CONSERVATION PLAN FOR THE HUDSONIAN GODWIT

(*LIMOSA HAEMASTICA*)

Version 1.0

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Nathan R. Senner[1]

WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK

Conservation Plan Author:

[1]Department of Ecology and Evolutionary Biology, Cornell University, E145 Corson Hall, Ithaca, New York 14853-2701, nrs57@cornell.edu.

For further information:

Manomet Center for Conservation Sciences, www.manomet.org

Western Hemisphere Shorebird Reserve Network: www.whsrn.org

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EXECUTIVE SUMMARY

The Hudsonian Godwit, *Limosa haemastica*, is the smallest and least well known of the four shorebird species in the genus *Limosa*. Major difficulties exist in studying *Limosa haemastica*, mainly because it spends much of the year in remote locations.

The known nesting areas of the Hudsonian Godwit (hereafter, "godwit" refers to Hudsonian Godwits) occur in three disparate regions in the Nearctic: the Hudson and James Bay region of northeastern Canada; the Mackenzie and Anderson river deltas of northwestern Canada; and scattered pockets of appropriate habitat in southcentral and western Alaska.

The Hudson and James bay populations, estimated at 36,000 individuals, are already at the target population level, while the Alaskan population, estimated at 14,000 individuals, should be increased by 25% according to the U.S. Shorebird Plan (Brown et al. 2001). Godwits are much more concentrated during the non-breeding season, when they gather in three main areas in southern South America: Bahía Lomas, Chile and Bahía San Sebastián, Argentina, both on the island of Tierra del Fuego, and Isla Chiloé and the adjacent mainland coast in central Chile.

It is not entirely clear whether the three breeding populations also spend the boreal winter in different areas or if the different populations mix from year to year. It also is not known what routes the three groups follow between breeding and non-breeding areas. Groups of godwits stage during the fall at areas to the south of their breeding grounds in Canada and Alaska, especially on the upper Cook Inlet in southcentral Alaska; the Quill Lakes and Luck Lake in Saskatchewan; and upper James Bay in Ontario. The godwits, generally, are not seen again in any numbers until they arrive in the very southernmost state of Brazil, Rio Grande do Sul, and northernmost provinces of Argentina, particularly Buenos Aires. Within the past few decades, however, observers have noted large groups of godwits using oxbow lakes along the upper Amazon, near Manaus, Brazil, thus presenting what may be an important stopover site midway between staging areas in southern Canada and better known stopover sites in southern South

America. It is not yet understood what proportion of the population uses these lakes or from which breeding areas these birds originate.

The migration route of northbound godwits remains similarly vague. Godwits use a slightly different suite of stopover sites on their way north through Argentina before aggregating at Lagoa do Peixe in southern Brazil; but it is not known whether there are any other stops between southern Brazil and the south Texas coast. Godwits regularly use rice fields and other flooded areas along the Central Flyway, particularly in Kansas and South Dakota. The last know staging areas south of the Canadian breeding grounds are a handful of sites scattered across Alberta, Saskatchewan, and Manitoba.

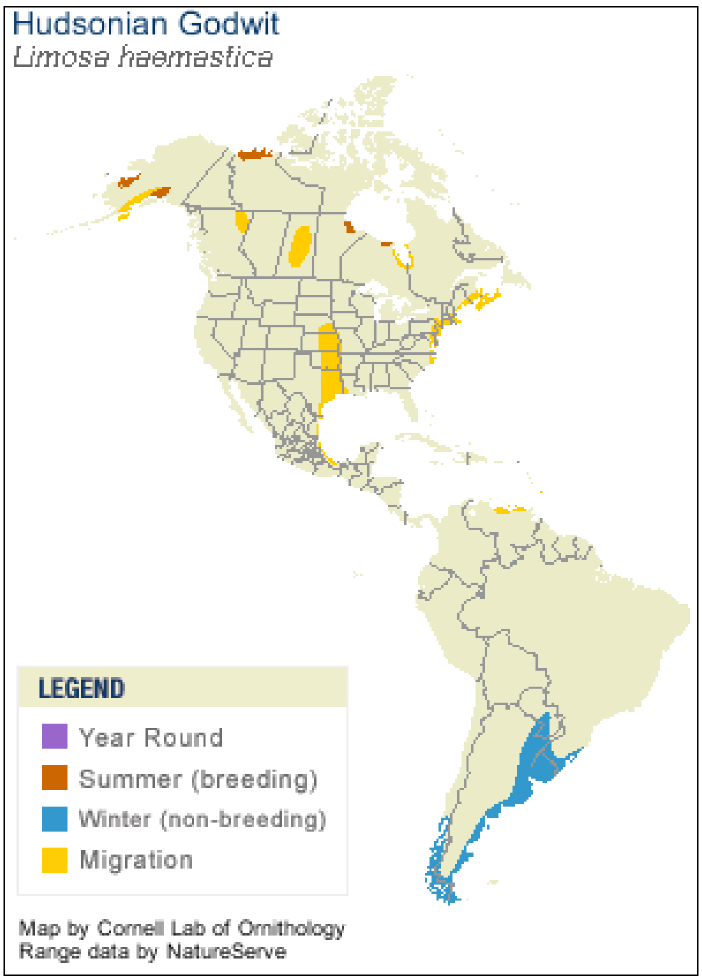

Figure 1. Breeding areas (in red) and non-breeding areas (in blue) of the Hudsonian Godwit.

As a result of the paucity of knowledge about most aspects of the Hudsonian Godwit's annual cycle and their small world population of an estimated 70,000 individuals, godwits are of high conservation concern (USSCP 2004; Morrison et al. 2006). Immediate conservation priorities focus on:

1) Defining the migration route for each of the three separate breeding populations.

2) Searching for further breeding areas, possibly in southwestern and northeastern Alaska and across the central Canadian arctic.

3) Protecting habitat during all stages of the godwits' annual cycle. Imminent threats exist, particularly in the Mackenzie River Delta, where there is a proposal to build a large oil and natural gas pipeline; the upper Cook Inlet in Alaska where a proposed bridge and coal mine may disrupt godwit breeding and staging areas; on Isla Chiloé where the aquaculture trade is beginning to compromise many of the most important wintering areas for godwits; and on Tierra del Fuego, where the proximity of important non-breeding sites to major shipping routes increases the possibility of an oil spill effecting a large portion of the population.

4) The education of landowners and managers about the impacts of their practices, particularly on agricultural lands in central North America, to godwits and other shorebirds.

This conservation plan presents an outline of the current knowledge of the godwits' ecology—including population status, distribution, migration patterns, and habitats used—a listing of the known sites that are most important to godwits throughout their annual cycle, a summary of apparent conservation threats currently facing godwits, and suggestions about actions that should be taken to address current conservation threats. To gather this information a variety of sources were used, including published studies, the unpublished observations of biologists throughout the godwits' range, the sightings of amateur ornithologists across the hemisphere, and the experiences of the author during his studies of godwits. With this information in hand, I hope that scientists, resource managers, the concerned public, and funding agencies can work to provide for the long-term conservation of Hudsonian Godwits.

PURPOSE

The Hudsonian Godwit, *Limosa haemastica*, is one of the most poorly studied of all waders breeding in North America. This, in combination with the species's small population size, its reliance on a few very important wintering (period of time during the boreal winter) and staging sites, and the existence of imminent threats to important habitats throughout the godwits' annual cycle caused the U.S. (Brown et al. 2001) and Canadian Shorebird Conservation Plans (Donaldson et al. 2000) to list the Hudsonian Godwit as a species of high conservation concern. As a result of those rankings and the general need to better coordinate efforts to study and conserve godwits, this review and plan was developed with support from the Manomet Center for Conservation Sciences and the Western Hemisphere Shorebird Reserve Network.

The goal of this plan is to generate broader interest in conserving, monitoring, and researching godwits in addition to consolidating and reporting on recent information learned about godwits. If these goals are met, this plan will provide a first step in a process that will eventually include:

- Conservation of unprotected areas that are important to godwits;
- Better management practices in areas important to godwits;
- A systematic identification of important habitats and breeding areas;
- More complete monitoring of the godwit population;
- Progress toward understanding migration patterns and yearly movements; and
- Creation of a working group whose responsibility and goal it is to study and conserve godwits.

MANAGEMENT STATUS AND NATURAL HISTORY

Although Hudsonian Godwits have been little studied, there is a long history of work by biologists, extending back for the better part of a century, beginning with Alexander Wetmore's observations of godwits along the Argentine coast during the early part of the 20th century; continuing through the studies at Churchill, Manitoba by Joseph Hagar and Jospeh Jehl Jr. during the 1960s and 1970s; the work in southcentral Alaska by Francis Williamson and Mary Smith; and the work of Guy Morrison, Brian Harrington, Luis Espinosa Gallegos, and Daniel Blanco from the 1970s until the present. Here, I summarize the current state of knowledge about Hudsonian Godwits and their ecology, specifically in the areas of taxonomy, population estimates, distribution, migration patterns, and major habitats.

MORPHOLOGY

The Hudsonian Godwit is a large shorebird that exhibits significant sexual dimorphism. During the breeding season, females weigh an average of 289.0 g (n=6), while males weigh an average of 220.0 g (n=6). Wing length and area also differ significantly between sexes, with females on average larger (Jehl and Smith 1970).

TAXONOMY

There are no recognized subspecies or races, although the different breeding populations exhibit a high degree of genetic differentiation (Haig et al. 1997). Birds breeding on the Mackenzie and Anderson river deltas in northwestern Canada are highly distinct from birds breeding near Churchill, Manitoba and more closely related to birds breeding in Alaska. Despite these genetic differences, no morphological or behavioral differences have been noted among populations (Elphick and Klima 2002).

POPULATION ESTIMATE AND TREND

In the U.S. Shorebird Conservation Plan, Morrison et al. (in press) estimate the total population for Hudsonian Godwits to be 70,000 birds, with 14,000 breeding in the western population and 56,000 in the James Bay population. All population estimates come from counts at migration stopover sites (James Bay in fall; U.S. prairie pothole region in spring) and wintering areas on Tierra del Fuego and Isla Chiloé. No systematic survey of godwits has taken place on any of the breeding grounds (Donaldson et al. 2000; Klima and Elphick 2002).

Solid estimates of population trends are also lacking. Appendix 1 of the U.S. Shorebird Conservation Plan (Brown et al. 2001) suggests a decline in the Alaskan population, and the Canadian Shorebird Conservation Plan (Donaldson et al. 2000) notes a 5% annual decline in counts from the maritime provinces. Bart et al. (2007) also estimated a 3% annual decline from 1974-1998 in the number of Hudsonian Godwits using Canadian maritime and north Atlantic stopover sites in the United States. Bart et al., however, did not present data from any of the major fall staging areas for Hudsonian Godwits and thus is not clear how these findings relate to the larger population.

Based on aerial surveys of Tierra del Fuego taken annually between 2000-2006, where counts have ranged between 31,100 and 66,800 birds, with a mean of 45,000, Morrison and Ross (unpubl. data) note no consistent population trend in the Tierra del Fuego population. Similarly, ground counts on Isla Chiloé and the nearby mainland from 1993-2005 have shown no consistent pattern (Espinosa et al. 2006).

Besides the recent winter coverage of Tierra del Fuego and southern Chile, there have been no systematic counts of godwits at major stopover sites or breeding locations that would allow for the formulation of an overall population trend. Indicative of circumstances across their breeding grounds is the situation in western Alaska, where, as McCaffrey (pers. comm.) concludes: "We certainly don't have any evidence of population change in either direction out here in western Alaska. We have only marginal information about population size, let alone trend."

DISTRIBUTION

Breeding Season

Hudsonian Godwits breed in widely dispersed areas across the Nearctic. Areas of known breeding activity are centered around: 1) Churchill, Manitoba and the southern Hudson Bay-northern James Bay region, extending from the very northern fringe of Ontario north and west along the coast into Manitoba; 2) the Mackenzie and Anderson river deltas in the Northwest Territories and Nunavut; and 3) in southcentral and western Alaska, especially in the upper Cook Inlet area, the Andreafsky Range and Koyukuk River floodplain, on the Seward Peninsula, and possibly along the Noatak River (Kessel 1989; Andres et al. 1999; McCaffery and Harwood 2000; Elphick and Klima 2002; Ontario Breeding Bird Atlas 2006). Much remains unknown about the distribution of godwits on the breeding grounds and, the number of known breeding areas does not match the estimated population size (Elphick and Klima 2002).

Non-Breeding Season

Godwits are largely restricted to a few sites during the non-breeding season, most of which host major concentrations of birds. The two largest are found on the island of Tierra del Fuego: Bahía

Lomas on the Chilean side (western) of the island and Bahía San Sebastián on the Argentine side. The other major non-breeding site is Isla Chiloé in central Chile. On Chiloé, the adjacent mainland along the shore of the Seno de Relóncavi near Puerto Montt, and the large estuary near Maulin, godwits use a number of small bays and inlets where groups of up to 5,000 individuals rest and feed. At the majority of sites, however, groups of a few hundred to a thousand birds are more normal (Morrison and Ross 1989).

Hudsonian Godwit habitat on Isla Chiloé, Chile. Photo courtesy of L. Espinoza.

Good numbers of godwits also spend the boreal winter at a number of sites along the coast of the Argentine mainland, especially near Río Gallegos and along the southern end of Bahía Samborombón (Morrison and Ross 1989; Blanco et al. 1995; Blanco et al. 2006). Much smaller numbers have been found at a few sites inland in Argentina and north of Chiloé along the Chilean coast (Senner 2006b). A few individuals spend the season as far north as Peru on the Pacific coast and southern Brazil on the Atlantic (Morrison and Ross 1989; Senner 2006a).

Sightings during migration mainly occur in areas that lie directly between breeding sites and non-breeding sites, but some individuals stray to New Zealand and Australia almost annually. Hudsonian Godwits also have been sighted in both Europe and South Africa during the boreal fall (Grieve 1987; Elphick and Klima 2002).

MIGRATION

Little is known about the migration of Hudsonian Godwits. It is unknown whether birds from the three distinct breeding areas take separate migration paths to and from southern South America. It is generally thought that the species makes an elliptical migration: in the fall leaving from Canada and flying over the Atlantic to sites along the Amazon Basin before proceeding to coastal sites in southern Brazil and northern Argentina, and in the spring staying to the west after leaving Argentina and southern Brazil and making landfall in North America along the coast of northern Mexico and Texas. However, this route has never been confirmed with telemetry work or even resightings of banded birds (Hagar 1966; Morrison 1984; Elphick and Klima 2002).

Southbound Migration

Southward migration begins as early as late June in Upper Cook Inlet for some males, with numbers of females and then juveniles coming in mid-July and early August (Elphick and Klima 2002). Peak numbers at lakes in Saskatchewan occur during the first half of August (Alexander and Grotto-Trevor 1997) and along James Bay during the middle of August (Morrison 1984; Table 1). Recently, Aropuk Lake on the Yukon River Delta has been confirmed to be one of the largest godwit staging areas in North America during July and early August. Initial high counts included 5,300 individuals during the second week of July (McCaffery and Conklin 2004; McCaffery et al. 2005). All individuals are gone from the more northerly staging areas—e.g., upper Cook Inlet, Yukon-Kuskokwim Delta, and Churchill and La Pérouse Bay, Manitoba—by the end of August, from Saskatchewan by early September, and James Bay by mid-October (Jehl and Smith 1970; Elphick and Klima 2002).

Small numbers of godwits are rarely observed in the fall throughout much of the eastern United States, but are regular migrants at a few spots along the mid-Atlantic coast, especially in southern Massachusetts and along Delaware Bay (Veit and Peterson 1993; Hess et al. 2000; Elphick and Klima 2002). Autumn records also exist from the West Indies, where sightings are normally associated with strong easterly winds (Richardson 1976); from Barbados, where they are uncommon (Raffaele et al. 1998); from Panama (Ridgely 1989); and from Baja California (Billings and McCaskie 2005), but not from elsewhere in Mexico or Central America (Stiles and Skutch 1989; Howell and Webb 1995). While records during the southbound migration between the major Canadian and Alaskan staging sites and stopover sites in Brazil and Argentina are few, their existence has been used to infer the migration routes of the different godwit populations.

Individuals have been noted from Venezuela as early as late July (Swallow 1994), but the bulk of birds do not begin arriving in South America until September. Because of the paucity of sightings of godwits on the north coast, most are believed to overshoot the coast and stop somewhere south of the Orinoco River delta (Hagar 1966; Elphick and Klima 2002). During one year of coverage (1993) as a part of the International Shorebird Survey (ISS), as many as 83 birds were counted in early October near Manaus, Brazil along the Amazon River (Harrington unpubl. data). Coverage of this area and the rest of Amazonia has been understandably sparse, and it remains unclear what proportion of the godwit population uses this area and how regularly.

Godwits are equally uncommon elsewhere in South America away from Argentina and central and southern Chile. They are listed as hypothetical in Columbia based on a few sight records (Hilty and Brown 1986), very rare in Ecuador (Ridgely and Greenfield 2001), rare in Peru (Clements and Shany 2001), accidental in Bolivia (Elphick and Klima 2002), and uncommon in Paraguay (Hayes and Fox 1991). It is likely that the limited amount of shorebird work undertaken in the past in many of these areas accounts for at least some of the presumed rarity of godwits, but in recent years there has been an increase in reported sightings, particularly along the coast of Perú (Senner 2006; Schulenberg unpubl. data).

Movements in southern Brazil, Argentina, and Chile are also poorly understood. The first migrants are noted in July along the Buenos Aires coast (Wetmore 1927; Blanco et al. 1995). The peak number of birds staging at Lagoa do Peixe in the southern Brazilian state of Rio Grande do Sul does not occur until November, which is roughly the same time that birds begin to accumulate in the southern reaches of Patagonia and at sites on Tierra del Fuego (Lara Resende 1988; Benegas pers. comm.). Interestingly, numbers peak in September at Punta Rasa, which is on the southern edge of Bahía Samborombón in the Buenos Aires province of Argentina, and nearly 500 miles to the south of Lagoa do Peixe in Brazil (Blanco et al. 1995). This difference in timing is possibly suggestive of the differential timing of migration by different age classes or sexes (Andres pers. comm.).

Harrington et al. (1993) suggest that southbound migrants avoid Argentine coastal locations in favor of inland ones. That paper, however, was based on ISS census data from a limited number of coastal sites, including Península Valdes, where godwits have rarely been recorded, in any season, over the past decade (Escudero pers. comm.). Furthermore, no inland sites hosting large numbers of godwits have been identified. This does not rule out the possibility that some godwits do use inland sites during the austral spring: For example, Laguna Mar Chiquita, Córdoba, Argentina has an exceptional record of 1,200 Hudsonian Godwits in one day (WHSRN 2003) and much of that vast inland saline lake is rarely visited or systematically surveyed (Michelutti pers. comm.). Additionally, the string of large saline lakes lining the eastern base of the Andes is used by important numbers of shorebirds during the austral spring.

Coverage is sparse at these sites, but there are no suggestions at this time that any of them hold large numbers of godwits (Torres-Dowdall pers. comm.).

Significant movements do occur along the Argentine coast between late August and early December, although obtaining good estimates from many of the sites is difficult (Blanco et al. 1995; Blanco pers. comm.). Eight sites have been identified as supporting at least 0.5% of the population during southbound migration: Punta Rasa (Bahía Samborombón), Albufer Mar Chiquita, Bahía Blanca, Bahía Unión-Bahía Anegada, Bahía Bustamante, Golfo San Jorge, Caleta Olivia, and Río Gallegos.

Figure 2. Movements of Hudsonian Godwits using Isla Grande de Tierra del Fuego. Bahia Lomas and Bahia San Sebastian are two of three most important wintering sites for godwits.

Godwits begin arriving at wintering sites in central Chile during late September and early October (Espinosa et al. 2006) and on Tierra del Fuego by the last two weeks of November and first week of December (Senner pers obs). Movements between the three Fuegan sites—Río Grande, Bahías Lomas and San Sebastián—and small areas of mudflats on the adjacent mainland Chilean coast can and do occur, although it is unknown how frequently and whether or not these movements are based on tides, seasonal changes in prey abundance, or patterns of human disturbance, such as ferry schedules (Senner pers. obs.; Morrison pers. comm.).

Northbound Migration

Northbound migration may begin as early as the latter half of January. Espinosa et al. (2006) have noted a spike in godwit numbers at sites near Puerto Montt and on Isla Chiloé, Chile, during this time—with numbers peaking during February, sometimes at almost double the numbers that were present in December—and have observed three godwits banded on Tierra del Fuego on Isla Chiloé during this period. It is possible that the increases in godwits present at surveyed sites near Puerto Montt and on Isla Chiloé represent regional movements, possibly away from remote sites on the islands surrounding Isla Chiloé or from unknown sites along the mainland south of Puerto Montt. Given the magnitude of the increase in godwits observed and the apparent unsuitability of the habitat dominating much of the southern Chilean coastline, these possibilities seem unlikely (Morrison and Ross 1989).

Most godwits leave Fuegan sites by late February and early March and begin gathering at sites to the north, especially at Río Gallegos, Albufer Mar Chiquita, and Lagoa do Peixe. This is a slightly different suite of sites than are used during the southbound migration (Table 1; Harrington et al. 1993; Blanco et al. 1995; González unpubl. data). González (unpubl. data) also notes that the same group of birds, banded at Río Grande on Tierra del Fuego, annually moves up the coast of Argentina, stopping at Río Gallegos, Golfo San Jorge, and San Antonio Oeste. Observers have not found these birds grouped at sites farther north, and it is not known how their migration strategy differs from other Hudsonian Godwits migrating north from Tierra del Fuego.

After staging at sites in northern Argentina and southern Brazil, godwits are presumed to make a non-stop flight to the U.S. coast of the Gulf of Mexico. Major staging areas are not found immediately on the Texas coast, but instead in flooded inland rice fields (Weeks pers. comm.). Given the ephemeral nature of flooded rice fields, there apparently are not consistently important single sites from year to year, but rather clusters of sites within agricultural districts that annually support large numbers of birds passing through. Chambers and Warren counties, east of Houston, Texas, U.S.A. appear to receive the largest concentrations annually, and, although high counts in these areas are generally not on the scale of those noted in South America, they do occasionally reach 500 to 700 individuals (Skagen et al. 1999; Weeks pers. comm.).

Godwits are noted more sparsely along the entire rest of the Gulf Coast, including somewhat regularly along the coast of Laguna Madre in the Mexican state of Tamaulipas and rarely as far south as the Yucatan Peninsula (Coffey 1960; Howell and Webb 1995). Godwits are also occasionally seen along the Pacific coast in northern Guatemala and in the southern Mexican states of Chiapas and Oaxaca, especially at the lagoons along the Pacific coast of the Isthmus of Tehuantepec (Binford 1989; Howell and Webb 1995; Grosselet pers. comm.). It is not known whether birds stopping at these Pacific sites are coming from wintering areas on Chiloé or if all godwits use roughly the same route when migrating north.

From Texas, the godwits move up the center of the United States, mainly using flooded agricultural fields and lakes and reservoirs with low water levels. In Oklahoma, the majority of birds pass through Tillman, McClain, Cleveland, and Tulsa Counties (Grzybowski pers. comm.). In Kansas, godwits are concentrated at three major wetland complexes, Cheyenne Bottoms Wildlife Management Area (Barton County), which has had a high count of 6,850 godwits; Quivira National Wildlife Refuge (Stafford County); and Slate Creek Marsh (Sumner County) (Skagen et al. 1999; Grzybowski, Hands, Young pers. comm.). North of Kansas, the migration broadens, encompassing parts of both Iowa and Nebraska, although it appears that the main path of the migration leads through Nebraska (Dinsmore et al. 1984; Silcock and Jorgensen pers. comm.). In Nebraska, most observations come from the eastern Rainwater Basin, a series of shallow wetlands that cover 10,000 hectares and parts of 12 counties in southcentral Nebraska (Jorgensen 2004; Silcock pers. comm.). Iowa receives smaller numbers of birds each spring, with the highest one-day counts reaching 100 birds (Dinsmore et al. 1984).

Migration continues along this broader front as the birds move north, with fairly large numbers of birds observed in both Minnesota and South Dakota, although the majority of sightings come from western Minnesota and eastern South Dakota (Jenssen 1987; Tallman et al. 2002).

Outside of Alaska, the last areas reporting large numbers of godwits south of their breeding grounds come from North Dakota and extreme southern Canada. North Dakota has had single day counts as high as 420, with the peak beginning during the third week in April and extending through the fourth week of May (Skagen et al. 1999; Martin pers. comm.). Saskatchewan and Manitoba receive the bulk of the godwits moving through southern Canada—with high counts as great as 600 in southeastern Manitoba at Oak Hammock Marsh WMA, 360 at the Reed-Chaplin Lakes complex in extreme southcentral Saskatchewan, and 1450 at the Quill Lakes in southcentral Saskatchewan—although Alberta occasionally receives flocks of up to 100 birds (Manitoba Avian Research Committee 2003; Important Bird Areas of Canada 2007; Korlyk unpubl. data). From there, scattered individuals are reported moving through the Yukon Territory, mostly stopping along the margins of freshwater lakes near Whitehorse. Larger movements occur along the Hudson and James bay shorelines (Jehl and Smith 1970; Cooke et al. 1975; Eckert et al. 2003).

Across the central part of North America observers note that small flocks of godwits can be observed flying overhead, but not necessarily stopping, during much of the day at peak migration periods (Grzybowski pers. comm.). This observation has a couple of implications for the godwits' migration strategy: 1) It most likely involves movements between ephemeral water sources that may change each year, as opposed to a movement between important permanent staging sites such as an estuary or bay. 2) As suggested by Skagen et al. (1999), the godwits may only stop once along the flyway, and then only when it is absolutely necessary.

Along the upper Cook Inlet in southcentral Alaska, the first individuals arrive around the last week of April and the peak occurs sometime in May. During Gill and Tibbitts' (1999) two-year study of migration in the region, the peak occurred in the last week of May in 1997 and second week in 1998. This difference may only be inter-annual variation or it may indicate a migration with two peaks, one at the beginning and one at the end of the month. In 1997, while the largest numbers came during the last week of May, significant numbers were sighted during the first week of May, followed by a period of nearly three weeks when few godwits were recorded. A similar pattern emerged in 1998 and may suggest either the early arrival of males and the late arrival of females, or the early arrival of birds nesting to the north and west of the region and the late arrival of local breeders. There appear to be no large concentrations north and west of the upper Cook Inlet during the northbound migration.

In general, peak migration in Oklahoma and Kansas occurs during early-to-mid April, in Iowa and Nebraska late April to mid May, in Minnesota, South Dakota, North Dakota, and southern Canada early-to-mid May, in southcentral Alaska early-to-mid May, in the Yukon late May, and in Churchill late May-early June (Jehl and Smith 1970; Dinsmore et al. 1984; Jenssen 1987; Skagen et al. 1999; Eckert et al. 2003; Grzybowski and Silcock pers comm.).

MAJOR HABITATS

Breeding Season

Across their breeding range, godwits prefer open sedge meadows with small ponds. In Manitoba and in much of southcentral and western Alaska, these sedge meadows are often found interspersed with small trees: in Alaska, black spruce, *Picea mariana*, and in Manitoba, tamarack, *Larix laricina*, and black spruce (Williamson and Smith 1964; Hagar 1966). Nests are usually placed on small upland areas or hummocks found within the marsh. In Alaska, these upland areas are often characterized by lichens, mosses, grasses and small shrubs (such as sweet gale, *Myrica gale*) and dwarf arctic birch, *Betula nana* (Williamson and Smith 1964). In Manitoba, sweet gale and dwarf arctic birch are replaced by dwarf birch, *Betula glandulosa*, and snow willow, *Salix reticulata*, as well as by dwarf rhododendron, *Rhododendron lapponicum*, bog rosemary, *Andromeda polifolia*, and blueberry, *Vaccinium uliginosum* (Hagar 1966; Elphick and Klima 2002).

Godwit breeding habitat near Churchill, Manitoba, Canada. Photo by Nathan Senner, July 2005.

The proximity of the sedge meadows to the border between tundra and taiga appears to be an important component of the godwits' nesting habitat throughout Manitoba and the majority of Alaska, but not in the Northwest Territories and parts of western Alaska (Gratto-Trevor 1996; McCaffery and Harwood 2000). In western Alaska, McCaffery and Harwood (2000) noted godwits inhabiting dwarf shrub meadows kilometers away from the closest large wetlands or trees. In northwestern Canada, godwits continue to utilize open sedge marshes, but they do so beyond the tree line.

These wet meadows retain small upland areas, often with dwarf willows and birch, where the godwits nest (Senner pers. obs.).

Another common characteristic across much of the godwits' breeding range is a close proximity to tidal mudflats where the non-incubating member of a pair is able to feed. In the upper Cook Inlet region of Alaska, five godwit nests were an average of 3 km from tidal mudflats (Gill and Tibbitts 1999), and Hagar (1966) speculates that godwits do not use a seemingly suitable strip of habitat 50 km from the coast at Churchill because of its great distance from intertidal feeding areas.

It is not well understood which combination of these habitat characteristics is most important to godwits. This information may well prove important, since a number of investigators—Hagar 1966, McCaffery and Harwood 2000; Elphick and Klima 2002—comment on the apparent discrepancy between the amount of suitable habitat and the number of breeding areas identified and used by godwits.

Migration and Non-Breeding Season

The sites used by godwits during migration while in South America versus North America differ in important ways. Feeding sites in South America are mostly large intertidal estuaries—e.g., Bahía Samborombón, Río Gallegos, Bahía Lomas and Bahía San Sebastián—characterized by strong tidal fluctuations and deep, soft mud (Morrison and Ross 1989; Blanco et al. 1998; Senner 2006b). Other habitat types used for feeding in South America, but less frequently than intertidal areas, include inland saline lakes, sewage lagoons, salt marshes, slow-flowing streams with muddy banks, flooded fields, and occasionally upland grasslands (Myers and Myers 1979; Morrison and Ross 1989; Senner 2006b). Senner (2006b) notes that deep, soft sediment suitable for probing with the entire length of the bill was the common feature of all South American sites where he observed feeding godwits.

In general, habitats used for roosting include sandy beaches, rocky intertidal shelves (known as *restingas*), islands in rivers and freshwater and saline lakes, open mudflats above the tide line, and occasionally upland grassland or steppe (Morrison and Ross 1989; Senner 2006b). Roosting sites are often located a number of kilometers away from feeding areas and sometimes in a completely different complex of habitats. For instance, in Río Grande, Argentina, godwits used three different roosting sites depending on tidal fluctuations and human disturbances: a sandy area on a spit of land extending into the Atlantic Ocean, a stretch of beach backed by a field of beach grass along the mainland approximately 8 km away, and a small lake with muddy islands, roughly 3-5 km inland. Similarly, at Bahía Lomas, Chile, when tides completely covered the mudflats, birds move up into the halophytic zone adjacent to feeding areas, fly across the narrowest point of the Strait of Magellan to roosting areas along beaches of the continental mainland, or fly inland to roosting areas on the open steppe (Senner 2006b; Senner pers. obs.).

Godwits leaving to feed on a falling tide at Bahia Lomas, Chile. Photo by Kate Coddington Senner, 2005

In contrast to South America, North American sites are largely found inland. The majority of sites used by godwits are flooded agricultural fields or the beds of lakes or reservoirs with low water levels (both freshwater and saline), but godwits also use marshes, sloughs, and sewage lagoons (Elphick and Klima 2002). Godwits use coastal areas in some parts of North America, particularly along Hudson and James bays and at numerous locales in Alaska, but also during their southbound migration when small numbers of birds stage along the Gulf of St. Lawrence, the Bay of Fundy, and sites farther south in Massachusetts and the mid-Atlantic states (Hagar 1966; Hicklin 1987; Maisonneuve et al. 1990; Veit and Peterson 1993; Gill and Tibbitts 1999; Hess et al. 2000).

The habitat frequented during the boreal winter is similar to that used during migration through South America. For example, Bahía San Sebastián, the site of the godwits' largest non-breeding concentration, is a bay 80 km wide and 45 km from the coastline to the mouth of the bay. At low tide up to 15 km of mud are exposed, while at high tide 3 km often remain exposed. The majority of the godwits use the northern half of the bay, which is protected by a long shingle spit that traps and collects sediments. Whereas the southern half of the bay has mostly hard, wave-beaten mud and sand, the northern half is dominated by extremely soft, deep mud and many small channels that meander across the mudflats. Other wintering sites on Tierra del Fuego, on the mainland of Argentina, and in Chile are very similar, differing only slightly in the firmness of their mud and the size of their intertidal areas (Morrison and Ross 1989; Senner 2006b; Senner pers. obs.).

CONSERVATION SITES

This section of the conservation plan identifies sites of conservation importance for Hudsonian Godwits following the protocol recommended by the Western Hemisphere Shorebird Reserve Network (see, for example, Fernández et al. 2006). According to this protocol, all sites during migration and the winter period that support >1% or more of the overall population are considered "areas of importance" for godwits. Additionally, because of the lack of season-long census data from many staging locations and lack of quality estimates of turnover rates, I will also follow Fernández et al. (2006) and include any site that, during the migration period, reports a one-day high count of 0.5% of the population. Given that the current population estimate for godwits is 70,000 (Morrison et al. in press), sites hosting a minimum 500 birds over the course of the migration or winter season or more than 250 birds during migration have been included in this plan.

Despite the straightforwardness of this approach, many of the important migration sites were to hard to quantify or define: the location of flooded agricultural fields change from year to year, water levels of lakes and reservoirs change depending on weather patterns, and marshes undergo plant succession or are managed for different species. Accordingly, in some of the states that the godwits pass through during spring migration through North America, I have only identified important counties. This gives a broader perspective on the areas that are important to godwits.

Important breeding areas also are difficult to quantify. Because of the lack of any recent work detailing breeding densities or broad-scale census data, knowledge of godwit breeding areas is limited. There are, however, a few sites of undeniable importance, which will be included in this plan.

BREEDING SITES

Historically, three areas have been identified as the most important breeding areas for Hudsonian Godwits: the Hudson Bay region surrounding Churchill and La Pérouse Bay, Manitoba; the Mackenzie Delta region of the Northwest Territories and Nunavut, stretching from the Mackenzie River in the west to the Anderson River in the east; and the upper Cook Inlet region of south-central Alaska, especially the area near the mouth of the Susitna River and the western Kenai Peninsula (Williamson and Smith 1964; Hagar 1966; Gill and Tibbitts 1999). Other, possibly important areas occur in western Alaska, especially in the Yukon Delta National Wildlife Refuge and Andreafsky Wilderness Area (McCaffery and Harwood 2000).

MIGRATION SITES

Northbound Migration

Through the southern part of South America, godwits appear to make moderately long flights, on the order of a few hundred to a thousand miles (González pers. comm.). From central South America, they then appear to make a long nonstop flight to northern Central America and southern North America. Skagen et al. (1999) suggest that once in North America, godwits exhibit a "quick passage" along a "narrow band:" in essence, that godwits move through the continental United States during a short period of time, roughly between late April and late May, and are restricted to the area between western Iowa and central Kansas. Skagen et al. also posit that this is possibly indicative of a situation in which godwits are most likely only making one stop, regardless of the latitude, while passing through the continental United States and, then, only stopping for a necessary refueling in between long flights. If this hypothesis is true, it would explain why godwits often appear to invade an area in certain years and are completely absent in other years: large flocks may be flying as far as they can without stopping, and when they do need to stop, they may stop en mass wherever they find suitable habitat. For instance, during the spring of 2004, there were 347 godwits reported from Minnesota, while in the spring of 2005 there were only 17 (NAB 60:3). This strategy differs significantly from the strategies of a species like Whimbrel, *Numenius phaeopus*, which migrate in small groups and appear at many locations spread across a great distance, or of a species like Western Sandpiper, *Calidris mauri*, which, especially along the west coast of the United States, stops at a series of sites that are important on an annual basis (Skagen et al. 1999; Fernández et al. 2006).

This migration strategy may explain the distribution and nature of important migration sites during the northbound migration. Overall, 18 of the 24 sites identified during the northbound migration are found in North America, and of those, seven are counties or other areas that spread across ecological boundaries (anthropogenic or otherwise), such as Calhoun County in Texas or the Eastern Rainwater Basin in Nebraska (Table 1; http://www.whsrn.org/Hudsonian-Godwit-Map.kmz. *GoogleEarth required. Download [free] at* http://earth.google.com/). Another result of this type of migration strategy is that conservation must be approached on a regional as opposed to a site-by-site basis. During any given year a host of sites may be of vital importance to godwits, while the next year a completely different suite of sites may be important. Such a strategy may also require that each group of sites be healthy and viable every year so that passing godwits have an opportunity to stop and successfully refuel if a stopover is necessary.

This “narrow band, quick passage” strategy may not extend to the godwits’ movement through South America. It is interesting to note, however, that as commented by Blanco et al. (1995) and Harrington et al. (1993), the godwits use different sites during their southbound and northbound migration through southern South America. Of the 10 sites identified in Argentina and Brazil, three are only of importance during the northbound migration—Río Gallegos, San Antonio Oeste, and Albufera Mar Chiquita—and three are only of importance during the southbound migration—Bahía Bustamante, Golfo San Jorge, and Estuario de Río Deseado.

Southbound Migration

Unlike northbound migration, southbound migration in North America is characterized by the use of a number of very important staging areas that annually host large numbers of godwits just south of breeding areas. Although numbers may differ between years at these sites, they are used by significant numbers of godwits each year. These sites include Aropuk Lake in the Yukon Delta in Alaska; the mouth of the Albany River and the western coast of James Bay in Ontario; and Porter Lake, Luck Lake, and Quill Lakes in Saskatchewan (Morrison 1984; Elphick and Klima 2002; McCaffery and Conklin 2004). There have been no important sites identified south of the Canadian border and north of southern Brazil. Overall, 23 sites have been recognized as important during the southbound migration. Of these, five also are important for the northbound migration: Bahía Blanca, Bahía Samborombón, Lagoa do Peixe, the Quill Lakes, and Luck Lake (Table 1; http://www.whsrn.org/Hudsonian-Godwit-Map.kmz. *GoogleEarth required. Download [free] at* http://earth.google.com/).

It is also possible that godwits employ a similar strategy while they are passing through central South America—i.e. Brazil, Paraguay, and Bolivia—as they do while passing through North America on their northbound migration (i.e. stopping only once and only when necessary), but there is such sparse information about this area that the majority of sites being used, if any, have not yet been discovered. If this were the tactic used by godwits moving through this region, however, it would explain the use of the Bahía de Asunción in Paraguay, where godwits only occur on a sporadic basis (Hayes et al. 1990; Hayes and Fox 1991; Hayes 1995; Clay unpubl. data).

NON-BREEDING SITES

We recognize sixteen sites of importance during the boreal winter (Table 1; http://www.whsrn.org/Hudsonian-Godwit-Map.kmz. *GoogleEarth required. Download [free] at http://earth.google.com/*). The majority of these occur on Isla Chiloé and the adjacent mainland of central Chile; the rest are on the Atlantic coast, with two on Tierra del Fuego, three on the mainland coast of Argentina, and one in southern Brazil. Despite the fact that the locations on Isla Chiloé are each relatively small and the godwits probably use multiple sites on the island throughout the course of a year, they all will be treated as separate "sites" for the purposes of this conservation plan. Morrison and Ross (1989) and subsequent surveys by Espinosa et al. (2006) and others (Senner unpubl. data) all suggest that each site annually hosts substantial numbers of godwits.

As with Isla Chiloé, movements probably also occur between Bahía Lomas, Bahía San Sebastián, and Río Grande (Figure 3), as well as between those sites and sites on the adjacent continental mainland (Senner pers. obs). There have been no studies of site fidelity at South American sites, although a small group of godwits that was banded at Río Grande on Tierra del Fuego in 2001 continues to return to that location year after year (Benagas pers. comm.; Senner pers. obs.).

Also included are two sites that have yet to yield high counts with numbers of godwits greater than the threshold of 1% of the population. The high counts from these locations, however, are just below that threshold and each presents compelling reasons for its inclusion: Isla Lemuy is a small island off the east coast of Isla Chiloé and is rarely, if ever, comprehensively surveyed. During the boreal winter of 2005, a number of areas on the island that were reachable by road were surveyed and 465 godwits were recorded (Senner unpubl. data). Much of the rest of the island is inaccessible by road, but contains areas with appropriate godwit habitat, which almost certainly support the additional numbers of godwits necessary to reach the 500 individuals threshold. Further work is needed to ascertain its true significance.

The study that found 473 godwits at Lagoa do Peixe relied on International Shorebird Survey data, and it is unclear how complete this coverage was (Harrington et al. 1993). And, given the nature of Morrison and Ross' (1989) survey methods, many of the godwits at Lagoa do Peixe were likely not encountered during their aerial surveys because godwits use areas slightly inland from the immediate coast line (Senner pers. obs.).

CONSERVATION THREATS

Hudsonian Godwits are listed as a species of high conservation concern (Category 4) in the U.S. Shorebird Conservation Plan (2004). This classification results from a number of different factors. First and foremost is the godwits' small population size, estimated at 70,000 individuals (Morrison et al. in press). Compounding the small population size is the fact that godwits aggregate in large numbers during the non-breeding season at a small number of locations. In addition, godwits appear to employ a migration strategy that involves long flights and stops only when necessary, thus apparently requiring readily available habitat at almost any stage during their migration (Skagen et al. 1999). Finally, godwits use a number of habitats that are currently facing significant changes or degradation: estuaries, agricultural and ephemeral wetlands, and the border between tundra and taiga ecosystems. Following the protocol of Fernández et al. (2006), I classified conservation threats into five categories: habitat loss and degradation; environmental contamination; human disturbance; climate change; and diseases.

HABITAT LOSS AND DEGRADATION

Habitat loss and degradation is the largest threat to shorebirds today (Bildstein et al. 1991) and Hudsonian Godwits are not immune to this threat despite the remoteness of the locations at which they spend much of the year. Loss and degradation of godwit habitats is spread across sites used at all times of the year. Current plans call for the increased commercial development at two of their main breeding areas; changes in farming practices and the degradation of agricultural areas after decades of intensive farming threaten some migration stopover sites; and increased pressure from aquaculture practices is endangering one wintering area, while the possibility of a large, new ferry terminal promising increased shipping traffic threatens another.

Plans are underway to lease much of the land surrounding the Mackenzie River Delta for oil and natural gas development as well as to build a pipeline connecting the proposed production facilities to infrastructure further to the south in Canada. In particular, the construction of two production facilities in the Kendall Island Bird Sanctuary, which is a godwit breeding area, and the pipeline, which will be routed through more godwit breeding areas, will be potentially detrimental to godwit use of the delta (V. Johnston pers. comm.; Senner pers. obs.).

On the north side of Knik Arm in the upper Cook Inlet, a proposed bridge may connect what is now an extensive, mostly roadless area with the city of Anchorage. A new coal mine and prison have also been proposed and there may be expansion of existing oil and gas activities (L. Tibbitts pers. comm.; S. Senner pers. comm.). This development may not only affect one of the main godwit breeding areas in Alaska, but also migratory godwits using the Susitna Flats and other staging areas on the north and west sides of Cook Inlet (Gills and Tibbitts 1999).

While potentially not as damaging as the threats facing the western breeding grounds, breeding areas along Hudson Bay are reflecting the effects of the overpopulation of the area by Lesser Snow Geese, *Chen caerulescens caerulescens*, and Ross' Geese, *Chen rossii*. As the populations of these two geese species have dramatically increased over the past two decades, they have caused the desertification of the habitats surrounding their breeding areas through the exposure of sediments and increased evaporation of moisture leading to hypersalinization (Handa et al. 2002). Declines in breeding density of Hudsonian Godwits have been documented at La Pérouse Bay north of Churchill, Manitoba (Kelley 2001) and, at Churchill, shorebird and godwit activity declined in degraded areas by 67% from that found in non-degraded areas (Sammler 2001). As desertification spreads across the region, a critical point may be reached at which time more large-scale declines in godwit breeding densities become noticeable.

Along their migration route, urban sprawl threatens a few areas important for godwits. This is a threat particularly in Texas, where the greater Houston area is encroaching upon many of the marshes and agricultural areas that the godwits use as stopover sites. Changing agricultural practices are possibly more of a threat in the area. Rice farming techniques are changing, and some farms now have less standing water during the spring than in the past (Weeks pers comm.).

In Nebraska, as well as in other areas where the predominant habitat is agricultural land or where wetlands are surrounded by agriculture, sedimentation is a major issue (Jorgensen 2004). According to Gleason et al. (2003), only 0.5 centimeters of sedimentation caused a 90% reduction in seedling emergence of hydrophytic plants and an essentially complete loss of total invertebrate emergence. Luo et al. (1997) estimate that all cropland playas on the high plains in Texas could be filled in within 95 years. It is unclear, on the whole, how much sedimentation directly affects godwit use of agricultural and interior wetland areas, but Jorgensen and others (Skagen 2006; Silcock pers comm.) estimate that the effect is significant.

Farther south, godwits face additional problems at both Bahía Blanca, Argentina and on Tierra del Fuego. Bahía Blanca, in addition to hosting significant numbers of migrant shorebirds, is one of the most contaminated estuaries in all of Argentina (Petracci pers. comm.). Military bases and chemical and petroleum refineries surround the bay and use it, to varying extents, as a repository for their waste products (Cabezali and Cubitto 1990; Baldini et al. 2001; Paoloni et al. 2003; Paoloni et al. 2005). There is little information on how this is affecting, or may affect, the bird life of the area, but it is presumed that the effects are not positive.

Both Bahias San Sebastián and Lomas on Tierra del Fuego and nearby Río Gallegos, and to some extent the entire length of Argentine Patagonia, are major areas for petroleum extraction and all are near the Strait of Magellan, which is a major shipping route for petroleum and other cargo. In 2004, oil was spilled in the Strait to the west of the main Chilean ferry terminal. Shorebirds using the two Fuegan bays were apparently unaffected as the spill happened during the austral winter, but the risk of future contamination is certainly present. The potential danger also will increase if a planned ferry and shipping dock is built on the north side of Bahía San Sebastián, which will increase the traffic in the bay and move routes closer to the intertidal areas used by godwits and other shorebirds.

The godwits' other important wintering area, Isla Chiloé, is also imperiled by the growth of intensive aquacultural practices (Espinosa et al. 2006). Most of the problems in this region stem more from direct human disturbance by algae collectors, but some of the estuaries used by godwits have extensive mussel farms (Senner

Seaweed collectors at Putemun, Chile.
Photo by Kate Coddington Senner, 2005.

pers. obs). As with the bays on Tierra del Fuego, increased traffic in and around the areas used by godwits increases the potential for oil spills or other contaminant exposure.

ENVIRONMENTAL CONTAMINATION

As noted in the previous section, many of the locations important to godwits are located near sites for oil and gas development that either are already in use or are proposed for use in the near future. This proximity increases the likelihood of an oil spill directly affecting godwits, which could have both immediate and long lasting effects on the site and, most likely, catastrophic effects on the godwit population. Consequently, the Alaska Shorebird Working Group (2000) found oil spills to be the largest single threat to shorebirds in the state.

Other areas of concern are the stopover sites in central North America. These stopover sites are either agricultural fields themselves or are in close proximity to agricultural areas. All are susceptible to toxic run-off from these areas. Pimentel et al. (1992) estimate that 670 million birds annually come in direct contact with pesticides on U.S. farms, and, of those, 67 million may die. In some cases, reservoirs and wetlands in areas heavily used for agriculture act as deposits for pesticides that have run off from eroding or flooded agricultural fields (Skagen 2006).

Contamination may not only be a problem in agricultural or industrial areas. A recent study found that 96% of all water bodies tested in the United States had at least trace levels of contaminants (Gilliom and Hamilton 2006). Although no Hudsonian Godwit has ever been found dead because of direction contamination, given the abundance of contaminants in the environment, godwits may encounter them during almost any part of their annual cycle.

South American sites are not immune to the possible effects of contamination either. The main threat in Bahía Samborombón is the agrochemicals used in the Río Salado Basin that are discharged into the bay and accumulate in the intertidal sediments (Blanco pers. comm.).

HUMAN DISTURBANCE

For much of the year godwits are beyond the reach of most types of human disturbance, but there are times when godwits are particularly susceptible to the activities of humans. Perhaps most important among these periods is the time that the godwits spend on Isla Chiloé and the Chilean mainland. Aquaculture activities have greatly increased on the island over the past five years. Facilities for oysters, mussels, and salmon have been developed in almost every bay and inlet on the island, increasing the boat traffic and human presence greatly on the water (Espinosa pers. comm.).

Perhaps more important is the burgeoning practice of collecting the algae that is left behind in intertidal areas after high tide for sale to markets in Japan. Collection of this algae requires a significant number of people to follow the falling tide, which often disrupts the feeding practices of the godwits and other shorebirds. At one of the most important areas for godwits on the island, Putemun, Senner (pers. obs.) observed a group of about 1000 godwits feeding on a falling tide. When the tide had fallen to the point at which the algae began to accumulate, a group of 50 or more people moved into intertidal area to collect the algae and several trucks were driven onto the fringes of the intertidal area. Apparently as a result, the godwits grouped together and flew off to another site, presumably to continue their feeding. Similar observations have been made at other sites on the island. Andres (pers. comm.) recorded more than 200 people on the tidal flats at Caulín and noted that godwit numbers at the site were significantly reduced from those recorded there two years before.

Although sites across Isla Chiloé and the adjacent Chilean mainland differ in the intensity with which they are farmed, five of the most important sites for godwits are regularly used by algae collectors (Senner pers. obs). Adding to these problems, small shanty towns housing the farmers and their families have become established along the edges of these bays. These towns are also accompanied by free-roaming dogs and dust-causing vehicles.

Similar problems with disturbance exist elsewhere in South America. Stray dogs are widespread across the continent, and although they may not be a direct threat to godwits and other shorebirds, they are an almost constant nuisance, frequently flushing feeding and roosting flocks and incurring energetic costs for the birds (Gill et al. 1996; Senner pers. obs.).

Godwits also face increasing disturbances from beach goers and other tourists at two important migration stopover sites in Argentina: San Antonio Oeste and Punta Rasa. Researchers at San Antonio Oeste have yet to find changes in shorebird roosting or feeding habits but note that the number of tourists visiting the beaches adjacent to the intertidal areas used by the godwits and other shorebirds has increased by 257% over the past eight years (Sawicki and Sawicki 2006).

Hunting also may still be an issue. Regulations and enforcement in South America are often lax, and although regulations prohibit the subsistence harvest of Hudsonian Godwits by rural and indigenous people in the Arctic (USFWS 2006), godwits may accidentally be taken because of their similarity to Bar-tailed Godwits, *Limosa lapponica*, which is still legally hunted.

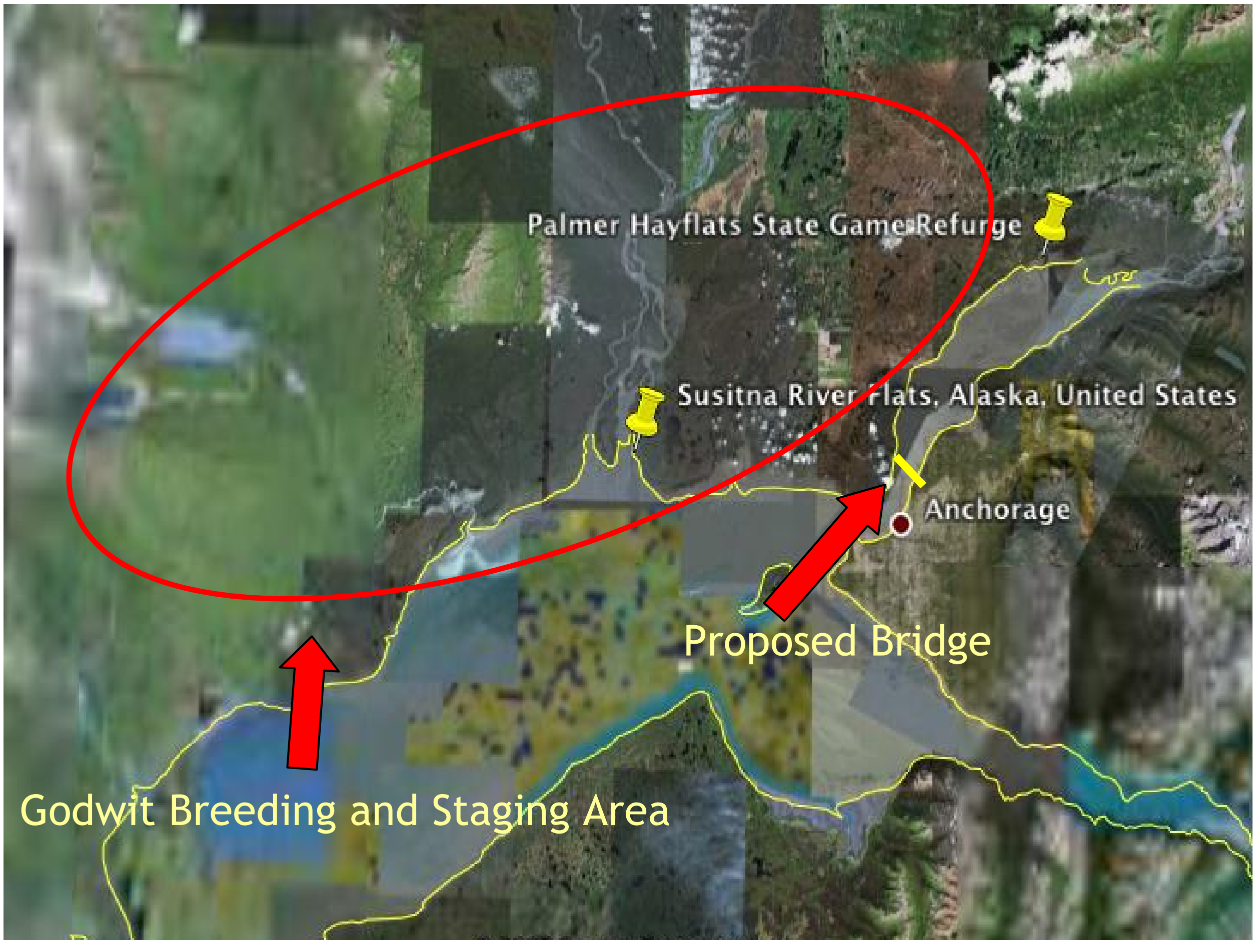

Figure 3. The proposed bridge across the Knik Arm of Cook Inlet would connect Anchorage with an area that is currently largely roadless and close to major godwit breeding and staging areas.

CLIMATE CHANGE

Effects of climate change with regard to godwits are not well understood. In sub-arctic and Arctic breeding areas, global warming has already changed the habitat by increasing the presence of trees (Lescop-Sinclair and Payette 1995; Gamache and Payette 2005). The spread of trees could have unexpected effects on godwits and the availability of appropriate breeding habitat. Given the godwits' use of the tundra-taiga border for breeding, it is possible that the spread of trees into the Arctic could mean an increase in the amount of habitat available for breeding. Conversely, it could also push the available habitat farther to the north, which in areas like the Mackenzie River Delta, where there is no additional land available to the north, is not possible.

Global warming could also have unexpected consequences for godwits during other times of the year as well. It is anticipated that warming temperatures in the northern Great Plains may cause the drying of important wetland complexes (Johnson et al. 2005). Godwits are presumably reliant on favorable winds and weather patterns to accomplish their long oceanic flights and warming ocean temperatures could change wind and weather patterns, thus disrupting those flights (Gill et al. 2005). An increase in the number and severity of storms, both during migration and while at staging sites, could have negative consequences for godwits (Piersma and Lindstöm 2004). Slight disruptions in migration timing and difficulty caused by unfavorable conditions also may influence the health of godwits reaching their breeding grounds and impair their ability to attract mates and successfully raise young (Gunnarsson et al. 2006). Finally, the amount of coastal habitat available to godwits may shrink as ocean levels rise, affecting the amount of available habitat for godwits both during winter and migration (Galbraith et al. 2002; Austin and Rehfisch 2003).

DISEASE

Diseases pose a near constant, if often low level, threat to bird populations. As a generalization, little is known about population level impacts of diseases to shorebirds, including godwits. Avian botulism, caused by the ingestion of the bacteria *Clostridium botulinum* either directly or through invertebrates, has periodic outbreaks each year in the United States and Canada (USGS National Wildlife Health Center 2005) and is known to cause death in some shorebirds, but apparently not to the degree that it affects other bird groups, such as waterfowl (Adams et al. 2003). The West Nile Virus also may be a threat, as it has now spread through most of the United States and southern Canada. Possibly an even greater threat is the spread of the H5N1 strain of Avian Influenza. It has yet to affect populations of any North American species, but it presents a large health concern for wild and domestic birds and for humans.

CONSERVATION STRATEGIES AND ACTIONS

GENERAL OVERVIEW

The first step to achieving these actions must be to organize a group of scientists and conservationists whose goal is researching, monitoring, and conserving Hudsonian Godwits. A list of current or potential collaborators on Hudsonian Godwit research and conservation programs (Table 5) is included in the plan to facilitate the creation of this group. Beyond creating a group that can begin to implement some of the suggested actions in this plan, the single most important step that can be undertaken is to learn more about all facets of the godwits' life and annual cycle. Without more information about godwits' movements, breeding habitats, and migration routes, it is difficult to begin to develop a comprehensive conservation strategy. Even without better information, however, it is important to start by identifying goals and actions that can be implemented in the immediate future.

Three primary types of actions need to be taken: protection of habitat during all parts of the annual cycle, implementation of management practices beneficial for godwits, and education of target audiences about godwits and their conservation.

CONSERVATION OF IMPORTANT HABITATS

To some degree, many of the sites important to godwits are already protected or otherwise safe from habitat degradation. Included amongst these are: the Yukon Delta in western Alaska; the Quill Lakes and Luck Lake in Saskatchewan; the coast of Hudson and James Bay; Cheyenne Bottoms in Kansas; Punta Rasa and Bahía Samborombón in northern Argentina; and Bahía Bustamante, Río Deseado, and Río Gallegos in Patagonia. However, there are a number of sites of major significance to godwits that need better protection. These areas or sites include the upper Cook Inlet region of Alaska (where although some sections, such as Susitna and Palmer Hay Flats, are already protected); the Mackenzie and Anderson river deltas in the Northwest Territories and Nunavut; stopover sites in the central United States; Bahía Blanca in northern Patagonia of Argentina; Bahías San Sebastián and Lomas on Tierra del Fuego; and Isla Chiloé and the adjacent Chilean mainland.

In Alaska and Canada, the threats come from proposed and continued oil and gas development, including the activity and infrastructure associated with exploration, development, and production phases. The window of time for protection is short. Along the Mackenzie River, an environmental impact statement is being developed and the Canadian government and the oil and gas companies involved project the start of construction on the production facilities and pipeline to be in 2009, with oil and gas flowing in 2011 (Johnston pers. comm.). A number of groups are already working to try to stop the project, especially some local indigenous groups, such as the Dehcho Natives, as well as some environmental organizations, like the Sierra Club of Canada and the Canadian Boreal Initiative (Reiterman 2006).   The Dehcho Natives still hold claims to 40% of the land that the pipeline is planned to pass over. Until those claims have been resolved the pipeline project cannot go through. This will likely only be a hurdle in process, however, and cannot be viewed as a long-term solution.

A similar coalition exists in opposition to the proposed bridge between Anchorage and the north side of the Knik Arm of Cook Inlet, but the future of the bridge is uncertain. Although the Alaska State Legislature committed some funds to the bridge in 2006, the Knik Arm Bridge and Toll Authority has yet to obtain all the necessary financing. In addition, the necessary environmental studies are not complete and there remain significant questions about siting, some of which are major issues (S. Senner pers. comm.)

In these areas (Mackenzie River Delta and the upper Cook Inlet), the purchase of habitats is not an option, especially at any significant scale. As has been done for the Kendall Island Bird Sanctuary in the outer Mackenzie River Delta, local and national groups need to identify which of the specific affected areas are most important to godwits throughout both regions, as well as significant breeding populations of other species (e.g., Tule White-fronted Geese, *Anser albifrons gambelli*, in the upper Cook Inlet), and to set as a goal the minimization of development in these areas. Another very necessary objective is to gain recognition for these sites as internationally important for godwits and other shorebirds. In the upper Cook Inlet region, several key sites for godwits are recognized as Important Birds Areas of continental significance, including Redoubt Bay, Susitna Flats, and Trading Bay, but none is yet recognized by the Western Hemisphere Shorebird Reserve Network. The Mackenzie River similarly has three recognized Important Bird Areas—Lower Mackenzie River Islands, Mackenzie River Delta, and Middle Mackenzie River Islands—but no recognition by WHSRN. It is important to note, however, that recognition as an IBA or WHSRN site will help elevate public awareness about these areas, but by themselves, will not achieve protection.

Bahía Blanca, in contrast with both the upper Cook Inlet and Mackenzie River Delta, has already been largely developed. The north side of the bay is ringed by two cities—Bahía Blanca and Punta Alta—as well as refineries for oil, gas, and other petrochemicals, and a large military base near Punta Alta. Some steps already are being taken to conserve some of the important areas around the bay: a small inlet off of the main bay between Punta Alta and Bahía Blanca, near the village of Villa del Mar, has been posted with small, hand-painted signs depicting the waterbirds that are often present and the area generally seems to be recognized by local residents as a sanctuary. Local teachers also have become part of the Sister Shorebird School Network and gather occasionally for field trips and educational events focused on shorebirds. A local biologist has also recently published a bird guide for the region (Petracci 2005).

Much work, however, remains. A first step is to push for designation of the bay as site of regional, if not global, importance to shorebirds. Not only do significant numbers of godwits move through the area, but so do White-rumped Sandpipers, *Calidris fusicollis*, Baird's Sandpipers, *Calidris bairdi*, Stilt Sandpipers, *Calidris himanatopus*, and Red Knots, *Calidris canutus* (Senner pers. obs.; Petracci pers. comm.). The next two steps require far greater efforts. First, protection for the islands and intertidal areas of the central bay must be sought. Currently these islands are largely undeveloped, and it is crucial that they remain so, as they provide the most extensive shorebird habitat within the bay and possibly also habitat for the vulnerable Pampas Meadowlark, *Sturnella defilippii* (Birdlife International 2006). The second step is to work for tighter restrictions on the chemical discharges from the military base and refineries into the bay. Studies have found that chronic small oil spills have left significant amounts of oil in the bay, in addition to high levels of fluoride, arsenic, and fecal contamination in the area's water table (Cabezali and Cubitto 1990; Baldini et al. 2001; Paoloni et al. 2003; Paoloni et al. 2005). This second step will be difficult as the military and petroleum industries wield tremendous influence in the region (Petracci pers. comm.).

Both Bahía Lomas and Bahía San Sebastián face the possible threat of major oil spills. This danger is compounded in San Sebastián by the proposal of a ferry terminal and small port on the northern side of the bay. Confronting this issue, unfortunately, involves more than simply an opposition movement against the construction of the terminal. Instead, it involves the continued contentious relationship between Argentina and Chile. Currently, all traffic to-and-from Tierra del Fuego must pass through Chile and use a Chilean ferry terminal. The impetus for the proposed ferry terminal at San Sebastián is an effort on the part of Argentina to recoup some of the revenue it loses to Chile through this arrangement and create a direct ferry route from continental Argentine cities, such as Río Gallegos, to the Argentine half of Tierra del Fuego. Although local conservation efforts are certainly important, this issue may ultimately be decided by political efforts at the national level in both countries.

At Bahía Lomas, all efforts must begin with convincing the regional and local governments of the international conservation importance of the bay. Previous efforts to designate the bay as either a Ramsar or WHSRN site have stumbled because of organizational concerns within the government bureaucracy at various levels (Matus pers. comm.). Resistance on the part of the government may recede with continued use of the area by biologists and with the realization at some level that oil extraction, shipping, and birds can coexist. The creation of some kind of ecotourism infrastructure could also help conservation efforts. Bahía Lomas currently lies far off the beaten path, with no real access by road or boat. While this remoteness is certainly helpful for the continued protection of the area, or at least benign neglect, greater attention and an influx of money may well be necessary for more permanent preservation.

While central Chile's burgeoning aquaculture industry has so far seemingly done no harm to the godwits and other wintering shorebirds in the region, steps must be taken to ensure that this continues. Fortunately, unlike in some other areas, progress is already being made. Work is under way to designate at least five of the bays on Isla Chiloé as part of a WHSRN site of hemispheric importance. It is also hoped that this effort, in addition to efforts made by La Estación Biológica Senda Darwin to educate the public about waterbirds on Isla Chiloé, can create an atmosphere that is beneficial for conservation actions on the island. Coupled with the election of a progressive government in Chile, the time may be right to push for greater awareness of environmental issues.

Isla Chiloé will likely be at the forefront of the environmental debate under the new government, however, as a bridge has been proposed to connect the island with the mainland across the Gulfo de Ancud; rampant logging has reduced the native forest to the few unreachable corners of the island; and aquaculture has become an increasingly profitable business in the region. Given this climate, a campaign to enforce and or make new laws regulating the spread of shanty-towns into sensitive habitats and their residents' harvesting of algae and other natural products from the estuaries should be developed.

The region where the conservation of important habitats is possibly the most needed, yet the most challenging, is in the central United States. If godwits stop just once in this region, but only when they are unable to continue any farther north, a network of habitats for these "emergency" stops must be available at all latitudes (Skagen et al. 1999, Mehlman et al. 2005). This is made more complicated by the nature of many of the areas that the godwits use—flooded agricultural fields. Given the ephemeral nature of water in these areas, changing agricultural practices, and the growing likelihood that small farms will be sold and subdivided for homes, a major effort must be made to restore naturally dynamic wetland habitats in the region. This is particularly important in south Texas, Oklahoma, Nebraska, and South Dakota, where the majority of the reports of godwits come from just such habitats. Whether these wetlands can be created through programs run by federal and state governments or through the efforts of private individuals and corporations, for godwits to have long-term success in this region there must be a suite of available sites where habitat quality does not change from year to year.

IMPLEMENTATION OF BENEFICIAL MANAGEMENT PRACTICES

In many of the areas that godwits frequent, the proper habitat is already present, but because of management practices the habitat is of sub-optimal quality or godwits and other shorebird are in some way unable to get full value out of their use of the habitat. This can cover a range of issues, from the management of water levels in a marsh ecosystem, to the enforcement of already existing laws, and regulation of cattle ranching and other activities in sensitive areas. These issues are particularly pertinent in three areas: the Hudson Bay lowlands, the central United States, and at Parque Nacional Lagoa do Peixe in southern Brazil.

To improve and maintain quality habitat at the Hudson Bay lowlands, efforts are underway to control population of "light" geese—Lesser Snow Geese and Ross' Geese, *Chen rossii*—throughout their annual cycle. Included amongst these activities are the initiation of spring hunts, increased harvest during traditional fall and winter hunts, and the implementation of management practices to limit the amount of standing crops near refuges along the geese's migration route and on their wintering grounds (Kelley 2001). Despite these efforts, degraded habitats in the Hudson Bay lowlands may be damaged irreversibly (Handa et al. 2002) and, as a result, further efforts implanted directly on the breeding grounds may be necessary to stop the desertification of any further habitat in the region (Kelley 2001).

As discussed in the previous section, there is a long-term need for protection of permanent wetland sites throughout the central United States. In the meantime, however, much can be done to use the existing habitats.

For example, one of the largest problems facing godwits and other shorebirds in both agricultural and natural wetland habitats in the central United States is sedimentation. Restoration and conservation of areas suffering from problems with sedimentation is achievable. Luo et al. (1997) suggest a number of practices that can change the rate of sedimentation and possibly also lead to a reversal of the process. The first step is to surround wetland areas with stretches of dense vegetation to help collect soil run-off from surrounding agricultural fields. For agricultural fields, only irrigation practices that minimize soil erosion and retain water for longer periods of time should be used. Doing so not only benefits the agricultural fields themselves, but also the surrounding wetlands. Unfortunately the removal of sediments is an expensive and risky process. If not done correctly, seed banks and wetland hydrology can be affected detrimentally.

On a positive note, Jorgensen (pers. comm.) notes that efforts to rid some playa wetlands in Nebraska of sedimentation problems have been successful. As with successful restoration efforts at Devil's Lake Wetland Management District in North Dakota (Andres pers. comm.), it also seems likely that with a focus on the restoration of vegetation surrounding wetlands, especially through such government programs as the Conservation Reserve Program (CRP) and the work of private conservation organizations, and with better management of their irrigation practices by farmers, much can be done to reverse this problem.

Similar agricultural problems plague parts of South America. Bahía Samborombón is largely surrounded by agricultural lands, known generally as the pampas. Parts of the pampas are regularly flooded, facilitating the movement of agrochemicals from these areas into the bay and the intertidal sediments there (Blanco pers. comm.). Regulations are in place limiting the use of some agrochemicals, but these regulations need to be better implemented. Efforts like those being undertaken in Nebraska and North Dakota also need to be implemented to slow the leaching of chemicals and sediments into the regional watershed and coastal estuaries.

Throughout much of Central and South America, national parks and reserves exist, but often in name only. This issue affects godwits in only a few areas, most notably at Parque

Nacional Lagoa do Peixe in southern Brazil. There, instead of poaching or deforestation, the problem is the continued large-scale presence of cattle in the park. It is highly unlikely that the park will ever or should ever be permanently free of cattle, but efforts should be made to limit the access of the cattle to some of the most important wetland areas (Lanctot et al. 2002). While godwits are often not in direct competition with cattle for food, disruption of the wetland ecosystem and its hydrology by cattle could have potential detrimental consequences for the godwits (Harris et al. 2005).

Compounding this issue is the relationship of IBAMA's (the Brazilian national park service) with local residents. During a recent visit to the park, a shorebird researcher was warned of recent confrontations between park workers and local farmers over the farmers' removal of plants from the park (Senner pers. obs.). In addition, previous altercations between the two groups have arisen over fishing rights in the park. Given this situation, it is probably necessary for outside groups to undertake most of the effort on this issue. It is not clear, however, which outside group would be most appropriate and effective at achieving this objective. A long-term solution, though, must involve a sustainable relationship between local residents and IBAMA.

EDUCATION

While education's results can be subtle, education is undeniably necessary to conserve godwits and other shorebirds. Scientists have much to learn about godwits, but what is already known about the species presents such an interesting and compelling narrative that efforts must be made to capitalize on the godwit's story.

Political stability has only recently come to some parts of the godwits' wintering range and, given this change, the timing may be right for new educational programs to be launched in those countries. The designation of sites for WHSRN, Ramsar, or Important Bird Areas recognition and the spread of programs like the Sister Shorebird School network (http://66.241.214.202) is certainly an important start, but additional outreach attempts must be undertaken.

One possibility, especially in areas that have already begun to capitalize economically on their natural surroundings, such as Chile or Argentine Patagonia, is the initiation of a network of local conservation groups similar to local Audubon chapters in the United States (http://www.audubon.org). While this may seem a daunting task, some organizations already exist, such as Panama Audubon (http://www.panamaaudubon.org), Belize Audubon (http://www.belizeaudubon.org), and Aves Argentina (http://www.avesargentinas.org.ar). Additionally, given the success of these organizations, the existence of pockets of environmental activism across the continent, and the growing importance of ecotourism to many local economies, the creation of a broader network of concerned individuals and local groups is not that great a stretch. The effort, however, must not stop with the creation of such groups. Rather they must also be included in all facets of the conservation process, including involvement with working groups, panels, and fundraising efforts, and hosting meetings and conferences.

Along with the creation of local Audubon-like chapters, the extension of Christmas Bird Counts or the expansion of Wetlands International's Neotropical Waterbird Census program throughout South America could be a powerful tool to create awareness and build constituencies interested in birds and bird conservation. Such efforts, as shown by their success in North America, can also be vital to our understanding of species' distributions and populations as they allow for the inclusion of local observations, which often come from areas seldom or never reached by scientists. In the Southern Hemisphere, Senner (pers. obs.) found a surprising degree of knowledge and interest about birds and the natural world among many different people. For the growth and success of conservation efforts in these countries, it is essential that this knowledge be tapped, and citizen science programs—like Christmas Bird Counts—can help do it.

In the United States and Canada, the problem is not with the creation of new educational programs, but with existing programs reaching new people and motivating them to take action. Additionally, godwits spend little time in readily accessible parts of the United States or Canada. How then can we bring information about godwits and their conservation needs to people in North America? Two different tactics hold promise: education through entrepreneurship and education targeted at specific groups.

The past decade has seen a dramatic increase in the number of bird-watching festivals and celebrations held around North America. These events represent an important new outlet for education as they invite a diverse cross-section of a community to participate in conservation-oriented activities through the promise of an influx of business into an area. These festivals have been remarkable in their ability to bring together such normally disparate groups as local chambers of commerce, Audubon chapters, hotels, restaurants, and birders. Such festivals as the

Río Grande Birding Weekend in McAllen, Texas or the Kachemak Bay Shorebird Festival in Homer, Alaska highlight what the business of birding can mean to small, out-of-the-way communities.

Creating or improving upon existing festivals along the godwits' migration corridor poses a possible way to educate the general public about godwits in a manner which both attracts a crowd generally uninitiated in the world of birds and which also makes conservation activities more appealing to local communities. Sites where this approach may work especially well are sites where the godwits spend considerable time or are predictable in their use of the area, such as in Isla Chiloé, southcentral Saskatchewan, southern Texas, or Churchill, Manitoba. There already are festivals in some of these locations. Where that is the case, it might be fruitful to encourage event organizers to make godwits a special focus of the festival.

Even beyond birding festivals, ecotourism is a very powerful conservation tool if used in the right manner (Klein et al. 1995). Because of the business connections that ecotourism creates within an area, it again educates and motivates new people to join in conservation activities. Promoting ecotourism may be especially beneficial to a number of regions, such as Saskatchewan, Tierra del Fuego, and Isla Chiloé.

The second type of educational outreach that should be specifically pursued in North America is the education of targeted audiences. While a series of signs at a nature reserve documenting the godwits' migration targets a general group of people, more focused outreach could positively impact other groups. Among the possible target groups are the farmers whose land is either used by godwits or which surrounds wetland areas used by godwits. Education of farmers about how to reduce sedimentation and use of pesticides, for example, could be enormously beneficial for the conservation of godwits and other shorebirds in the interior of the continent.

Other potential groups to target include the algae gathers in central Chile, ranchers and farmers at Parque Nacional Lagoa do Peixe, and subsistence harvesters across the Arctic.

RESEARCH AND MONITORING NEEDS

Hudsonian Godwits are one of the least-studied species of shorebirds breeding in North America. So much remains unknown about their annual cycle, habitat requirements, and migration routes that, arguably, conservation efforts cannot begin until more information has been gathered about their biology. A number of studies are beginning, but many important questions remain unanswered.

MIGRATION AND CONNECTIVITY BETWEEN BREEDING AND WINTERING AREAS

The first priority is to establish a firm connection between where godwits breed and where they winter. Given their three distinct wintering areas and their distinct breeding areas, it seems likely that godwits migrate annually between the same breeding area and the same wintering area and that these populations remain somewhat separate. This hypothesis is supported, to some extent, by the findings of Haig et al. (1997), who found a large degree of genetic differentiation among the three breeding populations, especially between Alaskan/Mackenzie birds and Hudson Bay birds.

An equally important task is to confirm the migration pathways used by godwits during their north-and-southbound migrations. Many scientists (Hagar 1966; Morrison 1984; Harrington et al. 1993; Elphick and Klima 2002) have hypothesized that godwits all make long, non-stop flights from southern Canada to the Amazon Basin, but this has yet to be proven on a large scale and is only supported by a few observations of birds near to Manaus, Brazil (Harrington unpubl, data) and the general lack of observations of large numbers of godwits from any other location south of Canada and north of southern Brazil. While this pattern seems likely, there is no information on whether birds from western Alaska are gathering with other godwits in central Saskatchewan before heading south or making a long, non-stop oceanic flight over the Pacific to southern Chile. Questions such as this one can easily be answered through work with satellite transmitters or possibly through a carefully planned mark-recapture/resighting project.

Answers to these questions are priorities not only because they are of scientific importance, but also because they are of central importance to conservation efforts.

USE OF STOPOVER SITES

Information about inter-annual variation in the use of staging and stopover sites is very important. What scant information is available suggests that sites are used only on the basis of necessity, particularly in the United States and in South America north of Argentina and southern

Brazil, and may go unused for a number of years between visits by godwits. Is this true along other sections of the migration route as well?

Information is also almost entirely lacking about patterns of use at sites used on a regular basis, such as Lagoa do Peixe, Punta Rasa, the mouth of the Albany River, Aropuk Lake, and the Quill Lakes. Observations and data regarding turn over, age and sex stratification, and habitat use at these sites are necessary in order to make informed decisions about stopover site conservation.

HABITAT REQUIREMENTS AND IDENTIFICATION OF BREEDING AREAS

Another gap in our knowledge about godwits involves the location of their breeding grounds and information about their habitat needs. Elphick and Klima (2002) point out that the number of breeding areas identified does not begin to match the population estimates at wintering areas in South America. This is true not only because relatively few regions in the breeding range have been identified as supporting godwits, but also because the density of godwits breeding in those regions is generally very low (1-2.4 pairs per km^2 in proper habitat on Mackenzie River Delta (Gratto-Trevor 1994; 1996)). Given the rate at which the Arctic and sub-arctic are being opened up to various types of resource extraction and as the effects of climate change begin to accelerate, it is important to identify any new areas that support godwits.

Along these lines, we also need better information on the specific habitat requirements of godwits on the breeding grounds. A few studies (e.g., Williamson and Smith 1964; Hagar 1966; Gratto-Trevor 1996) have described basic habitat use patterns, but it is unclear exactly which habitat cues godwits are using to choose their nesting areas. With this information we might be able to make better predictions about where other, thus far unnoticed, breeding areas are located and also which habitat types are most important for conservation.

FOOD REQUIREMENTS

Godwits have been noted to forage for a wide variety of prey and plant items, but it remains unknown which of these are most important and at which times of the year they are important (Baker 1977; Alexander et al. 1996; Piersma et al. 1996; Bala et al. 1998; Ieno 2000; Senner 2006b). This information is pivotal in identifying which links in an ecosystem are most necessary to support continued use by godwits and also for the identification of important migration and staging sites.

Status of First-Year Birds

Other godwit species generally do not begin breeding until their second year (Gratto-Trevor 2000), and it is generally assumed that Hudsonian Godwits are the same. This assumption is supported by observations of godwits during the boreal summer at a host of South American sites, including Isla Chiloé and Punta Rasa, Argentina, as well as at a number of sites in Peru; presumably these are first-year birds that did not make the migration northward (Blanco et al. 1995; Espinosa et al. 2006; Senner 2006a). Information documenting this phenomenon is needed, specifically about what percentage of first-year birds do not migrate north of South America and which sites within South America are important to these birds. Such information may prove important for conservation efforts, since a single catastrophic event at a site supporting large numbers of young, non-breeding godwits could decimate future godwit breeding stock.

Basic Information

While these other areas are priorities for research, many basic questions require more extensive work. Large gaps in knowledge include basic breeding season data on phenology, nest-site selection, pair bonds, and dispersal; demographic information; molt chronology; effects of contaminants; and daily time budgets, both during the breeding and non-breeding seasons. Any and all information collected on these topics will begin to help us make better decisions concerning godwits and their conservation.

Monitoring

Population Status

In recent years, Canadian Wildlife Service (CWS) biologists have flown aerial surveys over wintering sites on Tierra del Fuego, and these efforts, as well as those by the CWS and L. Espinosa and A. Von Meyer on Isla Chiloé, have begun to provide more solid population estimates than were previously available. It is hoped that these efforts can continue and that in combination with monitoring work in other regions, they can begin provide a complete picture of godwit distribution and population status throughout the year. More censuses also are needed at various points during the godwits' migration, especially at initial staging sites south of breeding areas, to attempt to document possible population trends and annual variation in site usage.

The regions most in need of surveys are the known breeding areas scattered across the Arctic and sub-arctic. While wide-scale census projects for shorebirds are underway across much the arctic, e.g. the Program for Regional and International Shorebird Monitoring (PRISM) (Bart and Earnst 2002; Bart 2005), due to the sparseness of godwit breeding areas, their low density in those areas, and their reliance on sites south of the Brooks Range and the islands of the Canadian Arctic, godwits are largely undersampled.

Monitoring of South American sites during the boreal summer also would be very helpful, possibly as a tool to gauge the previous year's breeding success.

Habitat Change

Monitoring of habitat changes at sites important to godwits is also much needed. Such monitoring will be extremely important as climate change and habitat modification begin to change many sites' characteristics. These efforts are needed soon, as baseline information is necessary in order to properly document rates of change and to make future strategic conservation decisions.

CONSERVATION TIMELINE

With the above conservation strategies and actions and research and monitoring needs laid out, it is important set a timeline for the achievement of those goals. This timeline should act as a guide for 1) the order in which conservation actions and research objectives should be pursued, and 2) a goal date for the completion of those activities and objectives.

By 2007

- Creation of Hudsonian Godwit working group that includes participants from across the entire Western Hemisphere.
- Recognition of Isla Chiloé as a WHSRN Site of Hemispheric Importance.

- Creation of a cohort of colored banded and flagged godwits comprising of godwits from both the Atlantic and Pacific non-breeding populations.
- Identification of important breeding areas within upper Cook Inlet and Mackenzie River Delta and protection of those areas from proposed developments in those regions.

By 2008

- Creation of a cohort of godwits with satellite trackers or data loggers.
- Initiation of studies of godwit breeding and non-breeding habits.
- Analysis of genetic differences between the different breeding and non-breeding populations, e.g., Hudson Bay and Alaska, Tierra del Fuego and Isla Chiloé.
- Recognition of more South American sites by WHSRN and Ramsar, e.g., Bahía Samborombón, Bahía Blanca, and Bahía Lomas.
- Identification of important stopover areas in central North America and initiation or continuation of restoration efforts at those sites, both through improvement of agricultural practices and protection of more permanent wetland sites as well as education of farmers and land owners.

By 2009

- Initiation of more extensive shorebird/waterbird monitoring program in the Southern Hemisphere.
- Resumption of surveys of all sites used by Hudsonian Godwits during the austral summer and initiation of regular surveys of North American staging areas during southbound migration.
- Census of Hudsonian Godwits using South American sites during the boreal summer.
- Initiation of more intensive conservation efforts at focal sites in South America, particularly Bahía Blanca, Tierra del Fuego, and Isla Chiloé.

By 2010-2015

- Completion of satellite transmitter/data logger and breeding/non-breeding habits studies.
- Protection of important and currently unprotected South American sites, e.g., Bahía Lomas, Bahía Blanca, Isla Chiloé, Seno de Relóncavi.
- Initiation of citizen science monitoring programs and Migratory Bird Days/Festivals across the Southern Hemisphere.
- Revision of Hudsonian Godwit Conservation Plan.

EVALUATION

At the moment, no working group exists to cooperate on godwit research and conservation. The first step in the implementation of this plan is to formulate such a group, the goal of which should be to foster and coordinate research, monitoring, and conservation of Hudsonian Godwits. There is poor communication about godwits along the entire length of their migration pathways and this lack of communication is exacerbated by language differences (Spanish, Sranan Tongo, Dutch, French, Portuguese, and English). For example, papers are published in one language and overlooked in others, and when important new staging or breeding areas are found, or habitats are threatened, people in other hemispheres are often uninformed. For a godwit group to be successful, it must involve scientists, conservationists, and educators from throughout the godwits' entire range, and it must first work to foster communication. Those interested in becoming a part of such a working group should contact either Jim Johnson with the U.S. Fish and Wildlife Service in Anchorage, Alaska (Jim_A_Johnson@fws.gov) or Nathan Senner in Ithaca, New York (nrs57@cornell.edu).

One of the most important tasks undertaken by the Hudsonian Godwit working group will be to evaluate the progress of godwit conservation efforts. This will not be an easy task, as it will involve evaluating a number of different types of objectives and actions occurring, sometimes, at vastly different scales.

Of these objectives, the easiest to measure the success of will be the amount knowledge gained—whether or not we have begun to fill in the holes in our knowledge about godwits (i.e. migration routes, breeding biology, habitat use). Knowledge, however, does not equal conservation, and the most important steps in the evaluation process will be to make sure that the knowledge that we have gained has been put to use conserving godwits. The actual conservation of godwits should be assessed using some or all of these measures: 1) The number of acres of godwit habitat protected through legislation or conservation easement; 2) The number of local groups created that focus on shorebird and godwit conservation; 3) The number of conservation groups that join the Hudsonian Godwit working group and agree to include godwit conservation within the scope of their work; 4) The amount of local and national legislation passed that is aimed at helping shorebirds; 5) The number of important areas for godwits either identified or protected or both; 6) The number of threats that can be removed from the list of concerns for godwits; and, ultimately, 7) The number of Hudsonian Godwits occurring in the wild.

While the conservation of any species is a daunting and long-term task, the Hudsonian Godwit presents a hopeful subject:

- At the moment, its population appears to be stable after a long period of decline and decimation by hunting (starting early in the 20^{th} century).
- Some of its most important habitats are protected or, at the very least, currently out of the reach of human development and disturbance.
- The advent of the internet and easy travel around the Western Hemisphere are facilitating communication and cooperation.

Many hurdles remain, but this plan can be an important beginning for conservation efforts focused on Hudsonian Godwits. Hopefully, this plan will generate both interest and action throughout the Western Hemisphere. Success, however, will require the attention and efforts of both public and private organizations, as well of many individuals spread across the godwit's range.

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TABLE 1. List of important Hudsonian Godwit sites (or complex of sites) during northward migration. List of abbreviations: IBA—Important Bird Area; LP—Local Protection; NAB—North American Birds; NWR—National Wildlife Refuge; PP—Provincial Park; PN—Parque Nacional or National Park; RAMSAR—Ramsar site; RN—National Reserve; SP—State Park; SRA—State Recreation Area; WHSRN—Western Hemisphere Shorebird Reserve Network; WMA—Wetland Management Area. Seasonal Use Codes: W—Boreal Winter; S—Southbound Migration; N—Northbound Migration; B—Breeding Season. (Also see http://www.whsrn.org/Hudsonian-Godwit-Map.kmz. *GoogleEarth required. Download [free] at http://earth.google.com/*).

Site Name	Province/State	Country	High Count	Seasonal Use	Site Designation	Source
Bahía San Sebastián	Tierra del Fuego	Argentina	19340	W	WHSRN, RAMSAR, PP	Morrison and Ross 1989
Bahia Lomas	Region XII	Chile	11660	W	RAMSAR	Morrison and Ross 1989
Rio Gallegos	Santa Cruz	Argentina	1000	S,N,W	WHSRN, PP, LP	Ferrari et al. 2002
Estuario Río Deseado	Santa Cruz	Argentina	520	S	LP	Nores 1988
Golfo San Jorge	Santa Cruz	Argentina	550	S	None	Nores 1988
Bahía Bustamante	Chubut	Argentina	6900	S,N	None	Nores 1988

Site Name	Province/State	Country	High Count	Seasonal Use	Site Designation	Source
Yaldad	Region X	Chile	1650	S,N,W	None	Morrison and Ross 1989
Huildad	Region X	Chile	1800	S,N,W	None	Andres, Espinosa, Johnson unpubl. data
Isla Lemuy	Region X	Chile	465	S,N,W	None	Senner unpubl. data
Castro	Region X	Chile	1382	S,N,W	None	Andres, Espinosa, Johnson unpubl. data
Putemun	Region X	Chile	7000	S,N,W	None	Andres, Espinosa, Johnson unpubl. data
Curaco de Vélez	Region X	Chile	4500	S,N,W	None	Andres, Espinosa, Johnson unpubl. data
Caulín	Region X	Chile	1700	S,N,W	None	Andres, Epinosa, Johnson unpubl. data
Quetalmahue	Region X	Chile	1950	S,N,W	None	Morrison and Ross 1989
Estuario de Maulin	Region X	Chile	572	S,N,W	None	Morrison and Ross 1989
Seno de Relóncavi	Region X	Chile	4940	S,N,W	None	Morrsion and Ross 1989
San Antonio Oeste	Río Negro	Argentina	800	N	WHSRN, PP	Blanco et al. 1995
Bahía Blanca	Buenos Aires	Argentina	400	S,N	PP (part of estuary)	Petracci unpubl. data

Site Name	Province/State	Country	High Count	Seasonal Use	Site Designation	Source
Albufera Mar Chiquita	Buenos Aires	Argentina	600	S,N,W	LP	Blanco et al. 1995
Bahía Samborombón	Buenos Aires	Argentina	5330	S,N,W	RAMSAR, PP	Vila et al. 1994
Lagoa do Peixe	Rio Grande do Sul	Brazil	800	S,N,W	PN, WHSRN, RAMSAR	Harrington et al. 1993
Calhoun County	Texas	United States	327	N	None	Skagen et al. 1999
Jackson County	Texas	United States	660	N	None	Skagen et al. 1999
Big Lake State Park	Missouri	United States	310	N	SP	Skagen et al. 1999
Cheyenne Bottoms	Kansas	United States	6850	N	RAMSAR, WMA, WHSRN	Skagen et al. 1999
E. Rainwater Basin	Nebraska	United States	1139	N	IBA	NAB 59:3
Freeman Lakes	Nebraska	United States	1033	N	WPA	NAB 59:3
Lake Thompson	South Dakota	United States	713	N	SRA	Skagen et al. 1999
Lac Qui Parle County	Minnesota	United States	300	N	None	Skagen et al. 1999
Edmunds County	South Dakota	United States	360	N	None	Skagen et al. 1999
Long Lake/ McKenzie Slough	North Dakota	United States	250	N	NWR, IBA, WHSRN	Martin unpubl. data

Site Name	Province/State	Country	High Count	Seasonal Use	Site Designation	Source
Devils Lake	North Dakota	United States	423	N	WMA, IBA	Skagen et al. 1999
Crookston Sewage Lagoons	Minnesota	United States	300	N	None	Jansen 1987
Minot Sewage Lagoons	North Dakota	United States	420	N	None	Skagen et al. 1999
Roseau County	Minnesota	United States	291	N	IBA	Skagen et al. 1999
Gulf of St. Lawrence	Quebec	Canada	632	S	IBA	Maisonnueve et al. 1990
Oak Hammock Marsh	Manitoba	Canada	600	N	WMA, RAMSAR, WHSRN, IBA	Important Bird Areas of Canada 2007
Chaplin Lake	Saskatchewan	Canada	360	N,S	WHSRN, IBA	Skagen et al. 1999
Luck Lake	Saskatchewan	Canada	4000	N,S	Ducks Unlimited	Skagen et al. 1999
Middle Quill Lake	Saskatchewan	Canada	2500	N,S	PP, WHSRN, RAMSAR, IBA	Roy 1996
Little Quill Lake	Saskatchewan	Canada	1800	N,S	PP, WHSRN, RAMSAR, IBA	Roy 1996
Saskatoon	Saskatchewan	Canada	437	S	None	Skagen et al. 1999
Porter Lake	Saskatchewan	Canada	1978	S	IBA	Important Bird Areas of Canada 2007

Site Name	Province/State	Country	High Count	Seasonal Use	Site Designation	Source
Buffer Lake	Saskatchewan	Canada	444	S	IBA	Important Bird Areas of Canada 2007
North Point	Ontario	Canada	1500	S	IBA	Morrison and Harrington 1979
Albany River Mouth	Ontario	Canada	10000	S	PP, IBA	Morrison 1984
Shagamu River Mouth	Ontario	Canada	920	S	PP, IBA	Wilson and McRae 1993
Pen Islands	Ontario	Canada	8800	S	IBA	Morrison et al. 1995
Kaskattama River Mouth	Manitoba	Canada	700	S	WMA, IBA	Important Bird Areas of Canada 2007
Churchill	Manitoba	Canada	500	N,S,B	NP, IBA	NAB 59:98
Susitna Flats	Alaska	United States	725	N,S	IBA	Gill and Tibbitts 1999
Carter Spit	Alaska	United States	230	S	BLM, IBA	Seppi 1995
Aropuk Lake	Alaska	United States	5300	S	NWR	McCaffery et al. 2005

TABLE 2. List of the threats posed to the conservation of Hudsonian Godwits and the strategies that should be employed to address those threats.

Site Name	Conservation Threat	Conservation Strategy
BREEDING SITES		
Entire Breeding Region	Climate change; subsistence harvest.	Federal regulation, education, reduction of greenhouse gas emissions.
Mackenzie River Delta, Northwest Territories/Nunavut, Canada	Proposed oil development and pipeline construction.	Identification as areas of international importance by WHSRN; identification of specific sites important to godwits; efforts to stall or halt construction.
Cook Inlet, Alaska, United States	Construction of bridge and roads; expansion of oil and gas development; proposed coal mine.	Identification as areas of international importance by WHSRN; identification of specific sites important to godwits; efforts to stall or halt construction.
Hudson and James bays, Ontario/Manitoba, Canada	Degradation of habitat by Lesser Snow Geese.	Increased Snow Goose harvest/rehabilitation of degraded habitat.
MIGRATION SITES		
Upper Texas Coast, Texas, United States	Suburban sprawl.	Preservation and restoration of natural wetland habitats.
Central North America	Changing agricultural practices; sedimentation; pesticide contamination; climate change.	Preservation and restoration of natural wetland habitats; implementation of better agricultural practices to reduce sedimentation; education of landowners; creation of ecotourism programs in some areas.
Parque Nacional Lagoa do Peixe, Rio Grande do Sul, Brazil	Habitat degradation by cattle.	Cooperation between landowners and conservation groups to minimize presence of cattle in sensitive areas.
Bahía Samborombón and Punta Rasa, Buenos Aires, Argentina	Environmental contamination from agrochemicals.	Promotion of better agricultural practices and the use of fewer agrochemicals. Improve governmental oversight.

Site Name	Conservation Threat	Conservation Strategy
Bahía Blanca, Buenos Aires, Argentina	Environmental contamination.	Identification of area's importance by WHSRN; preservation of intertidal areas in central bay; tighter restrictions on industrial discharges in bay.
San Antonio Oeste, Río Negro, Argentina	Human disturbance by beachgoers.	Take measures to ensure that important habitats remain little used by beachgoers.
WINTERING SITES		
Tierra del Fuego, Argentina and Chile	Danger of oil spill; proposed new ferry terminal at Bahía San Sebastián.	Designation as site of importance by WHSRN (Lomas); increased attention for areas through ecotourism; improvement of relations between Argentina and Chile.
Isla Chiloé and Puerto Montt area, Region X, Chile	Disturbance and degradation of habitat by aquacultural practices.	Implementation of restrictions on aquacultural practices; creation of education and ecotourism programs.

TABLE 3. List of possible collaborators on research projects and conservation actions. List of abbreviations: CWS—Canadian Wildlife Service; Manomet—Manomet Center for Conservation Sciences; PRBO—PRBO Conservation Science; UNPA—Universidad Nacional de la Patagonia Austral; USFWS—United States Fish and Wildlife Service; USGS-BRD—United States Geological Survey, Biological Resources Division; and WSG—International Wader Study Group.

Name	Affiliation	Location	Country	Email
Carlos Albrieu	UNPA	Rio Gallegos, Santa Cruz	Argentina	albrieuc@infovia.com.ar
Joaquín Aldabe	Aves Uruguay	Montevideo, Montevideo	Uruguay	joaquin@aldabe.org
Brad Andres	USFWS	Denver, Colorado	U.S.A.	Brad_Andres@fws.gov

Name	Affiliation	Location	Country	Email
Luis Benegas	Museo de Río Grande	Río Grande, Tierra del Fuego	Argentina	lbenegas@netcombbs.com.ar
Daniel Blanco	Wetlands International	Buenos Aires, Buenos Aires	Argentina	deblanco@wamani.apc.org
Lisa Chirrey	CWS/ Carleton University	Ottawa, Ontario	Canada	timmiak@gmail.com
Chris Elphick	University of Connecticut	Storrs, Connecticut	U.S.A.	elphick@uconnvm.uconn.edu
Luis Espinosa		Puerta Varas, Región IX	Chile	lespinosa@surnet.cl
Graciela Escudero	CENPAT	Puerto Madryn, Chubut	Argentina	gra_aves2@yahoo.com
Carmen Espoz	Universidad de Santo Tomás	Santiago, Región Metropolitana de Santiago	Chile	cespoz@santotomas.cl
Sylvia Ferrari	UNPA	Rio Gallegos, Santa Cruz	Argentina	sferrari@uarg.unpa.edu.ar
Robert Gill	USGS-BRD	Anchorage, Alaska	U.S.A.	robert_gill@usgs.gov
Cheri Gratto-Trevor	CWS	Saskatoon, Saskatchewan	Canada	Cheri.Gratto-Trevor@ec.gc.ca
Patricia Gonzalez	Fundación Inalafquen	San Antonio Oeste, Río Negro	Argentina	ccanutus@yahoo.com.ar
Brian Harrington (retired)	Manomet	Manomet, Massachusetts	U.S.A.	bharrington@manomet.org
Jim Johnson	USFWS	Anchorage, Alaska	U.S.A.	Jim_A_Johnson@fws.gov

Name	Affiliation	Location	Country	Email
Vicky Johnston	CWS	Yellowknife, Northwest Territories	Canada	Vicky.johnston@ec.gc.ca
Ricardo Matus	Nature Patagonia	Punta Arenas, Región XII	Chile	rmatusn@123.cl
Brian McCaffery	USFWS	Bethel, Alaska	U.S.A.	Brian_McCaffery@fws.gov
Guy Morrison	CWS	Toronto, Ontario	Canada	guy.morrison@ec.gc.ca
Nathan Senner		Ithaca, New York	U.S.A.	nrs57@cornell.edu
Ines Serrano	IBAMA	São Luis, Maranhão	Brazil	ines.serrano@ibama.gov.br
Humphrey Sitters	WSG	Exeter, Devon	U.K.	hsitters@aol.com
Lee Tibbitts	USGS-BRD	Anchorage, Alaska	U.S.A.	lee_tibbitts@usgs.gov
Jorge Velenzuela		Castro, Región X1	Chile	jorgevalenzu@gmail.com
Nils Warnock	PRBO	Petaluma, California	U.S.A.	nwarnock@prbo.org