Counts and captures of Hudsonian Godwits and Whimbrels on Chiloé Island, Chile, January–February 2007

JAMES A. JOHNSON[1], BRAD A. ANDRES[2], HUMPHREY P. SITTERS[3], JORGE VALENZUELA[4], LAWRENCE J. NILES[5], AMANDA D. DEY[6], MARK K. PECK[7] & LUIS A. ESPINOSA[8]

[1] U.S. Fish & Wildlife Service, Migratory Bird Management, 1011 East Tudor Rd., Anchorage, AK 99503 USA. Jim_A_Johnson@fws.gov
[2] U.S. Fish & Wildlife Service, Division of Migratory Bird Management, PO Box 25486, DFC-Parfet, Denver, CO 80225-0486 USA
[3] Limosa, Old Ebford Lane, Ebford, Exeter EX3 0QR, UK
[4] Centro de Estudios y Conservación del Patrimonio Natural, Freire 463, Castro, Chile
[5] Conserve Wildlife Foundation of New Jersey, PO Box 400, Trenton, NJ 08625 USA
[6] New Jersey Division of Fish & Wildlife, Endangered & Nongame Species Program, PO Box 400, Trenton, NJ 08625-0400 USA
[7] Royal Ontario Museum, Centre for Biodiversity & Conservation Biology, 100 Queens Park, Toronto, Ontario M5S 1C6, Canada
[8] Union de Ornitólogos de Chile, Sociedad Ornitólogica Neotropical, Casilla 301, Puerto Varas, Chile

---

Johnson, J.A., B.A. Andres, H.P. Sitters, J. Valenzuela, L.J. Niles, A.D. Dey, M.K. Peck & L.A. Espinosa. 2007. Counts and captures of Hudsonian Godwits and Whimbrels on Chiloé Island, Chile, January–February 2007. *Wader Study Group Bull.* 113: 47–52.

Keywords: Hudsonian Godwit, *Limosa haemastica*, Whimbrel, *Numenius phaeopus*, non-breeding population, biometrics, Chiloé Island, Chile

Chiloé Island in southern Chile is known to support some of the largest non-breeding populations of Hudsonian Godwits *Limosa haemastica* and Whimbrels *Numenius phaeopus* along the Pacific Coast of South America. Although breeding populations from western and eastern North America are suspected of segregating in the non-breeding season, we lack the information necessary to confirm differential use of South American coastlines. Therefore, biologists from Chile, England, Canada, and the U.S.A. undertook a study in Feb 2007 to address some of the many gaps in our understanding of the non-breeding biology of these species. We captured, measured, collected blood and feathers from, and flagged 106 Hudsonian Godwits and 93 Whimbrels. We also conducted counts of these species at 46 known aggregation sites and 50 randomly selected shoreline segments to generate a more complete estimate of the populations using Chiloé Island. From captured birds, we provide preliminary biometric information. Numerous projects are planned or are being undertaken to further our knowledge of Hudsonian Godwit and Whimbrel populations during the non-breeding season.

La isla de Chiloé ubicada en el sur de Chile se conoce por sostener algunas de las mayores poblaciones no reproductivas de zarapito de pico recto (*Limosa haemastica*) y zarapito común (*Numenius phaeopus*) a lo largo de la costa pacifico del hemisferio Sur. No obstante se sospecha que las poblaciones reproductivas del oriente y occidente de América del Norte se segregan longitudinalmente durante el periodo no reproductivo, se carece de información precisa para validar este supuesto sobre uso diferencial de las costas de América del Sur. Debido a esto, biólogos de Chile, Inglaterra, Canadá y U.S.A., llevaron a cabo un estudio durante febrero del 2007 para permitir aclarar vacíos en el comprendimiento de la biología en poblaciones no reproductivas de estas especies. Se capturaron, midieron, colectaron muestras biológicas y anillaron 106 zarapitos de pico recto y 93 zarapitos comunes. Además se efectuaron censos de estas especies en 46 sitios de agregación conocidos, y 50 segmentos de litoral seleccionados aleatoriamente para generar una estimación más completa de las poblaciones que usan la isla de Chiloé. Se obtuvo información biométrica preliminar de las aves capturadas. Actualmente son preparados varios proyectos que permitirán mejorar el conocimiento sobre poblaciones de zarapito común y zarapito de pico recto durante la estación no reproductiva.

INTRODUCTION

Chiloé Island in southern Chile supports one of the largest non-breeding populations of Hudsonian Godwits *Limosa haemastica* and Whimbrels *Numenius phaeopus* on the Pacific Coast of South America (Espinosa *et al.* 2006, Morrison & Ross 1989). It is suspected that Hudsonian Godwits and Whimbrels that spend the non-breeding season on Chiloé Island breed in Alaska and western Canada, and that Hudsonian Godwits and Whimbrels that spend the non-breeding season on the Atlantic coast of South America, including Tierra del Fuego, breed in the vicinity of Hudson Bay (Elphick &

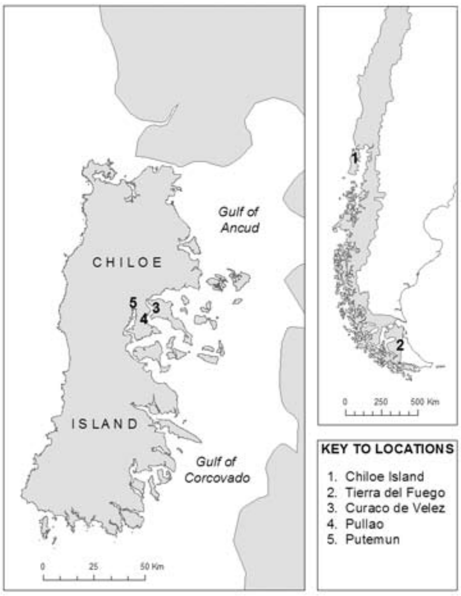

Fig. 1. Map of southern Chile (shaded) and Argentina (unshaded, upper right) and Chiloé Island with locations of Hudsonian Godwit and Whimbrel capture and re-sighting sites (on left).

Klima 2002, McCaffery & Harwood 2000, Skeel & Mallory 1996). However, we lack the information necessary to support this notion of differential use of South American coastlines by the different breeding populations of the two species.

Both Hudsonian Godwits and Whimbrels have been identified as species of high conservation concern in Canada (Donaldson *et al.* 2000) and the United States (Brown *et al.* 2001, U.S. Shorebird Conservation Plan 2004). These designations are due to small population sizes, suspected population declines, restricted breeding and non-breeding distributions (particularly for Hudsonian Godwits), and high threats during the non-breeding season. Demographic information including estimates of density, population trends, and adult survival are sparse or lacking (Brown *et al.* 2001, Donaldson *et al.* 2000, Elphick & Klima 2002, Skeel & Mallory 1996). Biometric data are limited, as are many aspects of the species' non-breeding ecology (Elphick & Klima 2002, Higgins & Davies 1996, Skeel & Mallory 1996).

Therefore, biologists from Canada, Chile, England, and the U.S.A. undertook a study during Feb 2007 to address some of the gaps in our understanding of these species. Herein, we provide preliminary results of shoreline surveys, capture efforts, and biometrics recorded for Hudsonian Godwits and Whimbrels. We also include a list of research and conservation projects that are either being undertaken or are planned for the near future.

STUDY AREA

Located in Chile's 10th region and within the Valdivian Temperate Rain Forest ecoregion, Chiloé Island (42°30'S, 73°45'W) has a wet-temperate climate that is strongly influenced by the Pacific Ocean. Annual precipitation exceeds 2,000 mm with a mean annual temperature of 12° C (Errazuriz *et al.* 1998, Senda Darwin Biological Station, five-year record). The island is 190 km long and 55–65 km wide (Fig. 1). The western side of the island receives high annual rainfall and is difficult to access; the predominantly steep, rocky coastline is directly exposed to the Pacific Ocean and contains the only federally protected coastline on the island. The eastern shore, in the rain shadow of the interior mountains, is warmer, drier, and supports the majority of the island's human population and industry, primarily agriculture and aquaculture (Errazuriz *et al.* 1998). The eastern coastline, sheltered by numerous islands in the Gulf of Ancud and Gulf of Corcovado, is comprised mainly of mixed sand and gravel beaches and includes many bays (Subiabre & Rojas 1994). Larger bays provide mudflat and saltmarsh habitats that are used by Hudsonian Godwits and Whimbrels for feeding and roosting; more linear shorelines are also used by feeding and roosting Whimbrels (Andres *et al.* 2007). Tidal range on Chiloé can exceed six metres.

COUNTS

Because of low densities and scattered, poorly delineated distributions in remote areas, surveys of Hudsonian Godwits and Whimbrels during the breeding season are logistically and economically impractical. Thus, estimates of the species' population sizes have been derived mainly from counts on non-breeding grounds during the austral summer and at North American staging and migration stopover sites (Espinosa *et al.* 2006, Morrison & Ross 1989, Morrison *et al.* 2006). In 2006, Guy Morrison, Ken Ross and LAE conducted an aerial survey of Hudsonian Godwits and Whimbrels along the coasts of Chiloé Island and the adjacent mainland. During this survey, it was apparent that the behavior, habitat use, and density of both species, particularly Whimbrels, were important factors that influenced their detectability. For example, most Hudsonian Godwits were detected in large, conspicuous flocks in bays along the eastern shore of Chiloé Island, which were flushed as the survey aircraft flew overhead. Conversely, Whimbrels, although also aggregated in large flocks at sites where Hudsonian Godwits occurred, were less prone to flush when the survey aircraft flew overhead, were more cryptic both on the ground and in flight than Hudsonian Godwits, and were also sparsely distributed along the island's coastline (B. Andres & J. Johnson pers. obs.). These traits could result in lower detection rates and, subsequently, produce an underestimate of population size. To obtain a more complete estimate of the population of Whimbrels inhabiting Chiloé Island, JV, BAA, and JAJ conducted an intensive ground survey that included sites that supported known aggregations (predominantly large, sheltered bays) and randomly selected beach segments.

Between 25 Jan and 2 Feb 2007, we surveyed 46 known aggregation sites and 50 random shoreline segments. Three additional, remote shoreline segments were surveyed during 8–9 Feb. We are in the process of using these counts to generate an updated population estimate for Pacific coast Whimbrels and Hudsonian Godwits and suspect it will exceed previous estimates. The ground surveys also allowed us to determine feasibility of sites for capturing Whimbrels and Hudsonian Godwits with a cannon net.

CAPTURES

Our objectives for capturing birds were to: 1) develop an individually-marked population to study local and regional movement patterns and turnover rates, and to aid in studies of non-breeding ecology and demographic parameters (e.g. time budgets, adult survival rates); 2) collect blood and feathers that will be used in genetic and isotopic analyses to determine sex, and geographic origins of populations; 3) record biometrics to compare sexes and known populations, describe moult patterns and schedule, and estimate age-ratios; and 4) collect samples to test for the presence of the avian influenza H5N1 subtype.

We used a cannon net at two coastal locations, Pullao (42°28'29"S, 73°39'52"W) and Curaco de Vélez (42°25'54"S, 73°37'37"W), which are <10 km apart and supported 6,000 and 1,500 feeding and roosting Hudsonian Godwits and Whimbrels, respectively. The net was set >4 hours before high tide and was positioned to target roost sites. Characteristics of roost sites differed between the capture locations. At Pullao, birds roosted on slightly-elevated, sandy areas in the supratidal zone and at Curaco de Vélez roost sites were on elevated areas in the intertidal zone, which became islands during high tide. The net was fired 0.5 to 1 hour before high tide. Birds were placed in keeping cages, which were modified from Clark (1986) to accommodate large waders. Any bird suspected to be in compromised health (i.e. not standing) was released immediately to avoid capture myopathy. We alternated capture locations so that each site was visited every other day. This schedule minimized both disturbance to the birds and the probability that they avoided one of the two sites because of our activities.

We attached a red flag with individually inscribed alpha (e.g. AA) or numeric codes (e.g. 01; Clark *et al.* 2005) to the left tibia of both species and a yellow Darvic ring (indicating year and location of capture) above a U.S. Fish and Wildlife metal band to the right tibia of Hudsonian Godwits and a dark blue ring over metal to the right tibia of Whimbrels. We recorded the following biometrics: length of exposed culmen, length of head and culmen, length of the flattened and straightened wing, length of tarsus, and mass. We also recorded the state and score of primary moult (Ginn & Melville 1983) of Hudsonian Godwits and Whimbrels, and the breast moult index (the proportion of breast feathers in active moult according to the scale: 0 = none, 1 = <5%, 2 = 5–20%, 3 = >20%), the stage of growth of actively-moulting breast feathers (according to the scale: 1 = in pin, 2 = <⅓ grown, 3 = between ⅓ and ⅔ grown, 4 = >⅔ grown but not fully grown) and proportion of breeding plumage (Piersma & Jukema 1993) of Hudsonian Godwits. Blood was collected from the brachial vein and stored in Longmire Buffer solution. We collected the 9th secondary for future stable isotope analyses, which for adults and birds that spent the boreal summer in non-breeding areas are grown on the non-breeding grounds and on the natal grounds for birds fledged in 2006. The Chilean federal agency Servicio Agrícola y Ganadero collected cloacal samples to test for the presence of H5N1 avian influenza.

Between 2 and 7 Feb, we caught 106 Hudsonian Godwits, 93 Whimbrels, two Red Knots *Calidris canutus*, and one American Oystercatcher *Haematopus palliatus* during five capture attempts. The vast majority of birds appeared healthy following their release – they either flew or walked away from the capture location. Two individuals, however, showed symptoms of capture myopathy. The first, a Whimbrel, was unable to stand when released. The second, a banded Hudsonian Godwit found the following day at a site 7 km across water, was also unable to stand. Although both birds were alive when last observed, their fates were unknown.

BIOMETRICS

With few exceptions, culmen, tarsus, and wing lengths for Whimbrels and Hudsonian Godwits were within the reported ranges for the species (Table 1; see Skeel & Mallory 1996, Higgins & Davies 1996 and Elphick & Klima 2002). There was a tendency toward a bimodality in measurements that may have been sex related (Figs 2 & 3). Masses of Hudsonian Godwits captured on Chiloé were greater than those captured on the breeding grounds or in Tierra del Fuego (Table 1; see Elphick & Klima 2002). Whimbrels captured on Chiloé were also heavier than birds captured on the breeding grounds (Table 1; see Skeel & Mallory 1996). We will compare biometrics between sexes and among known populations when molecular sexing and genetic analyses have been completed. An initial indication from the culmen measurements, however, is that there may be a strong male bias in the sex ratio of Hudsonian Godwits on Chiloé because, according to Prater *et al.* (1977), the culmen lengths of most males are ≤84 mm and of most females ≥85 mm (compare Fig. 3).

AGE AND MOULT

The timing and extent of moult in Hudsonian Godwits and American Whimbrel (*N. p. hudsonicus*) populations is poorly known. Thus, our initial attempt to use moult patterns to age both species proved challenging and resulted in more questions than answers. We hope our understanding of moult schedule and patterns will be enhanced by further study.

The age that Hudsonian Godwits and Whimbrels first breed is unknown, however, it is likely that individuals remain in non-breeding areas throughout their second and third calendar years. After fledging, juveniles retain their original tertials, remiges, rectrices, and many lesser and greater upperwing coverts throughout most or all of the first twelve months of their lives (see Elphick & Klima 2002 and Skeel & Mallory 1996). Thus, at the time of our studies in February, they (i.e. second calendar year birds that fledged in 2006) should be clearly distinguishable from older individuals by the com-

Table 1. Biometrics of Hudsonian Godwits and Whimbrels captured during Feb 2007 at Chiloé Island, Chile

	Hudsonian Godwit			Whimbrel		
	Mean (SD)	**Range**	**N**	**Mean (SD)**	**Range**	**N**
Culmen length (mm)	77.6 (6.7)	66.2–96.1	106	87.3 (5.7)	75.8–102.3	93
Total head length (mm)	114.9 (7.2)	102.1–134.9	106	128.0 (6.2)	115.8–143.0	92
Wing length (mm)	216.8 (6.8)	204–232	82	260.5 (8.0)	241–274	30
Tarsus length (mm)	59.1 (3.2)	53.6–66.9	105	61.9 (2.8)	55.0–67.9	93
Mass (g)	271.0 (29.8)	219–353	106	514.0 (65.0)	378–689	93

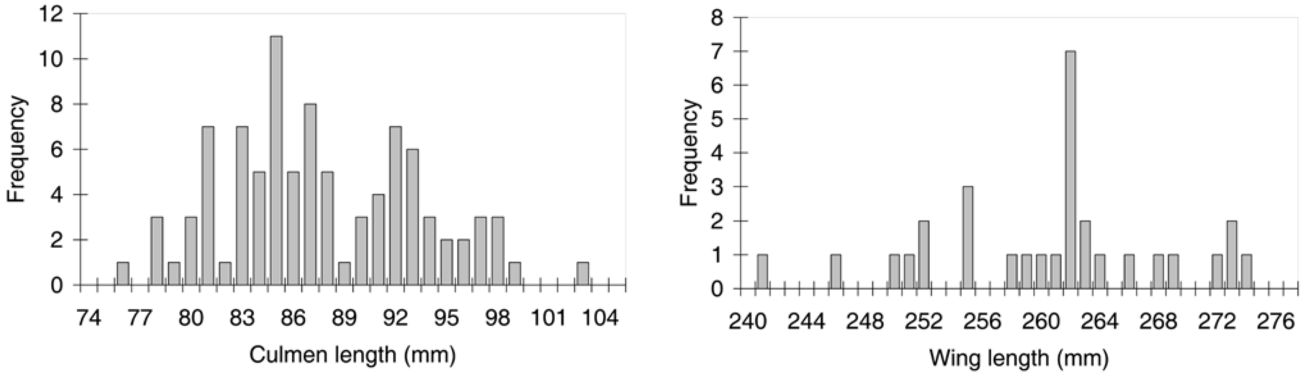

Fig. 2. Frequency distribution of culmen and wing lengths of adult Whimbrels captured during Feb 2007 on Chiloé Island, Chile.

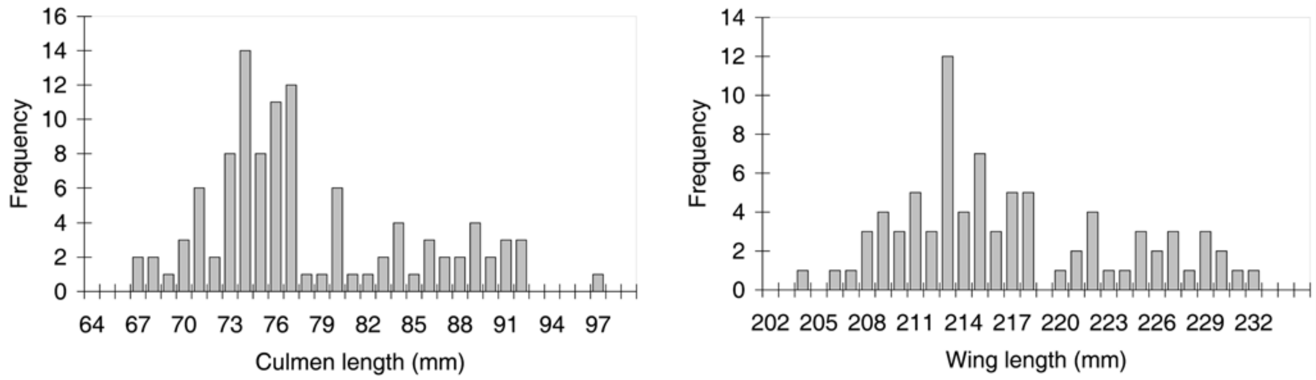

Fig. 3. Frequency distribution of culmen and wing lengths of adult Hudsonian Godwits captured during Feb 2007 on Chiloé Island, Chile.

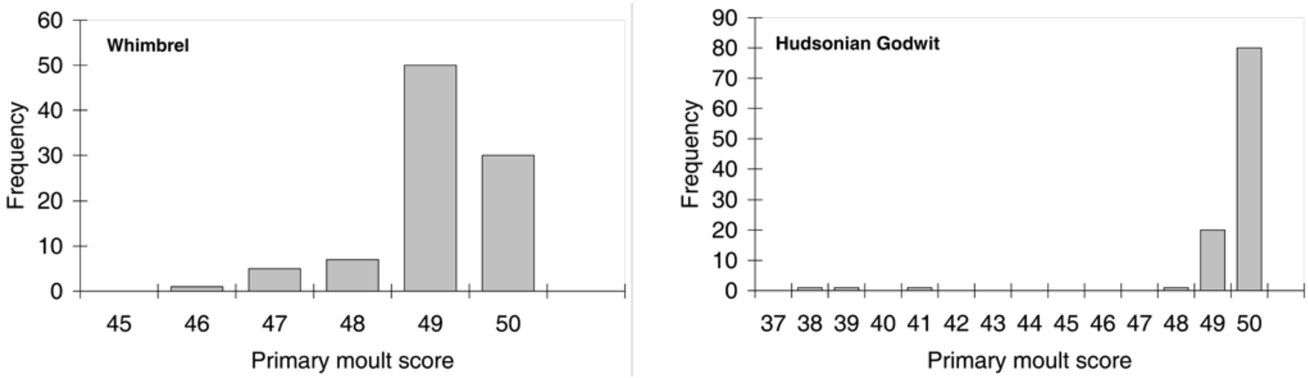

Fig. 4. Primary moult scores of adult Whimbrels and Hudsonian Godwits captured during Feb 2007 on Chiloé Island, Chile. Maximum and completed moult score = 50.

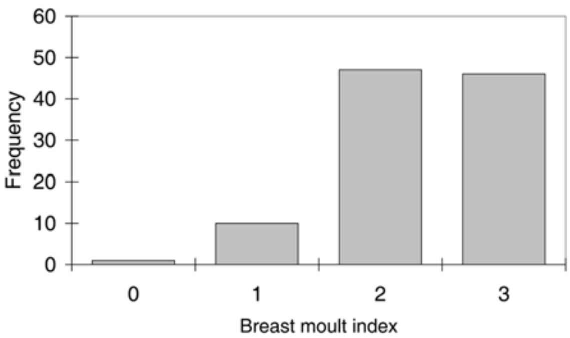

Fig. 5. Breast moult index of Hudsonian Godwits captured during Feb 2007 on Chiloé Island, Chile (0 = no active breast moult; 1 = <5% breast feathers actively moulting; 2 = 5–20%; 3 = >20%).

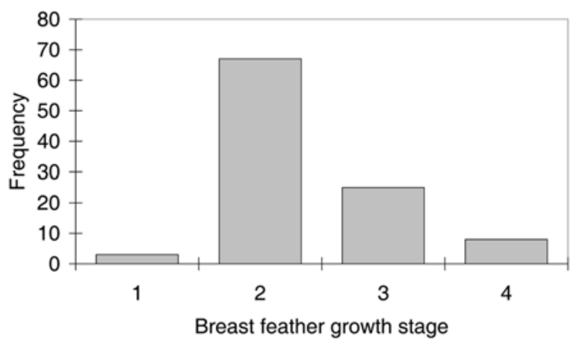

Fig. 6. Growth stage of the actively growing breast feathers of Hudsonian Godwits captured during Feb 2007 on Chiloé Island, Chile (1 = in pin; 2 = <⅓; 3 = ⅓–⅔ grown; 4 = >⅔ grown but not fully grown).

paratively advanced wear of these feathers. We suggest that Hudsonian Godwits in their third or fourth calendar year (i.e. hatched in 2004 or 2005) that remained in non-breeding areas during the boreal summer may also be distinguished from younger and older individuals by the condition and coloration of their primaries (see below).

Nearly all birds caught were either in active primary moult or had apparently only recently finished (having unworn primary tips) and were therefore aged as adults; only two (<2%) captured Hudsonian Godwits, and no Whimbrels, were determined to be second calendar year birds (i.e. juveniles). The fact that we observed very few second-year Hudsonian Godwits and no second-year Whimbrels suggests one or more of the following possibilities: 1) both species experienced very low productivity during the 2006 breeding season; 2) the flock we targeted consisted mostly of adults, 3) second-year birds of both species winter elsewhere.

Although we did not attempt to distinguish third/fourth-year birds from adults, we observed that about 10–20% of Hudsonian Godwits captured had slightly brownish primaries (i.e. slightly faded). These feathers contrasted with the grey primaries of adults that had either just completed moult or were actively moulting. These brownish primaries had edge wear too slight to be those of second-year birds that had grown them >six months earlier in the Arctic. Moreover, they did not have any of the buff-edged juvenal inner median coverts described by Higgins & Davies (1996) and Prater *et al.* (1977). We suggest the following possibilities: 1) they were early failing adults that had arrived much earlier than successful adults and had completed their primary moult earlier; 2) they were third/fourth-year birds that had not migrated to the Arctic and had started and finished their primary moult earlier than the adults (unlike in other regions, such as NW Australia, where most immature shorebirds start moult earlier but finish at the same time as adults (C.D.T. Minton, pers. comm.)); or 3) they were second-year birds and their primary wear was surprisingly limited (although they had lost all buff tips to their inner median coverts through wear). The "brownish" birds tended to have little or no breeding plumage. This would favor the idea that they were third/fourth-year birds, hypothesis 2 above. Assuming our determination of adults is correct, most adult Hudsonian Godwits and Whimbrels had completed, or were close to completing their primary moult, when we captured them in early Feb (Fig. 4). Clearly, further observations are needed to determine age-specific moult patterns in Hudsonian Godwits and Whimbrels in this part of the world.

The majority of adult Hudsonian Godwits were in very active breast moult (breast moult index = 2 or 3; Fig. 5), and breast feathers were at a relatively early stage (mostly 2; Fig. 6). This pattern indicates that they were actively changing into alternate plumage, but were unlikely to depart for some time, because they would probably not migrate while in active body moult. This is consistent with observations that Hudsonian Godwits do not depart from Chiloé Island until April (Espinosa *et al.* 2006). Fifty-nine percent of adult Hudsonian Godwits had ≤ half of their full alternate plumage (Fig. 7). There was a strong, negative correlation between the proportion of alternate plumage and culmen length (Pearson coefficient, $r = -0.59$, $n = 104$, $P = <0.0001$), suggesting that pre-alternate moult of males was more advanced than in females.

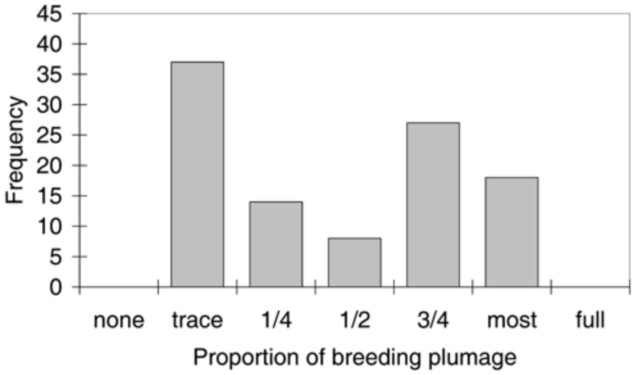

Fig. 7. Proportion of breeding plumage of adult Hudsonian Godwits captured during Feb 2007 on Chiloé Island, Chile.

RESIGHTINGS

Local movement patterns of Hudsonian Godwits and Whimbrels have not yet been examined in detail. We suspect, however, that there is a high degree of connectivity among sites that are in close proximity and that offer sheltered environments for feeding and roosting birds in a variety of wind conditions. Three Hudsonian Godwits banded at either Pullau or Curaco de Vélez (individual codes were not identified) were resighted at Putemún (6 to 10 km away) on 24–25 Feb 2007 (see Fig. 1).

In addition, a Hudsonian Godwit banded on Chiloé was resighted on the Naknek River (58°38'24"N, 156°33'49"W), east of King Salmon, Alaska on 12 May 2007 (S. Clawson & R. Russell, pers. comm.). A second Hudsonian Godwit, banded at Bahia Lomas, Chile during January 2002, was resighted at the Naknek River on 8 June 2007 (S. Clawson pers. comm.). These are the first known resighting records in Alaska of Hudsonian Godwits banded in South America. Further resighting efforts along the flyways of both our study species during migration periods will enhance our understanding of their migration strategies and large-scale connectivity between breeding and non-breeding grounds.

ONGOING AND FUTURE OBJECTIVES

Although counts at selected sites have been conducted for many years (Espinosa *et al.* 2006), there is still much to learn about the non-breeding ecology of Hudsonian Godwits and Whimbrels inhabiting Chiloé Island and other non-breeding sites. The following projects are already being undertaken or are proposed for the future:

1. *Determine the size of Hudsonian Godwit and Whimbrel populations on Chiloé and neighboring islands.* Using data collected during Feb 2007, habitat specific density estimates will be used to generate a more complete estimate for Chiloé and neighboring islands.
2. *Conduct population genetics analyses to determine linkages between breeding, staging, and non-breeding populations of Hudsonian Godwits and Whimbrels.* Prior genetic analyses of Hudsonian Godwits indicate significant population subdivision exists among the three breeding areas of western and southcoastal Alaska, northwestern Northwest

Territories, and Hudson Bay (Haig *et al.* 1997). We suspect a similar pattern exists for Whimbrels. Combined with survey results from non-breeding areas, an understanding of the proportion of breeding populations in non-breeding areas will allow us to more accurately estimate the size of each breeding population.

3. *Determine migratory routes, key stopover sites, and migration strategies of Hudsonian Godwits and Whimbrels.* The low probability of resighting banded birds necessitates the use of satellite tracking technology to obtain this information. Satellite transmitters will be attached to a minimum of five Hudsonian Godwits and five Whimbrels captured on Chiloé during Dec–Jan 2009.
4. *Compare biometrics between sexes and among known populations.* The high degree of genetic differentiation among breeding populations of Hudsonian Godwits suggests that discernible biometric differences among populations may exist, yet systematic studies of biometrics are lacking. Biometric information for Whimbrels is also limited.
5. *Increase the number of individually marked Hudsonian Godwits and Whimbrels on Chiloé Island.* We intend to continue our capture efforts in 2008 to generate more accurate and precise estimates of local and regional scale movements, turnover rates, demographic parameters (e.g. adult survival, sex ratios, age ratios, age of first breeding). Furthermore, the continued handling of birds at different times throughout the year will aid a more complete description of moult schedule and patterns .
6. *Capture a sufficient number of Red Knots to determine the taxonomic and ecological status of non-breeding populations at Chiloé Island.* We intend to use a combination of biometric information and genetic analysis to determine whether Chiloé Island supports *C.c. rufa* (same subspecies that occurs in Tierra del Fuego), *C.c. roselaari*, or an unknown subspecies. Furthermore, determining population size, distribution, and habitat use during the non-breeding season will provide information crucial to implementing an effective conservation strategy.
7. *Work with Chilean municipal, regional, and federal agencies and organizations to protect sites supporting large concentrations of waterbirds (including Hudsonian Godwits and Whimbrels).* We will continue to strive to build local programs that inform and educate the public about waders and the intrinsic and economic value of conserving wader populations and the sites where they occur.
8. *Continue to monitor numbers of Hudsonian Godwits and Whimbrels using bays on Chiloé Island.* We intend to continue periodic counts as part of the Neotropical Waterbird Census and other efforts.

The importance of understanding aspects of non-breeding ecology, population size and trends, demographic parameters, and linkages between breeding and non-breeding populations attains more pressing significance as anthropomorphic environmental changes that impact shorebird ecology increase in scope and duration. On Chiloé Island, disturbance to Hudsonian Godwits and Whimbrels and the loss and alteration of habitats they use is likely to increase following the expansion of aquaculture and urban development in coastal areas. Furthermore, sites that support large concentrations of the species currently do not have protected status. Recently, an international working group was formed to address concerns and increase communication among countries and individuals involved in Hudsonian Godwit research (see report of the first meeting of the Hudsonian Godwit Working Group on page 22 of this volume). The effective management and conservation of Hudsonian Godwit and Whimbrel populations will benefit from the shared efforts of international collaborations like this one, which strives to address concerns across a species' range.

ACKNOWLEDGEMENTS

Thanks to teacher Daniela Barria, student Gabriel Huenun, and veterinarian Julissa Jeria, from the Servicio Agrícola y Ganadero, for assisting with banding operations. R. Lanctot, B. McCaffery, and C.D.T. Minton provided helpful comments on an early version of the manuscript. Funding for this work was provided by the authors' institutions.

REFERENCES

Andres, B.A., J.A. Johnson & J. Valenzuela. 2007. Whimbrels use novel high tide roosts during the contranuptial season in southern Chile. *Wader Study Group Bull.* 112: 67–68.

Brown, S., C. Hickey, B. Harrington & R. Gill (Eds.). 2001. *United States Shorebird Conservation Plan,* 2nd ed. Manomet Center for Conservation Sciences, Manomet, Massachusetts, U.S.A.

Clark, N. 1986. Keeping-cages and keeping-boxes. *Wader Study Group Bull.* 46: 32–33.

Clark, N.A., S. Gillings, A.J. Baker, P.M. González & R. Porter. 2005. The production and use of permanently inscribed leg flags for waders. *Wader Study Group Bull.* 108: 38–41.

Donaldson, G.D., C. Hyslop, R.I.G. Morrison, H.L. Dickson & I. Davidson. 2000. *Canadian Shorebird Conservation Plan.* Canadian Wildlife Service Special Publication, Ottawa, Canada.

Elphick, C.S. & J. Klima. 2002. Hudsonian Godwit (*Limosa haemastica*). In: *Birds of North America* 629.

Errázuriz, A., J. González & M. Henríquez. 1998. Manual de Geografía de Chile, 3ra ed. Editorial Andrés Bello, Santiago. 443 pp.

Espinosa, L., A.P. von Meyer & R.P. Schlatter. 2006. Status of Hudsonian Godwit in Llanquihue and Chiloé provinces, southern Chile, during 1979–2005. *Wader Study Group Bull.* 109: 77–82.

Ginn, H.B. & D.S. Melville. 1983. *Moult in Birds*. British Trust for Ornithology, Tring.

Haig, S., C.L. Gratto-Trevor, T.D. Mullins & M.A. Colwell. 1997. Population identification of Western Hemisphere shorebirds throughout the annual cycle. *Mol. Evol.* 6: 413–427.

Higgins, P.J. & S.J.J.F. Davies. 1996. *Handbook of Australian, New Zealand and Antarctic birds. Vol. 3. Snipe to pigeons.* Oxford Univ. Press, Melbourne, Australia.

McCaffery, B.J. & C.M. Harwood. 2000. Status of Hudsonian Godwits on the Yukon-Kuskokwim Delta, Alaska. *Western Birds* 31: 165–177.

Morrison, R.I.G. & R.K. Ross. 1989. *Atlas of Nearctic shorebirds on the coast of South America, Vol. 2.* Canadian Wildlife Service, Ottawa.

Morrison, R.I.G., B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor & B.A. Andres. 2006. Population estimates of North American shorebirds, 2006. *Wader Study Group Bull.* 111: 66–84.

Piersma, T. & J. Jukema. 1993. Red breasts as honest signals of migratory quality in a long-distance migrant, the Bar-Tailed Godwit. *Condor* 95: 163–177.

Prater, A.J., J.H. Marchant & J. Vuorinen. 1977. *Guide to the identification and ageing of Holarctic Waders.* British Trust for Ornithology, Tring.

Skeel, M.A. & E.P. Mallory. 1996. Whimbrel (*Numenius phaeopus*). *Birds of North America* 219.

Subiabre, A. & C. Rojas. 1994. *Geografía física de la región de Los Lagos*. Ediciones Universidad Austral de Chile, Valdivia, Chile.

U.S. Shorebird Conservation Plan. 2004. *High Priority Shorebirds – 2004.* Unpublished Report, U.S. Fish and Wildlife Service, Arlington, Virginia, U.S.A.