantially. Without that knowledge, agencies will have difficulty justifying godwit-specific conservation in the face of other pressing shorebird priorities. In Georgia, some aerial survey work and winter surveys are already being conducted (B. Winn, pers. comm.), but coast-wide surveys (aerial surveys in particular) are needed to better understand the species' distribution in other portions of the region, during both migrations and in winter. Most existing data come from CBCs, which are not especially reliable data, nor are they powerful enough for most species to detect trends with any reliability.

Probably the most urgent need at the more-accessible sites within the region is to ameliorate the threat of human disturbance (watercraft, fishing, crabbing pedestrians, dogs), particularly where godwits concentrate to forage and roost. Many of these sites are also important to other high-priority shorebirds (e.g., American Oystercatcher at Rachel Carson/Howell Rock/Shackleford Banks and the Lower Cape Fear sites, and Piping Plover and Red Knot at Clam Shoals and Ocracoke Inlet). Roost sites used at high tide are especially in need of protection and/or closures. In South Carolina, complete closures of shorebird loafing areas at Cape Romain NWR are planned for winter 2005/2006, which would be an excellent opportunity to study changes in shorebird behavioral ecology and body mass compared to that of similar areas not under closure. Motions to completely close South Carolina Department of Natural Resources seabird nesting islands—also Marbled Godwit loafing areas—will also begin in winter 2005/2006. At Cape Romain, the South Carolina Department of Natural Resources is considering reductions in the number of permits allowed for commercial crabbing (N. Dias, pers. comm.). In addition, habitat protection is needed for sites along the coast, river deltas, and upstream that godwits use during high tide. Concomitant to the habitat protection need is the need for public education on the deleterious effects of fertilizer runoff and contamination from pet excrement at coastal and delta/riparian sites (N. Dias, pers. comm.).

RESEARCH & MONITORING NEEDS

Research and monitoring activities are crucial components of conservation. Hence, we have attempted to identify some priority needs in this section. The needs identified are not a complete list of all possible research topics, but they do represent the critical information gaps that, if filled, would provide a sound basis for further development of Marbled Godwit conservation planning at all spatial scales. The list of needs includes those identified by two important sources: (1) the *Tri-National Initiative for Marbled Godwit Conservation* (Farmer et al. 2002), which identifies Marbled Godwit research priorities agreed upon by an international group of scientists (now part of the Marbled Godwit 'network'---see below) who convened at meetings in Mexico and North Dakota; and (2) a summary of the information provided by collaborators for this plan and its associated important site data matrix.

1) *Biogeography & Migration Connectivity*—Little is known about the linkages between specific Marbled Godwit breeding and wintering sites, which sites serve as key stopovers during northward and/or southward migration, or the species' dispersal capabilities (important for determining whether the relatively isolated subpopulations across the species' range are at greater risk of extirpation than birds nesting in the range core). Efforts should focus on delineating the specific migration corridors and winter areas used by birds from different parts of the breeding range (e.g., eastern Prairie Potholes versus western Prairie Potholes, Alaska, James Bay). Linkages between seasonal habitats could be identified using a number of tools, including satellite transmitters, stable isotopes, and genetic analyses.
2) *Migration Habitats & Ecology*—We need a better understanding of habitat quality at stopover sites, as indicated by a) length of stay and turnover rates, b) body condition (i.e., fat stores), and c) rates of fat gain. Use of satellite telemetry could reveal migration routes and stopover areas and lengths of stay, and capturing/measuring godwits at migration sites could help improve our understanding of their physiological ecology at stopovers.
3) *Breeding Habitats & Trends*—CWS and the HAPET office in North Dakota have already initiated key research to improve survey methods on the breeding grounds and produce the predictive breeding habitat models for Marbled Godwits included in this plan. Efforts to evaluate and refine the models should continue. In addition, efforts to intensify survey and monitoring efforts in the breeding range should continue so that they meet at least the criteria of PRISM.
4) *Wintering Habitats & Trends*—Aerial and airboat surveys are needed throughout the wintering range, particularly in México and along the Gulf of Mexico and Southeast Atlantic coasts, to gain a full understanding of which wintering sites are key to the sustainability of subpopulations. We also need better information on the timing of use

and habitat relationships at those sites, including habitats used for foraging, roosting, and for escape during severe weather. As in the breeding range, winter monitoring protocols should meet at least the minimum criteria of PRISM.

5) *Demographics & Life-cycle Synthesis*—Several data synthesis and modeling tasks are needed to compile (quantitatively) the Marbled Godwit life history data that already exist. This would help refine future research efforts and allow us to model godwit demographics, energetics, productivity, and other parameters crucial to understanding the species' overall life cycle. Testing and evaluation of modeling efforts will be needed to determine mechanisms that may limit populations. Pertinent questions pertaining to this realm of research are included below.
   a) Do rates of survivorship vary between breeding, staging/stopover, and non-breeding sites?
   b) What are the most significant causes of mortality in each of the seasonal habitats?
   c) Do recruitment rates vary regionally and, if so, which factors are associated with that variation?
   d) To what extent do invasive/exotic species and contaminants affect godwits on their breeding, migration, and wintering grounds?
   e) To what extent does subsistence hunting affect the Alaskan and James Bay populations?

CURRENT/POTENTIAL PROGRAM/RESEARCH COLLABORATORS

After conducting data syntheses and modeling of what we know about Marbled Godwit ecology, important, sites, and threats, the next crucial step will be to conduct a broad-scale, international, collaborative project to fill gaps in our knowledge about godwits and threats to the species' future so that specific conservation actions can be determined. Agencies and organizations that have been involved in Marbled Godwit research, bird surveys, and/or monitoring, and which may represent potential future collaborators for combined efforts to investigate outstanding questions about godwits, are listed below. More details regarding specific individuals and their contact information are included in Appendix 4.

Canada

Canadian Wildlife Service (Prairie and Northern Region, Ontario Region)
Ontario Ministry of Natural Resources
Alberta Environment
Saskatchewan Environment
Manitoba Conservation Wildlife and Ecosystem Protection Branch
Prairie Habitat Joint Venture
Ducks Unlimited Canada
Trent University
Bird Studies Canada (general bird surveys)

United States

U.S. Fish & Wildlife Service: Regions 1-4, 6, 7; Offices of Migratory Bird Management; Bird Habitat and Refuges Divisions; Habitat & Population Evaluation Team, Partners Program
U.S. Geological Survey: Northern Prairie Wildlife Research Center, Fort Collins Science Center, Forest and Rangeland Ecosystem Science Center, Alaska Science Center, Patuxent Wildlife Research Center, National Wetlands Research Center, Texas Gulf Coast Field Research Station
U.S.D.A. Forest Service Region 1
National Park Service (Everglades National Park)
Joint Ventures: Prairie Potholes, Intermountain West, Playa Lakes, Sonoran, Pacific Coast, San Francisco Bay, Central Valley, Gulf Coast, Atlantic Coast
Upper Mississippi Valley Joint Venture
Alaska Shorebird Working Group
Ducks Unlimited
Manomet Center for Conservation Science
Point Reyes Bird Observatory Conservation Sciences
National Audubon Society
Humboldt State University
University of Alaska Museum
University of California at Santa Barbara Dept. of Ecology
University of Nevada at Reno
University of South Dakota
Alaska Department of Fish and Game
Washington Department of Fish and Wildlife
California Department of Fish and Game
Nevada Department of Wildlife
Utah Division of Wildlife Resources
Montana Fish, Wildlife, and Parks
North Dakota Fish and Game Department
South Dakota Fish, Game, and Parks
Minnesota Department of Natural Resources
Kansas Department of Wildlife and Parks
Texas Parks and Wildlife Department
Florida Fish & Wildlife Conservation Commission

Georgia Department of Natural Resources
South Carolina Dept. of Natural Resources
North Carolina Wildlife Resources Commission

<u>México</u>

Universida Autónoma de Baja California Sur
Ducks Unlimited de México
PRONATURA, A.C. Noroeste. Dirección de Conservación Sinaloa
PRONATURA, A.C. Noroeste. Dirección de Conservación Baja California Sur
PRONATURA, A. C. Noreste. Dirección de Conservación Tamaulipas
NABCI-México

NEXT STEPS & EVALUATIONS

With completion of this plan, the next steps must be identified and implemented to preclude this plan from 'collecting dust on the shelf' like some other conservation plans. Our hopes are no different, but at the same time we need to be realistic about what this one document can and cannot achieve. Several reviewers felt that this document should include an "implementation" plan, and yet this would entail a list of specific conservation activities that should be implemented at specific sites to achieve as-yet-undeclared conservation objectives. As much as we would like to have accomplished that, such results were far beyond the originally stated purpose of this plan and the resources that were made available for its development.

In reality, this plan is just the first step toward an on-the-ground conservation program for Marbled Godwits. Of course, a crucial next step is to distribute this document to the collaborators, non-governmental organizations, conservation action groups, natural resource agencies, stakeholders, and potential funding partners that represent each region (including site-level entities) within the Marbled Godwit's range. This will raise the level of awareness regarding Marbled Godwit conservation issues/needs and leverage additional support for actions already underway, as well as provide support for initiating new actions.

To go beyond the level of plan distribution, however, some additional synthesis is required—most likely accomplished through a coordinated effort. At a meeting of interested biologists in Minneapolis in August 2005, a Marbled Godwit 'network' was formed. This group, together with WHSRN and Manomet Center for Conservation Science, could potentially organize such an effort. Several regions within the Marbled Godwit's range were not represented at that meeting (i.e., Southern and Northern Pacific U.S., Gulf of Mexico U.S. and México, Southeastern U.S., Alaska, and James Bay) and should be represented in future planning meetings. The August meeting participants agreed to re-visit and clarify the goals of the Marbled Godwit network during the upcoming Shorebird Meeting in Boulder, Colorado in Feb-Mar 2006. In the meantime, the group is working to establish a Marbled Godwit list-server and website to provide a forum for the communications necessary for further developing the next steps, implementing conservation actions, and improving our understanding of Marbled Godwit ecology. Goals of the group will continue to include maintenance and implementation of the conservation plan. In this regard, we list below several potential "next steps" that should be considered to move Marbled Godwit conservation forward.

1) Conservation Goals—Establish some overarching conservation objectives that may include longer-term goals (e.g., regional population/habitat goals, establish timelines) and shorter-term goals (e.g., improving population estimates/monitoring efforts, establish timelines). These goals can be modified as necessary through an adaptive process.
2) Research Goals—Some data gaps need to be filled before we can achieve certain goals. For example, we need to identify sub-population structure before meaningful population goals can be established, or before we can determine which sites need to be conserved to protect those populations. In addition, research will help determine specific conservation actions that would provide the most cost-effective means of achieving site-specific to region-wide conservation goals.
3) Habitat/Population Acquisition/Management/Restoration Goals—A number of conservation actions are identified in this report—many of which seem feasible to implement and could be very effective in achieving established goals. To be most effective, each proposed conservation action should be 1) specific, 2) measurable, 3) achievable, 4) results oriented, and 5) time-fixed (see Adamchik et al. 2004). The idea is to clearly specify what will be done, why it will be done, and independent measures that will be used to evaluate the action's effectiveness.
4) Communication/Coordination Goals—Specific actions that could be taken to improve communication and coordination among regions and nations should be identified. In addition, criteria for evaluating the extent to which such actions enhance conservation efforts and goals achievement should be developed.

5) Policy/Legislation Goals—Assess/define the specific improvements needed with respect to policies and legislation designed to protect and enhance habitats used by godwits and develop methods of determining whether the improvements are being implemented.
6) Education Goals—Identify/implement audience-specific educational campaigns needed and survey target audiences after campaigns to determine their effectiveness.

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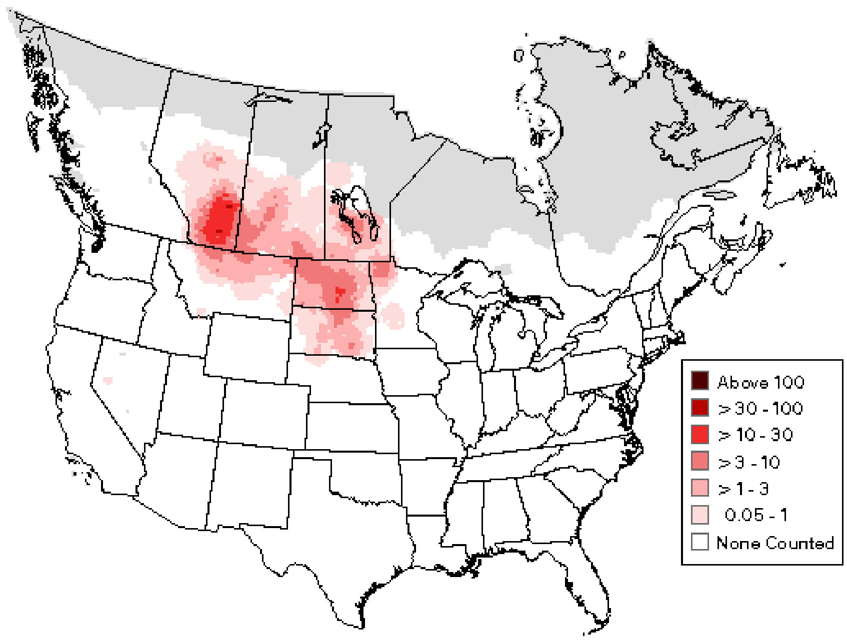
APPENDIX 1. Breeding Bird Survey (BBS) trend data for Marbled Godwit, 1966-2004 (Sauer et al. 2005).

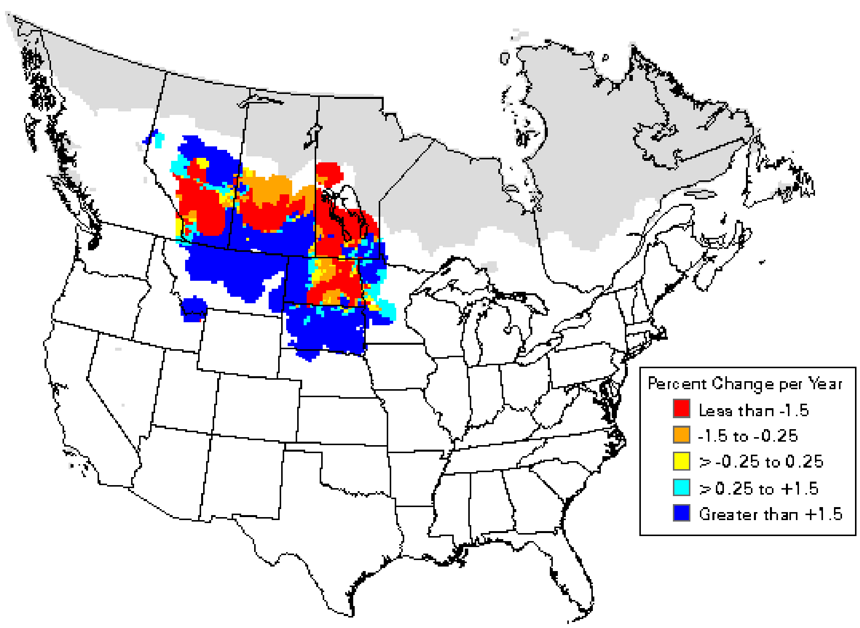
	1966-2004[2]						1966-1979[2]			1980-2004[2]		
Region	Trend	*P*	N	95% CI		RA	Trend	*P*	N	Trend	*P*	N
Alberta[1]	-0.90	0.44	66	-3.2	1.4	5.31	3.8	0.12	19	-0.3	0.85	65
Manitoba	-3.00	0.10	27	-6.4	0.4	1.93	-7.1	0.52	6	-3.7	0.01	27
Minnesota	-5.10	0.31	14	14.7	4.4	0.88	-38.5	0.06	6	0.6	0.79	13
Montana	2.70	0.69	15	10.0	15.4	0.57	23.2	0.43	3	10.6	0.01	14
North Dakota	0.80	0.48	35	-1.4	3.0	3.65	9.4	0.00	15	0.5	0.74	33
Saskatchewan	-1.70	0.26	52	-4.5	1.2	3.03	1.2	0.71	22	-2.4	0.24	42
South Dakota	4.50	0.48	13	-7.6	16.7	0.57	12.9	0.51	7	4.6	0.51	11
Aspen Parklands	-0.60	0.48	69	-2.2	1.0	1.3	7.3	0.08	24	-1.1	0.48	64
Drift Prairie	-2.00	0.15	51	-4.7	0.7	3.48	8.8	0.00	24	-2.3	0.27	46
Glaciated Missouri Plateau	0.10	0.96	70	-3.2	3.4	6.5	-0.5	0.82	23	0.08	0.71	65
Great Plains Roughlands	-2.00	0.65	20	-10.3	6.4	0.47	13.9	0.44	3	2.6	0.34	19
Black Prairie	15.30	0.13	10	-32.9	2.3	0.29	-33.3	0.17	4	-3.0	0.56	9
Central BBS Region	0.00	0.97	103	-2.4	2.4	1.54	8.3	0.01	37	1.1	0.44	97
Western BBS Region	-1.30	0.07	119	-2.6	0.1	3.54	2.7	0.12	41	-1.2	0.31	108
FWS Region 3	-5.20	0.32	14	-15.2	4.7	0.88	-38.3	0.06	6	0.5	0.8	13
FWS Region 6	0.90	0.56	63	-2.2	4.1	1.4	10.8	0.00	25	3.1	0.06	58
United States	0.70	0.63	77	-2.3	3.8	1.33	10.2	0.00	31	3.0	0.05	71
Canada	-1.40	0.02	145	-2.6	-0.2	3.69	2.4	0.16	47	-1.5	0.12	134
Survey-wide	-1.00	0.11	222	-2.1	0.2	2.39	4.3	0.01	78	-0.5	0.61	205

[1]Colors indicate the measure of credibility for BBS data. Red: data have >1 important deficiency, including very low abundance, very small sample size, and/or they are very imprecise. Yellow: data have ≥1 important deficiency, including low abundance, small sample size, are quite imprecise, and/or sub-interval trends are significantly different from each other ($P < 0.05$ based on a z-test, suggesting trend inconsistencies over time). Blue: data represented by ≥14 samples over the long term, are of moderate precision, and birds are moderately abundant on routes.

[2] See <http://www.mbr-pwrc.usgs.gov/bbs/cred.html> for details on derivations/limitations of BBS results.

APPENDIX 2. Breeding Bird Survey distribution and trends maps for Marbled Godwit, 1966-2003 (Sauer et al. 2004).





APPENDIX 3. Summary of threats and conservation priorities---as identified by site-based Marbled Godwit experts affiliated with state wildlife agencies, U.S. Fish and Wildlife refuges, Joint Ventures, Canadian Wildlife Service, PRONATURA, Dicks Unlimited, Ducks Unlimited Canada, and research institutions in the United States and Canada---within regions of the Marbled Godwit's range (including Mexico, United States, and Canada).

Region	**Principal Threats**	**Priority Actions Needed**
Universal---all sites	Habitat loss, lack of funding for habitat conservation, minimal coordination/ communication in conservation planning/ actions, lack of species' ecology information needed for maximizing efficiency of conservation planning/actions; rising sea levels.	**Habitat Protection, Management, Restoration**: develop fundraising strategies for habitat protection; develop relationships with existing/potential partners, including sportsmen's associations, non-governmental organizations, energy/mineral extraction/generation companies, Cattlemen's Association; acquire/protect habitats surrounding marine sites to ensure habitat availability as sea levels rise. **Research/Inventory/Monitoring**: conduct applied research to maximize benefits of habitat management/restoration for godwits, develop protocols/adequate funding for implementing habitat- and population-centered region-wide research/inventory/monitoring to bring population estimates/trend data/ecological information in line with PRISM standards. **Education**: nominate eligible WHSRN/IBA sites if not already designated; conduct habitat management workshops for resource managers. **Communication/ coordination**: coordinate/enhance communication for conservation planning/ efforts within/across regions/nations, especially with regard to securing/protecting water rights, developing/implementing surveys/monitoring populations; set up godwit listserver/website; provide web-based GIS layers of potential godwit habitat/meta-database of existing/future data.
Canada & U.S.—Prairie Habitat, Northern Plains/Prairie Potholes, & Upper Mississippi Valley/Great Lakes	**Overall region**: habitat loss/degradation/ fragmentation due to agricultural conversion, oil/gas development, coal (strip) mining, invasive/exotic plants; unknown levels of threat due to agricultural chemicals, contamination due to by-products of petroleum extraction, altered predator communities, botulism, West Nile Virus, haying/mowing/other land-management operations, fencing,	**Habitat Protection, Management, Restoration**: increase emphasis of U.S. Fish & Wildlife Service's Partners for Wildlife Program/Grassland Reserve Program, target likely funding partners/develop non-federal matching funds; lobby for additional best management practices in Canada's APF for wetland restoration, improved stewardship of riparian/wetland/grassland areas, buffer development, plugging wetland drains; in U.S. Farm Bill strengthen disincentives for tilling native grassland, allow some habitat management activities in Wetlands Reserve Program lands; control/eradicate leafy spurge, crested wheatgrass, smooth brome, spotted knapweed, Canada thistle, Russian olive & other woody vegetation in grasslands; control/eradicate cattails, reed

Region	Principal Threats	Priority Actions Needed
	powerlines/other tall infrastructures related to the energy/communications development. **Minnesota**: gravel and rock mining, loss of small dairy and ranching operations, suburban and exurban development, wetland sedimentation. **Staging sites**: inadequate water rights, dewatering/ draining due irrigation/development; selenium contamination, botulism, contamination from agricultural runoff, sedimentation.	canary grass, purple loosestrife in wetlands; monitor/remedy wetland contamination/sedimentation, develop buffers for diminishing wetland contamination/ sedimentation, strengthen regulations pertaining to site location for oil/gas wells and extraction/waste management methods; prioritize conservation of large/contiguous blocks (>130 ha, ≥800 m wide) of native grassland encompassing diverse wetland complexes in physiographic regions where godwits are common; leverage additional funding/habitat acquisition through mutual benefits to Northern Pintail, Greater Prairie-Chickens, Sharp-tailed Grouse, Ferruginous Hawk, Sprague's Pipit, Chestnut-collared Longspur, Baird's Sparrow; purchase lands and conduct wetland/grassland restoration where extirpations of small/isolated populations are likely; protect current water rights and coordinate region-wide strategies for changing legislative/policy-based actions to secure additional water rights for staging sites. **Research/Inventory/Monitoring**: determine factors limiting breeding populations, evaluate habitat management/restoration options and effects of contaminants/disease in uplands/wetlands, determine extent of genetic differentiation among subpopulations, conduct digitized inventory of all temporary/seasonal/semi-permanent wetlands in prairie Canada. **Education**: conduct community awareness-raising workshops to promote native grassland/wetland conservation, inform landowners about incentive programs, educate landowners on income-producing alternatives on native habitat, garner support of land trusts/birdwatchers/ nature conservation organizations, encourage general public to purchase Duck Stamps; provide habitat-management training for resource managers.
U.S.---Alaska	Small population size/probability of extinction, lack of knowledge about overall ecology, lack of monitoring, effects of oil/gas extraction/transport (spills), potential large-scale mining projects, altered predator communities. Yakutat Foreland: oil spills.	**Habitat Protection, Management, Restoration**: designate entire area used by breeding, foraging, staging Marbled Godwits as protected, and identify/protect this population's wintering sites; ensure ongoing evaluation/improvement/ updating of oil spill plans. **Research/Inventory/Monitoring**: improved protocol/increase research funds for determining the population's ecology/status; implement a reliable survey to determine extent of godwit harvest. **Education**: educate subsistence hunters on godwit identification.
Canada---James Bay	Small population size, lack of information on migratory connectivity/dispersal, no monitoring program, habitat loss from global climate change, increasing goose	**Research/Inventory/Monitoring**: improve population estimate, implement long-term population trend monitoring, determine nesting productivity/ survivorship/limiting factors; use marker-based methods (satellite radios, color bands, isotopes) to quantitatively assess habitat use/availability, determine

Region	Principal Threats	Priority Actions Needed
	populations, subsistence harvest.	dispersal capability, identify/protect important stopover/wintering sites; assess impacts of increasing Snow/Canada goose populations; determine population genetics; implement a reliable survey to determine extent of godwit harvest. **Education**: educate subsistence hunters on godwit identification.
U.S.—Intermountain West	Dewatering, inadequate water rights, contaminants including selenium/boron/arsenic/heavy metals, by-products of mineral extraction, rising salinity levels, lack of interagency regional planning and integrated management for determining water-use, swings in salinity levels, sedimentation, collisions with powerlines/fences/other infrastructures, botulism, mosquito control, avian cholera, sewage flows, shifts in agriculture/land use/conversion to crops that require less water, housing development/increased recreation.	**Habitat Protection, Management, Restoration**: complete the Great Salt Lake Shorebird Management Plan, secure additional water rights/access; initiate campaign/legislative process to develop a small reservoir on Bear River for increasing water available to Bear River Migratory Bird Refuge; complete a full evaluation of/plan for water use in the Imperial Valley, encourage the viability of rice farming, conduct additional restoration/water quality improvement for the Salton Sea and surrounding landscape. **Research/Inventory/Monitoring**: develop practical protocol/ tools for assessing population status/trends; use applied research to evaluate improve wetland management/best management practices for godwits, including ideal water depth, draw-down schedules, wetland type/diversity, effects of human disturbance; continue modeling efforts to provide landscape-scale conservation planning/implementation within Imperial Valley.
U.S.—Central Plains	Inadequate water supplies, sedimentation, invasions of phragmites/cattails.	**Habitat Protection, Management, Restoration**: garner additional funds/personnel for maintaining godwit habitat---especially control of cattails and phragmites; legislation and policies necessary for restoring adequate base flow to the Arkansas River and Walnut Creek.
U.S.—Northern Pacific Coast	Invasion of spartina, exotic/invasive invertebrates (European green crab and no monitoring program), oil spills, human activity, damage to or removal of the roost structures.	**Habitat Protection, Management, Restoration**: enhance site protection if research determines that this region harbors Alaska's breeding godwits; continue funding/work for spartina control; evaluate/update regional oil spill contingency plans. **Research/Inventory/Monitoring**: determine whether godwits in the region are from the Alaska population; determine impacts of invasive/exotic species---especially European green crab. **Education**: maintain/enhance human-godwit coexistence in Willapa Bay, educate local public as to godwit's watchable wildlife value, encourage wildlife tourists to promote godwit protection via patronage of local merchants and mentioning to merchants that godwits are purpose of visit.
U.S.—Southern Pacific Region	Habitat loss/degradation due to residential and industrial development, contamination from non-point/known sources,	**Habitat Protection, Management, Restoration**: immediate funding for easement programs, Land Trusts, and others, to conserve seasonally flooded agricultural lands and grazed pastures within proximity of important godwit

Region	Principal Threats	Priority Actions Needed
	contaminant/sediment runoff from agriculture, invasive species, mariculture activities, disturbance from recreational activities (boating, fishing, personal watercraft, claming), diminishing supplies of fresh water for wetlands, oil spills, spartina and European beach grass, European green crabs, Canada geese, invasive isopod (*Sphaeroma* sp.), warm-water discharges from power plants, powerlines across wetlands, increasing loss of livestock pastures and seasonally flooded agricultural areas.	sites; intensify invasive species control efforts---especially spartina, phragmites, European green crab, invasive isopods; conserve/protect seasonally flooded pastures/grazed grasslands potentially used as godwit roosts/alternative habitats during storms; protect sites from recreation-based disturbance; include a wildlife management component in the management plan for Lawson's Landing Campground at Tomales Bay to protect the godwit roosting area on that site. **Research/Inventory/Monitoring**: evaluate relative importance of nearby seasonally flooded agricultural lands/grazed pastures for godwits; evaluate effects of mariculture and mercury mining (Tomales Bay), invasive invertebrates, sedimentation; determine whether/which sites host godwits from the Alaska population. **Education**: increase efforts to diminish recreation-based disturbance; implement education program at Tomales Bay (campground areas especially) to diminish effects of disturbance due to boating.
México—Pacific & Gulf of California	Habitat loss and/or degradation due to mariculture and dams, land and water pollution from agricultural activities, tourism/development of coastal resorts, residential development, human disturbance, saltworks, utility development, agricultural development and decreased salinities in brackish wetlands, invasions of vegetation in wetlands, dewatering.	**Habitat Protection, Management, Restoration**: establish protection for key sites on Baja California Peninsula (especially Bahia San Quintin, Bahia Magdalena); develop/provide funding through PRONATURA for conservation easements with ejidotarios on lands surrounding important godwit sites; implement conservation plans at sites that have them (especially Marismas Nacionales), develop plans for sites that still need them and ensure that shorebird conservation is added to existing/future plans (Ojo de Liebre-Guerrero Negro, Laguna San Ignacio, Río Colorado Delta); restore habitat at Sinaloa/Nayarit sites where agriculture/water mining have degraded/destroyed habitat. **Research/Inventory/Monitoring**: develop/implement adequate monitoring/research programs to assess godwit population status/trends/distributions/habitat use---especially important at largest sites (Ojo de Liebre-Guerrero Negro, Laguna San Ignacio, Río Colorado Delta, Bahia San Quintin, Bahia Magdalena, Marismas Nacionales, Bahia Santa Maria); determine threat posed by agricultural pesticides, sewage, mariculture and mariculture dams. **Education**: nominate Ensenada Pabellones and Huizache-Caimanero as WNSRN and/or RAMSAR sites; educate local pubic in Sinaloa/Nayarit to increase public awareness of site importance to shorebirds, ecosystem function/ sustainability of coastal wetlands that sustain shorebirds and people, better stewardship of coastal wetlands; target the tourism industry in both Baja California and Sinaloa/Nayarit to raise

Region	Principal Threats	Priority Actions Needed
		awareness of site importance and diminish disturbance/habitat destruction.
U.S. & México—Gulf of Mexico Coast (including Louisiana & Florida)	Residential, resort, and industrial development; recreation-based disturbance, unleashed dogs and boaters entering protected areas; petroleum/chemical spills, non-point source pollution from industry/ agriculture, oil/gas and groundwater extraction causing subsidence of estuary habitats; dewatering of rivers and wetlands causing loss of freshwater habitats and saltwater intrusion in estuaries; large-scale fisheries, shrimp farming/effluent/toxic algal blooms; beach modification , potential feral hogs; lack of information about distribution/numbers.	**Habitat Protection, Management, Restoration**: acquire funding/protection for important sites and surrounding habitats from development/human disturbance, boating, dogs; habitat protection need is most immediate at Lanarck Reef and in the Rockport area; conserve/ protect freshwater sources/inflows to estuaries through acquisition/legislation/ policy; develop/evaluate/update regional oil/chemical spill contingency plans; implement additional or longer closures over greater areas and law enforcement to keep pedestrians/ boaters/dogs out of protected areas especially at Honeymoon Island, Caxambas Pass, Cape Romano. **Research/Inventory/Monitoring**: conduct region-wide inventory/ monitoring, genetics or isotope/color-banding work, and a study on migratory connectivity to determine status of the region's godwits; determine impacts of feral hogs on godwit habitats; evaluate effects of beach modification on godwits at Point Pinellas and Shell Key. **Education**: implement public education programs to improve compliance with closure areas, target operators of watercraft, tour operators, boat-rental operations; erect 'bird-friendly' closure fencing, signage.
U.S.—Southeastern Coastal Plains	Harvest of horseshoe crab eggs/other changes in prey base due to pollution, wetland degradation due to industrial/ agricultural sources/petroleum spills/ fertilizer runoff/pet excrement, development, recreation, tourism, invasive species, development of wind energy.	**Habitat Protection, Management, Restoration**: ameliorate recreation-based disturbance, including boating, crabbing, pedestrian traffic, unleashed dogs, at important foraging and roosting sites; reduce crabbing permits for important sites. **Research/ Inventory/Monitoring**: assess effects of region-wide declines in important prey bases, especially horseshoe crab eggs, due to harvest activities and pollution; conduct inventory/ monitoring (including aerial surveys) and genetics/isotope/color-banding work to assess population status/distribution/migratory connectivity of the region's godwits; take opportunities to research effects of closures on godwit behavior/habitat use. **Education**: educate local public on deleterious effects of fertilizer/pet excrement contamination at coastal/delta/upstream sites.

APPENDIX 4. List of, and contact information for, Marbled Godwit contacts and potential future collaborators.

Name	Title	Affiliation	Location	Phone	E-mail
Abraham, Ken	Waterfowl & Wetlands Scientist	Ontario Ministry of Natural Resources	Peterborough, Ontario	705-755-1547; 705-336-2987 (summer field)	ken.abraham@mnr.gov.on.ca
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Dale, Brenda	Wildlife Biologist	Canadian Wildlife Service, Environment Canada	Edmonton, Alberta	780-951-8686	brenda.dale@ec.gc.ca
Davis, Steve	Research Biologist	Canadian Wildlife Service,	Regina,	306-780-5342	stephen.davis@ec.gc.ca

Name	Title	Affiliation	Location	Phone	E-mail
		Environment Canada	Saskatchewan		
Demarest, Dean	Nongame Migratory Bird Coordinator	Region 4 U.S. Fish and Wildlife Service	Atlanta, Georgia	404-679-7371	dean_demarest@fws.gov
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