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Stop-over and Migration Ecology of the Whimbrel: Fall 2009 Season Report

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Coastal Zone Management Program
Northern Neck Audubon Society
Center for Conservation Biology

Cover: Whimbrel on mudflat near Box Tree marsh. Photo by Bart Paxton.

The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

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EXECUTIVE SUMMARY

The whimbrel (*Numenius phaeopus*) is a large, Holarctic, highly migratory shorebird. The North American race (*N.p. hudsonicus*) includes two disjunct breeding populations, both of which winter primarily in Central and South America. The western population breeds in Alaska and the Northwest Territories of Canada (Engelmoer and Roselaar 1998). The eastern population breeds south and west of Hudson Bay in Manitoba and Ontario (Skeel and Mallory 1996, Jehl and Smith 1970). The prevailing thought was that the western population followed a Pacific Coast migration route between breeding and wintering areas in Panama and western South America, and that the Hudson Bay population followed an Atlantic Coast migration route to wintering grounds in Northeast South America (Andres et al. 2009, Skeel and Mallory 1996, Morrison and Ross 1989). Both populations are of high conservation concern due to population declines in recent decades (Bart et al. 2007, Morrison et al. 2006, Watts and Truitt in press). Investigations into the migration routes of whimbrels staging in Virginia have shown a previously unknown link between the eastern and western populations as they stop-over in Virginia (Watts et al. 2008). The primary objective of this project is to examine the stop-over and migration strategies of whimbrels, as they relate to the conservation of the species.

A total of four 9.5 gram PTT satellite transmitters were deployed during the fall migration season. Average weight for the whimbrels with transmitters was 527.2 grams, or approximately 200 grams over mean winter (lean) weight. Ten digitally coded glue-on radio transmitters were attached to birds. The cumulative data give us insight into stop-over times for whimbrels as they stage on the Eastern Shore of Virginia before migrating to wintering grounds. Satellite and radio transmittered whimbrels departed the Eastern Shore between 31 August and 20 September 2009. Whimbrels arrived on the Eastern Shore in large numbers as early as early to mid-July due to record low temperatures and winter-like conditions on the breeding grounds.

Several unusual migration events were observed during the fall season. Twelve flights greater than 1,000km were documented during the fall. These flights took an average of 95 hours to complete. The average distance traveled during these flights was 2,697km. A total of 5 shorter flights on wintering grounds were also documented, with birds moving from initial locations in Dominica, Venezuela, and Guyana into French Guiana, Suriname, and Brazil, the primary wintering grounds for eastern whimbrels (Morrison and Ross 1989). The mean distance traveled on these flights was 597km with the mean time in flight 47.3 hours.

BACKGROUND

Context

The whimbrel (*Numenius phaeopus*) is a large, Holarctic, highly migratory shorebird. The North American race (*N.p. hudsonicus*) includes two disjunct breeding populations, both of which winter primarily in Central and South America. The western population breeds in Alaska and the Northwest Territories of Canada (Engelmoer and Roselaar 1998). The eastern population breeds south and west of Hudson Bay in Manitoba and Ontario (Skeel and Mallory 1996, Jehl and Smith 1970). The prevailing thought was that the western population followed a Pacific Coast migration route between breeding and wintering areas in Panama and western South America, and that the Hudson Bay population followed an Atlantic Coast migration route to wintering grounds in Northeast South America (Andres et al. 2009, Skeel and Mallory 1996, Morrison and Ross 1989). Both populations are of high conservation concern due to dramatic declines in recent decades (Bart et al. 2007, Morrison et al. 2006, Watts and Truitt in press). The primary objective of this project is to examine the stop-over and migration strategies of whimbrels, as they relate to the conservation of the species.

For more than a decade, scientists have believed that the seaside of the lower Delmarva Peninsula in Virginia played a significant role in the life history of the whimbrel. During spring migration in the mid-1990s, biologists from the Center for Conservation Biology (CCB) at the College of William and Mary and The Nature Conservancy (TNC) documented the densest concentration of whimbrels ever recorded in the western hemisphere within the barrier island lagoon system of the lower Delmarva Peninsula (Watts and Truitt, in press). It is believed that this site represents a critical coastal staging area where birds feed on vast numbers of fiddler crabs that inhabit the lagoon system to build up fat and energy reserves before making their last overland flight to the breeding grounds. It was previously assumed that birds staging along the lower Delmarva were exclusively from the Hudson Bay population. Investigations into the migration routes of whimbrels staging in Virginia have shown a previously unknown link between the eastern and western populations as they stop-over in Virginia (Watts et al. 2008, http://ccb-wm.org/programs/migration/Whimbrel/whimbrel.htm). Further investigations to determine the origins of whimbrels using the Eastern Shore of Virginia as a stop-over site are underway.

Objectives

The objectives of this project are to:

1) examine the stop-over and migration strategies of whimbrels as they relate to the conservation of the species

2) document specific migration routes using satellite transmitters and radio transmitters

3) investigate stop-over dynamics using conventional radio transmitters

4) determine the proportion of western and eastern whimbrels utilizing the Eastern Shore of Virginia as a staging area.

METHODS

Study Area:

The Virginia Barrier Island/Lagoon system includes the seaward margin of the lower Delmarva Peninsula from the mouth of the Chesapeake Bay to the MD-VA border (centered on 37 30 N, 74 40 W) (Figure 1). The chain of 14 barrier islands protects an extensive lagoon system that contains over 85,000 ha of tidal marsh, mudflats, and open water. The area has been designated as a UNESCO Biosphere Reserve (http://www.unesco.org), a Western Hemisphere Shorebird Reserve Site with international status (http://www.whsrn.org) and is the site of a National Science Foundation Long-term Ecological Research site (http://amazon.evsc.virginia.edu) and the focus of a multi-organizational partnership dedicated to bird conservation. A large portion of this system is in protective ownership.

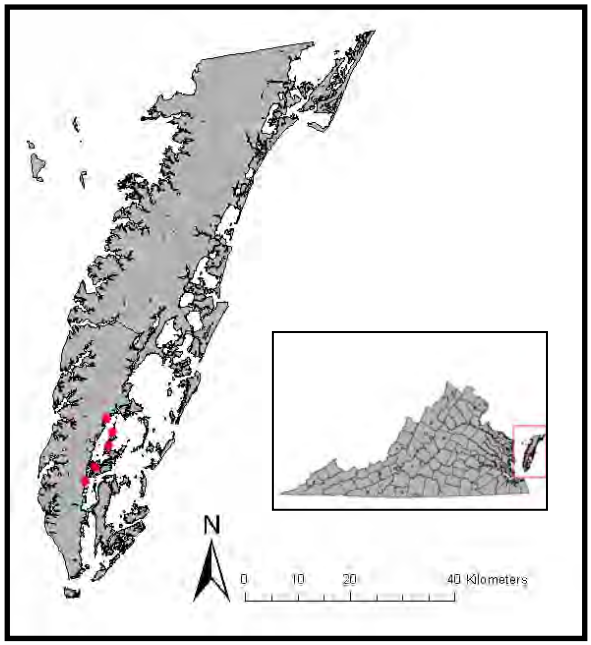

Figure 1. Location of all trapping sites (in red) on the Eastern Shore of Virginia portion of the Delmarva Peninsula, fall 2009 trapping season.

Trapping:

Trapping was conducted on all suitable days between 8 August and 5 September 2009. Whimbrels were captured using a modified rocket net capture system (Grubb 1991, King et al. 1998). Nets were placed within a waterproof box along the *Spartina alterniflora* line near the edge of tidal flats or creek banks used as high tide roosts (Figures 2 and 3). Recoilless rockets (flip-flop rockets) were attached to the net and placed on top of the box. The entire capture system was fully portable. Propellant was placed into the rocket and ignited electrically from a safe distance (>1000 feet). After ignition all birds were extracted and placed into holding cages until processing.

Figures 2 and 3. Camouflaged rocket nets set up within Box Tree Marsh in both spring (left) and fall (right).

Banding:

A serially numbered US Fish and Wildlife Service Incoloy® band was attached below the right metatarsal joint of the bird. A field readable lime green alpha-numeric band was attached above the left metatarsal joint. A yellow wrap-around darvic band was placed above the alpha-numeric band to identify the bird to banding location (Figure 4). Standard morphometric measurements, including wing, tail and culmen were recorded. Feather samples were obtained to establish sex of the individual using DNA analysis, and also to determine breeding and wintering origin using stable isotope analysis.

Figure 4. Whimbrel with field readable alpha-numeric flag and colored wrap-around darvic band on left leg, and USFWS Incoloy® band on right leg.

Transmitter attachment:

Radio transmitters were attached using digitally coded glue-on 9 gram transmitters made by Advanced Telemetry Services, Inc. Feathers were trimmed to allow contact between cyanoacrylate gel glue and feather tracts/skin. Transmitters were placed on the synsacrum anterior to the uropygial gland (Figure 5).

A 9.5 gram satellite transmitter was attached using a modified leg-loop harness (Watts et al. 2008, Sanzenbacher et al. 2000, Rappole and Tipton 1991). A Teflon® ribbon was used in place of elastic cord. The ribbon was fastened with brass rivets and cyanoacrylate glue was used to reduce fraying of the ribbon (Figure 6). Whimbrels were observed before release to confirm freedom of movement with the transmitter attached.

Figures 5 and 6. Placement of radio transmitter (left) and satellite transmitter (right).

Radio Transmitter Analysis

Boat surveys were used throughout the season to identify roost sites and to confirm departure dates. Stationary scans were recorded daily at Box Tree Marsh to determine site fidelity to initial place of capture. Several aerial surveys were flown to locate whimbrels within the Virginia barrier island-lagoon system and outside stationary scan range.

We determined the stopover duration for whimbrel that were marked with VHF radio tags and monitored for presence during migration stopover in the fall of 2009. We initiated deployment of tags on 8 August during fall migration. For data analysis, we summarized mark-recapture data into 5-day periods and recorded when individual whimbrel were captured and their radio signal detected (recaptured) within each period. The fall season included 8 periods.

In determining stopover duration, we took into account the amount of time that whimbrels remained in the study area after marking and were present in the study area before marking by analyzing data using recruitment models (Pradel 1996) and Stop Over Duration Analysis (SODA) (Schaub et al. 2001).

Recruitment, or reverse-time models, estimate apparent survival rates, re-sight probabilities and recruitment rates. Apparent survival is the product of the true survival rate and the rate of permanent emigration from the study area. Over the short duration of a migratory stopover, true survival is assumed to be equal to 1, therefore apparent survival is reduced to the emigration rate from the stopover location. Because hatching does not occur during migration, the recruitment rate is the probability of an individual arriving at the stopover location. Re-sight rates are the probability of an individual being captured or subsequently observed at each time step.

We used Program Mark (White and Burnham 1999) and information theoretic approaches (Burnham and Anderson 2001, Burnham and Anderson 2002) to determine the best model among a set of candidate models used to describe the stopover process. Our candidate model set allowed recruitment and emigration rates to be constant throughout the stopover period, vary by 5 day interval, or vary by 10 day interval. We assumed that resight rates differed for each 5 day interval of the study. To estimate stopover duration, we entered the best model into SODA to estimate stopover duration. This program calculated the average duration of stopover for each time period that a whimbrel was present in our study area.

RESULTS

Trapping

A total of 27 whimbrels were caught between 8 August and 5 September 2009. Twenty whimbrels were captured in Box Tree Creek, four were captured on Elkins Marsh tidal roosts, and two were captured on Webb's Island.

Satellite Transmitter Results

A total of four 9.5 gram PTT satellite transmitters were deployed during the fall migration season (Figure 7). Average weight for the whimbrels with transmitters was 527.2 grams or approximately 200 grams over mean winter (lean) weight. Satellite transmittered whimbrels departed the Eastern Shore between 1 September and 20 September 2009.

Several unusual migration events were observed during the fall season. Twelve flights greater than 1,000km were documented during the fall. These flights took an average of 95 hours to complete. The average distance traveled during these flights was 2,697km. A total of 5 shorter flights on wintering grounds were also documented, with birds moving from initial locations in Dominica, Venezuela, and Guyana into French Guiana, Suriname, and Brazil (Figures 8-11), the primary wintering grounds for eastern whimbrels (Morrison and Ross 1989). The mean distance traveled on these flights was 597km with the mean time in flight 47.3 hours.

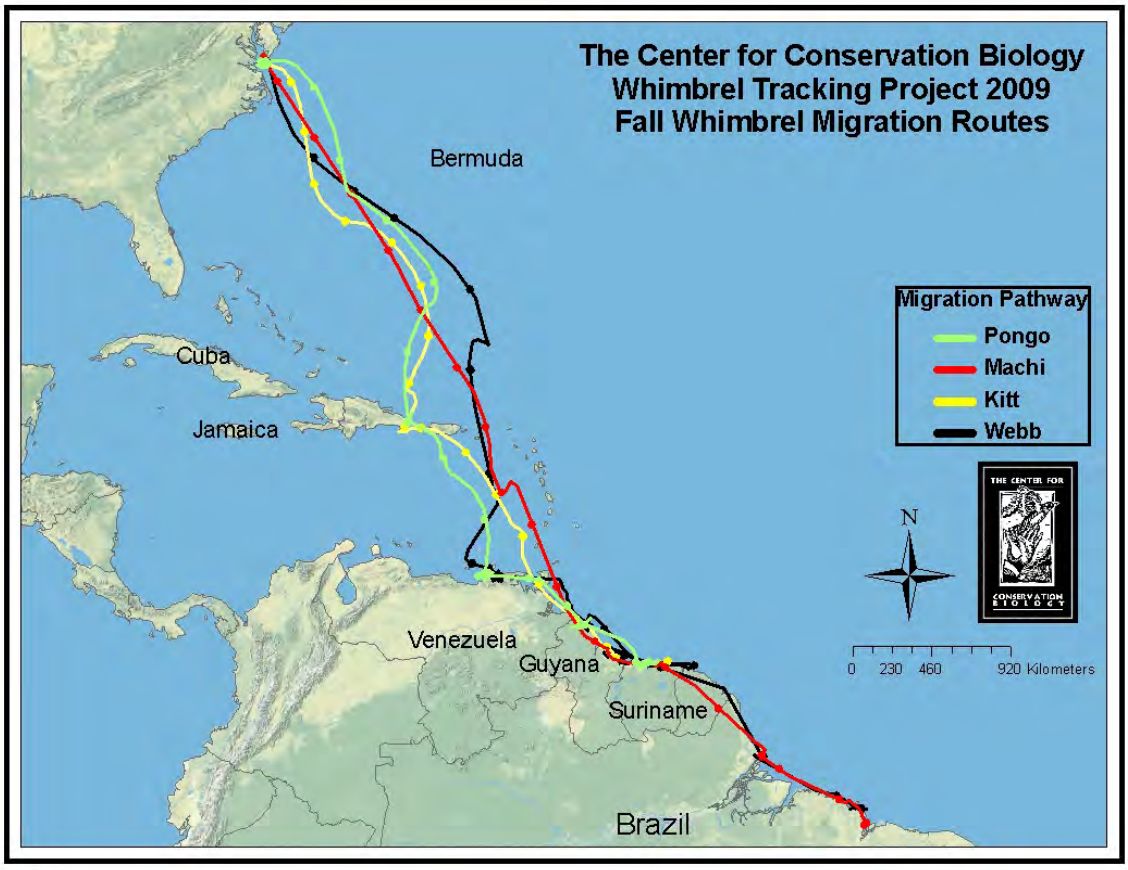

Figure 7. Composite map of all whimbrel migration events during the fall 2009 trapping season.

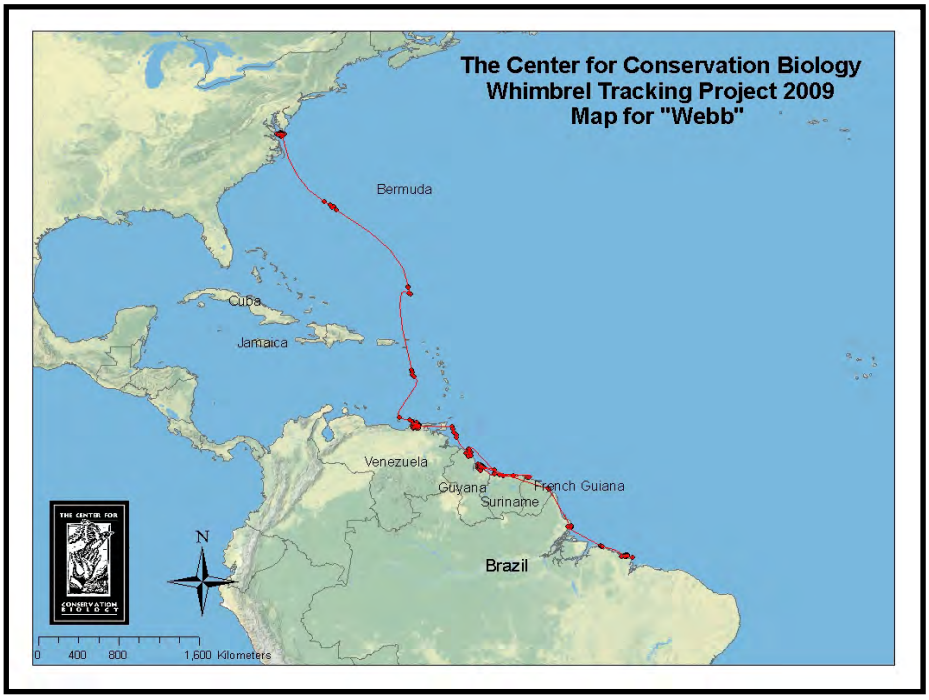

Figure 8. Map of Webb's migration through December 2009.

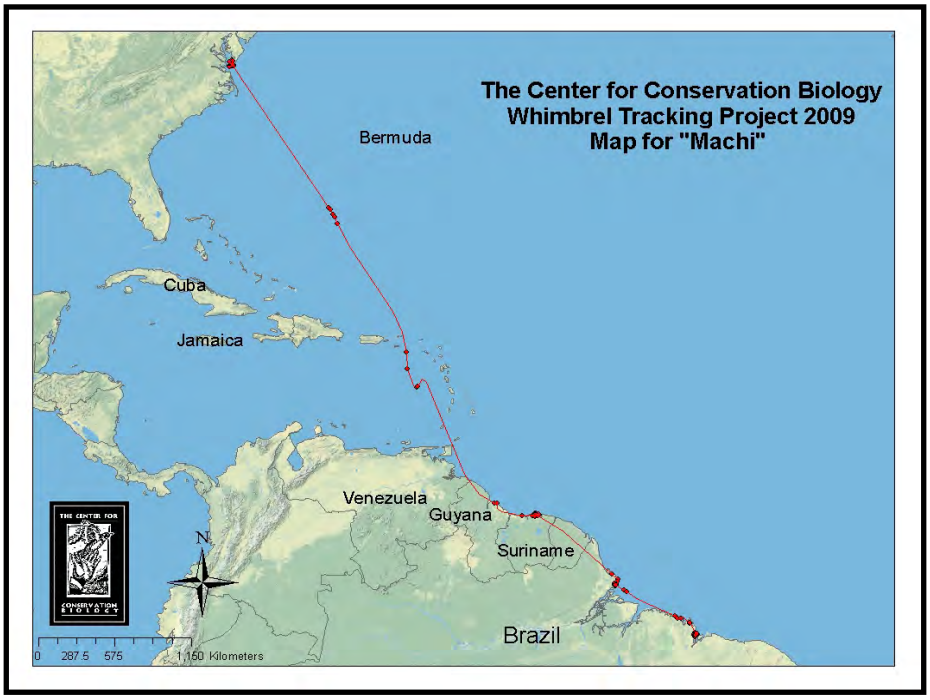

Figure 9. Map of Machi's Migration through December 2009. Transmitter signal was lost in late December.

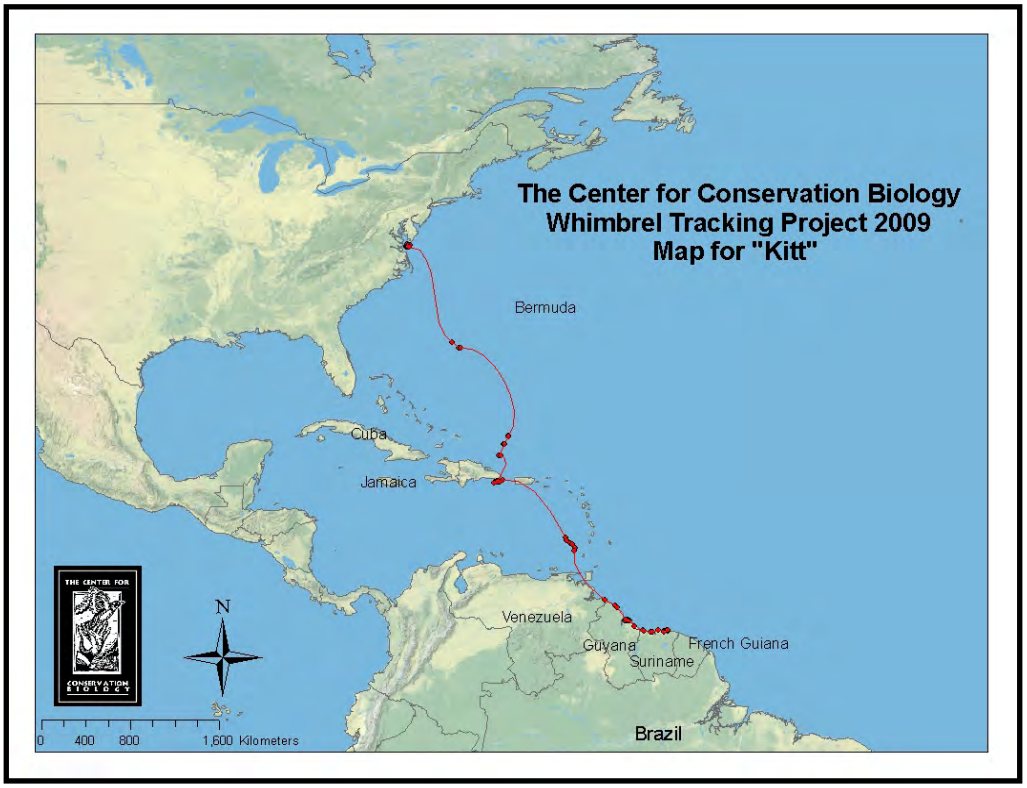

Figure 10. Map of Kitt's migration through December 2009.

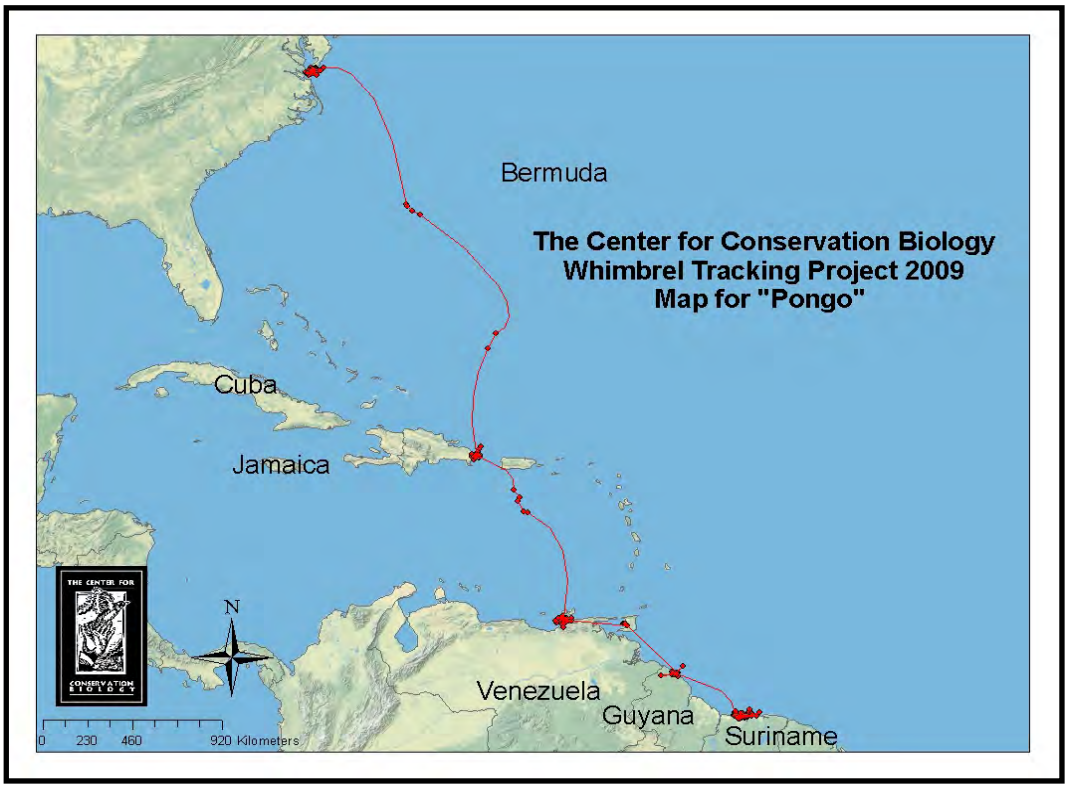

Figure 11. Map of Pongo's migration through December 2009.

Radio Transmitter Results

We were unable to check fit of the global model in Program MARK because our small sample size (N=10). Fall stopover was calculated assuming constant arrival and departure rates and time-dependent re-sight (Figure 12). We did not use model selection to compare alternative models because sample size was small. Given this small sample size, data is greatly over-dispersed, and any correction would select for the most conservative model (the model with the fewest parameters). These results should be interpreted with caution and used only as preliminary estimates of fall stopover dynamics.

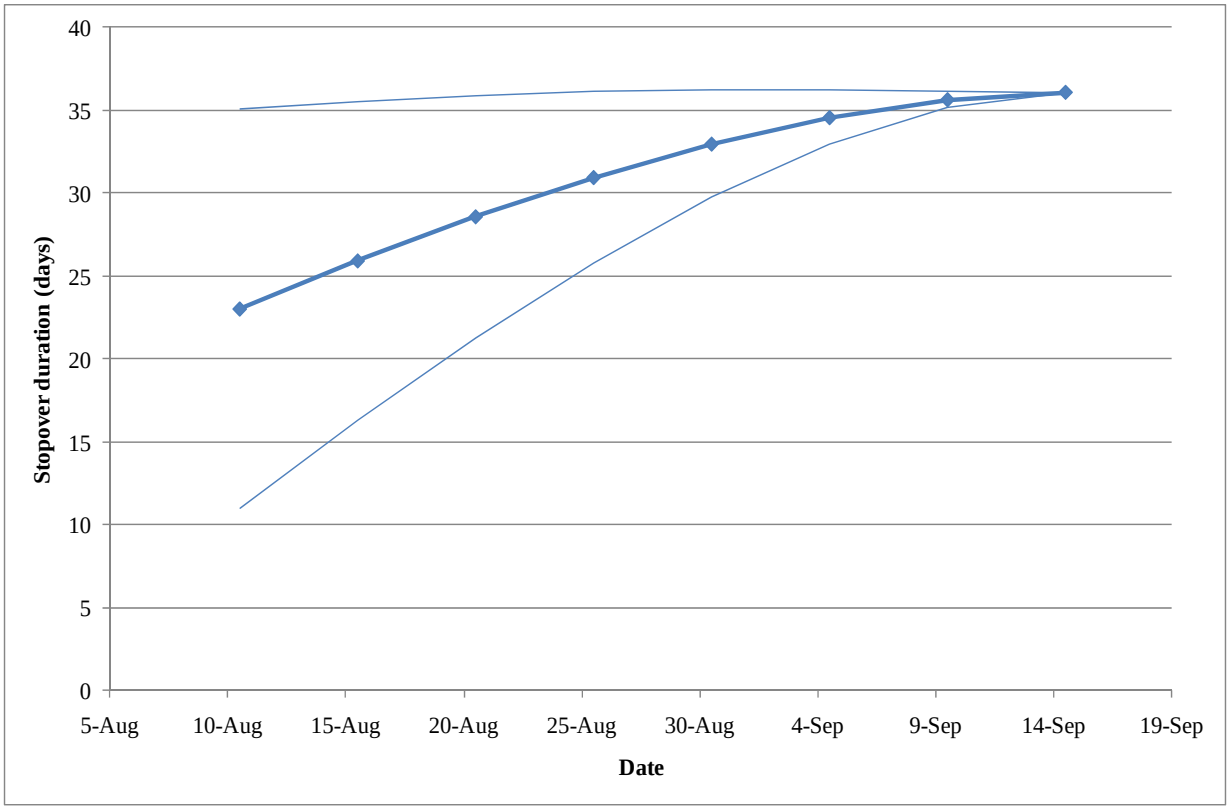

Figure 12. Duration that Whimbrel stopover in Virginia during fall migration. Stopover duration is given for 5 day periods, beginning 8 August. Lighter lines denote upper and lower bounds for 95% Confidence Intervals.

DISCUSSION

The whimbrel is one of a group of shorebirds that breed in the Hudson Bay Lowlands in subarctic tundra and alpine habitat (Skeel and Mallory 1996). Most in this group of

long-distance migrant shorebirds appear to be in decline (Bart et al. 2007, Morrison et al. 2006, Watts and Truitt in press), and the reasons for these declines are poorly understood. Hunting pressure, development of coastal wetlands and mangrove forests, human disturbance, and environmental contaminants remain a potential problem at migration and wintering sites (Ottema and Spaans 2008, Skeel and Mallory 1996, Vermeer and Castilla 1991, Mizrahi pers comm.). Pressures on breeding grounds include impacts of climate change (Walther et al. 2002) and large scale changes in plant distribution that have shifted the breeding range (Ballantyne 2009).

Satellite tracking data provides detailed habitat use of whimbrels during migration and on wintering grounds. This detailed information confirms the importance of critical staging areas during the life cycle of the whimbrel. At present (January 2010), all four satellite transmittered whimbrels are currently in Western Hemisphere Shorebird Reserve Network (WHSRN) Sites of Hemispheric Importance in South America. Satellite data, combined with detailed stopover data collected from radio tagged whimbrels, provides information on stop-over ecology and migration routes that are critical in the management of whimbrels and related long-distance migrant shorebirds. Preliminary data suggests that whimbrels stage in Virginia from 23.0 to 36.0 days, with the duration of stay increasing in later arriving birds. This is in contrast to spring migrants, where later arriving birds stay shorter periods of time than earlier arriving birds (CCB unpublished data). Arrival dates in Virginia are poorly modeled due to low sample size and late initial catch dates of whimbrels. A higher sample size of radio tagged migrants, distributed throughout the fall migration season, is needed to refine stop-over times of whimbrels in Virginia to better understand the importance of the location as a terminal staging area.

The whimbrel is a fiddler crab (*Uca sp.*) specialist in migration and on wintering grounds (Zwarts and Blomert 1990, Zwarts 1985, Mallory 1981). The indigestible matter of the carapace of the crabs creates a digestive bottleneck effect, where birds must pause from foraging to allow for digestion of the crabs (Zwartz and Blomert 1990, Zwartz and Dirksen 1990). The abundance of fiddler crabs on the Eastern Shore during both spring and fall migrations make this an extremely important stop-over site for whimbrels in both migration seasons. Individually marked whimbrels have been observed in both spring and fall migration seasons, suggesting site fidelity in both migration periods. One whimbrel transmittered in spring migration flew non-stop from breeding grounds near Hudson Bay back to Box Tree Marsh, the initial place of capture (http://ccb-wm.org/programs/migration/Whimbrel/88039.pdf). Studies focusing on quantifying the density and distribution of fiddler crabs on the Eastern Shore and to quantify foraging rates of whimbrels at this staging area are planned for both spring and fall 2010 migration seasons.

Several transoceanic migration events were captured during the fall migration. Two whimbrels migrated from the Eastern Shore directly to the shores of South America (Venezuela and Guyana). The other two transmittered birds flew to the Dominican Republic, staging there before continuing their migration to coastal South America. None of the four birds flew directly to their wintering grounds, all staged briefly at one or more sites in the Caribbean or in South America before continuing on to wintering

grounds. Further investigation of migration routes with satellite transmitters will likely show patterns of staging "hot spots", where congregations of whimbrels rest and fatten before continuing their journey to wintering grounds. These staging areas are important to survivorship of whimbrels in migration.

One of the most important aspects of whimbrel ecology documented is that an unknown proportion of birds utilizing the Eastern Shore of Virginia are of the western breeding population. Previously, all Atlantic Coast whimbrels were assumed to be of the eastern "Hudson Bay Lowlands" population (Andres et al. 2009, Skeel and Mallory 1996). Accurate population estimates of both eastern and western whimbrels are predicated on the idea that the two populations are segregated throughout their life cycle. It is critical that we be able to separate the two populations, whether by detailed study of DNA, finding origins through stable isotope analysis, or by morphometric differences. This will be a focus of research in the coming year.

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LITERATURE CITED

Andres, B.A., J. A. Johnson, J. Valenzuela, R. I. G. Morrison, L. A. Espinosa & R. K. Ross. 2009. Estimating Eastern Pacific Coast Populations of Whimbrels and Hudsonian Godwits, with an Emphasis on Chiloé Island, Chile. Waterbirds 32(2):216-224.

Ballantyne, K. 2009. Whimbrel (*Numenius phaeopus*) nesting habitat associations, altered distribution, and habitat change in Churchill, Manitoba, Canada. M.Sc. thesis. Trent University, Peterborough, Ontario, Canada.

Bart, J., S. Brown, B. Harrington and R.I.G. Morrison. 2007. Survey trends of North American shorebirds: population declines or shifting distributions? Journal of Avian Biology 38:73-82.

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. The U.S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, MA.

Burnham, K. P. and D.R. Anderson. 2001. Kullback-Leibler information as a basis for strong inference in ecological studies. Wildlife Research 28:111-119.

Burnham, K. P. and D.R. Anderson. 2002. Model Selection and Multimodel Inference: a Practical Information-Theoretic Approach. Springer, New York.

Center for Conservation Biology at the College of William and Mary/Virginia Commonwealth University (Website). http://ccb-wm.org/programs/migration/Whimbrel/whimbrel.htm. Accessed January 2010.

Center for Conservation Biology at the College of William and Mary/Virginia Commonwealth University (Website). http://ccb-wm.org/programs/migration/Whimbrel/88039.pdf. Accessed January 2010.

Engelmoer, M. and C.S. Roselaar. 1998. Geographical Variation in Waders. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Grubb, T.G. 1991. Modifications of the Portable Rocket-Net Capture System to Improve Performance. United States Forest Service Research Note RM-502.

Jehl, J.R. Jr., and B.A. Smith. 1970. Birds of the Churchill region, Manitoba. Manitoba Mus. Man and Nature Spec. Publ. no. 1.

King, D.T., J.D. Paulson, D.J. Leblanc, and K. Bruce. 1998. Two Capture Techniques for American White Pelicans and Great Blue Herons. Colonial Waterbirds 21(2): 258-260.

Mallory, E. P. 1981. Ecological, behavioral and morphological adaptations of a migratory shorebird (the Whimbrel, *Numenius phaeopus hudsonicus*) to its different migratory environments. Ph.D.diss. Dartmouth College, Hanover, NH.

Morrison, R.I.G, B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor, and B.A. Andres. 2006. Population estimates of North American shorebirds, 2006. Wader Study Group Bulletin 111:67–85.

Morrison, R. I. G. and R. K. Ross. 1989. Atlas of Nearctic shorebirds on the coast of South America. Vols. 1 and 2. Canadian Wildl. Serv. Spec. Publ. 325 pp.

Ottema, O. H. and A.L. Spaans 2008. Challenges and advances in shorebird conservation in the Guianas, with a focus on Suriname. Ornitología Neotropical 19:339-346

Pradel, R. 1996. Utilization of capture-mark-recapture for the study of recruitment and population growth rate. Biometrics 52:703-709.

Rappole, J.H. and A.R. Tipton. 1991. New harness design for attachment of radio transmitters to small passerines. Journal of Field Ornithology 62:335–337.

Sanzenbacher, P.M., S.M. Haig, and L.W. Oring. 2000. Application of a modified harness design for attachment of radio transmitters to shorebirds. Wader Study Group Bulletin 91:16–20.

Schaub, M., R. Pradel, L. Jenni, and J.-D. Lebreton. 2001. Migrating birds stop over longer than usually though: an improved capture-recapture analysis. Ecology 82:852-859.

Skeel, M. A. and E. P. Mallory. 1996. Whimbrel (*Numenius phaeopus*). The Birds of North America, No. 219 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and the American Ornithologists' Union, Washington, D.C.

Vermeer, K. and J.C. Castilla. 1991. High cadmium residues observed during a pilot study in shorebirds and their prey downstream from the El Salvador copper mine, Chile. Bull. Environ. Contam. Toxicol. 46:242-248.

White, G. C. and K.P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46:120-138.

Walther, G., E. Post, P. Convey, A. Menzel, C. Parmesan, T. Beebee, J. Fromentin, O, Hoegh-Guldberg, and F. Bairlein. 2002. Ecological responses to recent climate change. Nature 416:389-395.

Watts, B.D., B.R. Truitt, F.M. Smith, E.K. Mojica, B.J. Paxton, A.L. Wilke, and A.E. Duerr. 2008. Whimbrel tracked with satellite transmitter on migratory flight across North America. Wader Study Group Bulletin 115(2):119-120.

Watts, B.D. and B.R. Truitt. Decline of Whimbrels within a mid-Atlantic staging area (1994-2009). In Press.

Wilke, A.L. and R. Johnston. 2009. Conservation Plan for the Whimbrel (*Numenius phaeopus*). Version 1.0. Manomet Center for Conservation Sciences, Manomet, Massachusetts.

Zwarts, L. 1985. The winter exploitation of fiddler crabs *Uca tangeri* by waders in Guinea-Bissau. Ardea 73:3-12.

Zwarts, L. and S. Dirksen 1990. Digestive bottleneck limits the increase in food intake of Whimbrels preparing their departure from the Banc d'Arguin, Mauritania, in spring. Ardea 78: 257-278.

Zwarts, L. and A.M. Blomert. 1990. Selectivity of Whimbrels feeding on fiddler crabs explained by component specific digestibilities. Ardea 78:193-208.