

0023284

From: [Thayer Broili](#)
To: [Ted Simons](#)
Cc: [David Allen](#); [Britta Muiznieks@nps.gov](mailto:Britta_Muiznieks@nps.gov); [Sue Cameron](#); ['jessica stocking'](#); jim_fleming@usgs.gov; Michael_Rikard@nps.gov; ['Shiloh Schulte'](#); [Mike Murray](#); [Darrell Echols](#)
Subject: Re: NFWF American Oystercatcher Initiative and Grant
Date: 03/18/2009 04:36 PM
Attachments: [NFWF AMOY Proposal Narrative.docx](#)
[Stutchbury WOTH PUMA geolocators 2009 Science.pdf](#)

Ted,

Good to hear from you and congratulations of your new and continued AMOY research initiative. I'm copying Superintendent Mike Murray and Deputy Superintendent Darrel Echols so they can be up to date on what's going on. Give us a couple of days to digest and I'll get back to you on your issues. I would imagine we will want to issue a press release and we can discuss the details when we get back to you. Also, we'd very much like to meet with you and Jessica in the next several weeks. Britta is out of the Park from April 3 through 13 and I believe Mike and Darrell may also be scheduled to be gone sometime in that timeframe, but we'll get a tentative timeframe together for the visit when we get back on the press release.

Thanks for the information and we look forward to collaborating in your efforts.

Thayer Broili
Chief of Resource Management
Cape Hatteras National Seashore
Phone 252-473-2111 ext.137
Fax 252-473-2595
▼ ["Ted Simons" <tsimons@ncsu.edu>](mailto:tsimons@ncsu.edu)

"Ted Simons"
<tsimons@ncsu.edu>

03/18/2009 01:19 PM

To <Michael_Rikard@nps.gov>,
<Thayer_Broili@nps.gov>,
<Britta_Muiznieks@nps.gov>
cc <jim_fleming@usgs.gov>, "'Tom Kwak'"
<tkwak@ncsu.edu>, "'Shiloh Schulte'"
<saschult@unity.ncsu.edu>, "'jessica stocking'"
<jessica.stocking@gmail.com>, "Sue Cameron"
<camerons@coastalnet.com>, "David Allen"
<allend@coastalnet.com>, "'GOLDER, Walker'"
<WGOLDER@audubon.org>
Subject NFWF American Oystercatcher Initiative and Grant

Hello Michael, Thayer, and Britta,

The [National Fish and Wildlife Foundation](#) has selected the American Oystercatcher as one of a handful of focal species targeted for broad conservation initiatives over the next decade. They have proposed to

0023285

dedicate as much as \$10 million during that time to promote Oystercatcher conservation from Massachusetts to Florida. Walker Golder (NC Audubon), Sue Cameron (NC Wildlife Resources Commission), and I submitted a proposal to the Foundation last fall for research and management activities related to AMOY conservation in North Carolina. We recently learned that our proposal has been funded for the next three years and Walker, Sue, and I will collaborate on several objectives related to AMOY management on Federal, State, and private lands in the state (see attached NFWF AMOY Proposal Narrative).

With Shiloh Schulte graduating this summer, I have recently hired a technician, Jessica Stocking, who will help continue the productivity monitoring and mark-resight studies at Lookout and Hatteras this spring. I am planning to recruit a new graduate student to continue our work in the fall. We plan to deploy up to 20 [Geolocators](#) on birds this breeding season. These tags, which were used recently to track Wood Thrush from Pennsylvania to Brazil (see attached article) are capable of recording location information for up to 6 years. They should give us a much better picture of where our birds are going in the non-breeding season.

I would like to set up a time to visit over the next few weeks to introduce Jessica, and discuss plans for the field season. I'm also wondering if you think the National Park Service would be interested in issuing a press release about the NFWF focal species initiative and the grant for Oystercatcher work in North Carolina. Due to the management controversies surround this species and ORV's, I think it is important that we be proactive in informing the public that the funding is coming from an independent non-profit organization that supports wildlife conservation initiatives across the country, and that two of our primary objectives for the work involve studies of predator management, and understanding the importance of non-traditional nesting habitats on dredge spoil and marsh habitats. Both of these objectives were identified in the recent negotiated rulemaking process as priorities for future research and management.


Please let me know when we might visit over the next few weeks and your thoughts about issuing a press release. Thanks.

Best regards,

0023286

Ted
Ted Simons
Professor
USGS Cooperative Research Unit
Department of Biology
Box 7617 NCSU
Raleigh, NC 27695
919-515-2689
919-515-4454 Fax
tsimons@ncsu.edu

<http://www4.ncsu.edu/~simons>  NFWF AMOY Proposal Narrative.docx

 Stutchbury WOTH PUMA geolocators 2009 Science.pdf



National Fish and Wildlife Foundation - Keystone Initiative - Birds - Fall 2008, Full Proposal
 Title: American Oystercatcher Conservation Initiative--NC

Full-proposal Project Narrative

1. Long-Term Conservation Outcome(s): Elaborate on the long-term conservation outcome(s) summarized previously in the application; discuss what makes this outcome(s) achievable and important.

The American Oystercatcher (*Haematopus palliatus*) is recognized as an important indicator of ecological conditions on Atlantic coast beaches. Because the birds nest and feed along the outer beach, their populations are threatened by a variety of problems related to human activity including disturbance related to human recreation and off road vehicles (ORV's), loss of nesting habitat due to coastal development, erosion, and predation from introduced predators such as feral cats, red fox, dogs, rats, and super-abundant predators that thrive in the presence of humans, such as raccoon. Sensitivity to these problems and the fact that American Oystercatchers are large, conspicuous, and long-lived, makes them excellent indicators of environmental conditions in the coastal zone. Although oystercatchers are conspicuous breeders from Maine to Florida, evidence of population declines in several states is raising concern over the status of their populations. The US Shorebird Conservation Plan lists American Oystercatchers as a high priority species, and the bird was recently upgraded to a species of special concern in North Carolina, in part because of significant threats from development and heavy recreational use of coastal breeding habitats. A recent lawsuit and subsequent consent decree over the effects of beach driving on breeding coastal birds at Cape Hatteras National Seashore identified American Oystercatchers as a focal species which will serve as model for evaluating future management efforts.

Key long-term conservation outcomes resulting from this initiative will include: 1) Implementation of direct conservation actions focused on preventing human disturbances at 27 estuarine island and 3 barrier island nesting sites in NC; 2) An assessment of the feasibility and response of breeding oystercatchers to the removal of predators and the development of conservation strategies for predator management; 3) An assessment of the before and after response of breeding Oystercatchers to ORV management and a measure of productivity gains that can be expected when ORV disturbance during the breeding season is minimized; 4) An assessment of the relative costs of reproduction on traditional ocean-side sites (where birds can walk to foraging sites) and nontraditional sound-side, river estuary, man-made island, and mainland breeding sites where adult birds fly between foraging and nesting areas when they are provisioning their chicks, which will help identify habitats likely serving as population sources or sinks so that future management and habitat acquisition efforts can be targeted where they will provide the greatest population level response; 5) An assessment of key non-breeding stopover and wintering sites, disturbances and potential disturbances at these sites, and the development of conservation strategies for non-breeding sites; 6) The development and implementation of a secure online database for managing mark-resight records and productivity data for

Oystercatchers in the eastern United States; 7) Increased public awareness of human related threats to beach and island nesting birds, focused on species such as oystercatchers, piping plovers, other shorebirds, terns, and Black Skimmers.

2. Threats and/or Opportunities: Elaborate on the relationship of threats and/or opportunities to the long-term conservation outcome(s) and describe which of these threats and/or opportunities will be addressed in the project.

The "American Oystercatcher Conservation Plan" and "Business Plan for the Conservation of the American Oystercatcher" identified five major threats to American Oystercatchers. These include: loss of habitat from coastal development, disturbance from human recreational activities, elevated predation from predators associated with human activities, potential contamination of food sources, and global climate change. To address these threats, the Conservation Plan recommends the following: identification and protection of existing habitat, creation of new habitat, management of existing protected areas to reduce predation and disturbance, control of predator populations, and monitoring of population status and trends to measure conservation effectiveness.

The NC American Oystercatcher Conservation Initiative offers a unique partnership and opportunities to address the most significant threats to Oystercatchers and associated shorebirds and colonial waterbirds over a diverse suite of sites along most of the NC coastline. We will implement direct conservation actions focused on preventing human disturbances at 30 sites in public or private conservation ownership from Oregon Inlet to Cape Fear. Cape Hatteras National Seashore has recently implemented new policies to minimize the effects of ORV's on breeding birds. This provides an excellent opportunity to document the response of breeding Oystercatcher populations at Cape Hatteras National Seashore to newly implemented ORV management policies. Findings will build on 10 years of productivity monitoring conducted by the USGS Cooperative Fish and Wildlife Research Unit at NC State University. Predator studies at Cape Lookout National Seashore provide a unique opportunity to build on existing predator studies and measure the response of oystercatcher populations to predator management at Cape Lookout and at least one additional site. Personnel funded from this grant will enable us to monitor and assess nesting success at a diverse array of traditional and non-traditional nesting sites across the coastal region of NC, from Oregon Inlet to Cape Fear, which will help identify habitats likely serving as population sources or sinks so that future management and habitat acquisition efforts can be targeted where they will provide the greatest population level response. Personnel stationed in the northern, central, and southern coastal regions of NC will enable us to assess sites important for non-breeding oystercatchers (and other shorebirds) and potential disturbances at these sites. The existing oystercatcher database is outdated and labor intensive to enter, retrieve, and manage the volume of data being generated by researchers and partners along the Atlantic Coast. Based on existing database models developed for similar datasets in other states and in cooperation with the American Oystercatcher Working Group, we will create a secure, online database that is streamlined and efficient at managing oystercatcher data. Results from this initiative will be important in the development of conservation strategies for oystercatchers and associated species in NC, prioritization of conservation actions, protection of key sites, management and/or restoration of sites, and the design and placement of dredged sand on coastal islands.

- 3. Activities:** Elaborate on the primary activities that will be employed through the grant. Explain how these activities address the threats, opportunities and/or conservation outcome(s) described above. How do these activities relate to established plans (management, conservation, recovery, etc.)?

Predator Management: Managing predators to benefit breeding American Oystercatchers has been identified as a priority in the business plan drafted by the American Oystercatcher Working Group. There are few established guidelines in this area, and we believe initial efforts should focus on identifying the potential return on investment for different predator management strategies, and on avoiding the unintended consequences that can occur when management alters predator-prey relationships without the knowledge required to make informed decisions. We will do this by leveraging an on-going project evaluating the costs and benefits of partial raccoon removal on South Core Banks, Cape Lookout National Seashore, to make comparisons with total raccoon removals on two smaller islands in coastal North Carolina. The project on South Core Banks, funded by the National Park Service and the USGS (\$215,000 in 2006), is assessing the response of breeding American Oystercatchers, sea turtles, and Piping Plovers to a 50% reduction in the raccoon population. The project is directed by Dr. Ted Simons, USGS NC State, and Dr. Alan O'Connell, USGS Patuxent Wildlife Research Center. To date more than 150 raccoons on South Core banks have been individually marked and 60 animals radio collared. Radio telemetry and mark-resight studies using an array of infrared cameras on the island are providing estimates of raccoon population size, and demographics and an unprecedented picture of island raccoon ecology. The removal phase is scheduled for the fall/winter of 2008/2009 and monitoring will continue for six months after reducing the raccoon population by approximately 50%. We propose to continue research on raccoon and prey species on South Core Banks for an additional 36 months to determine the rate at which raccoon and American Oystercatcher populations respond to predator management. This work will be coordinated through the Cooperative Fish and Wildlife Research Unit at NC State University. Expanded monitoring will allow researchers to assess whether populations of non-target species such as mink or feral cats show responses to raccoon removal. We will simultaneously attempt total raccoon removals on up to two smaller islands in coastal North Carolina, Lea and Hutaff Islands, managed by the National Audubon Society, and Middle Core Banks, managed by the National Park Service. This work will determine the feasibility of total removal on small islands, the relative costs and benefits of partial versus total removal strategies, and quantify the benefits realized by breeding American Oystercatchers in the form of increased reproductive success.

Management of Disturbance—Breeding: Human disturbance can affect oystercatchers at every point in their life cycle. In particular the negative effects of human recreation and off-road vehicle use on nesting beaches are well documented. Cape Hatteras National Seashore has recently implemented new policies to minimize the effects of ORV's on breeding birds. We will document the response of breeding Oystercatcher populations at Cape Hatteras National Seashore to newly implemented ORV management policies. Findings will build on 10 years of productivity monitoring conducted by the USGS Cooperative Fish and Wildlife Research Unit at NC State University. Results will provide a before-after comparison of the response of breeding Oystercatchers to ORV management and a measure of productivity gains that can be expected when ORV disturbance during the breeding season is minimized. We will also implement direct protection measures at nesting sites throughout southern NC (Cape Fear River estuary, Lea and Hutaff Islands, Masonboro Island), southern Pamlico Sound islands (near Cedar Island and Ocracoke Inlet), and northern Pamlico Sound (islands near

Oregon Inlet) by posting, patrolling, and monitoring these islands throughout the breeding season. We will also initiate planning and market research (year 1) and implementation (year 2) for a NC coastwide education and outreach campaign focused on oystercatchers, piping plovers, other shorebirds, terns, and Black Skimmers.

Management of Disturbance—Winter: Disturbance at winter roosts and foraging areas is poorly understood in NC. We will conduct regular surveys at selected inlets and beaches, known roost sites, and associated foraging sites, during migration and winter, to determine the distribution and abundance of non-breeding oystercatchers along North Carolina's coast, and to assess all sources and potential sources of human disturbances. We will then develop a plan and specific actions to reduce or eliminate disturbances at key sites, and raise public awareness about the effects of disturbance.

Monitoring and Demographic Studies: We view objectives for population monitoring and demographic studies as closely linked and propose to integrate our approaches to these two topics from the business plan. We seek to measure the relative importance of traditional and non-traditional nesting habitats in sustaining American Oystercatcher populations. As human pressure on coastal nesting sites increases we have seen a steady movement of nesting American Oystercatchers from ocean beaches to non-traditional nesting sites on dredge spoil islands, coastal marshes, and estuaries. Although these sites are more easily managed to limit human disturbance and predation we know nothing about the extent to which these habitats contribute to sustaining oystercatcher populations. We propose to expand current monitoring of oystercatcher productivity along the coastal barriers in North Carolina to inland sites managed by Audubon and the NC Wildlife Resources Commission in the Cape Fear Estuary and Pamlico Sound. We will measure nesting success, chick provisioning and growth rates, adult foraging ranges, and juvenile dispersal and survival to determine differences in the roles traditional and non-traditional nesting habitats play in sustaining oystercatcher populations. We will employ traditional radio telemetry and assess the potential of recently developed satellite/GPS telemetry to document patterns of foraging behavior, dispersal and survival. Mark-resight and telemetry studies will provide direct metrics of the relative costs of reproduction on traditional ocean-side sites (where birds can walk to foraging sites) and nontraditional sound-side, river estuary, and mainland breeding sites where adult birds fly between foraging and nesting areas when they are provisioning their chicks. This information will help identify habitats likely serving as population sources or sinks so that future management and habitat acquisition efforts can be targeted where they will provide the greatest population level response.

Data Management: We will also create a secure, online database to manage all banding, re-sight, productivity, and survey/census data for all Atlantic Coast states in coordination with the American Oystercatcher Working Group.

4. Outcomes and Indicators: Describe the general monitoring approach that will be used to assess progress on one or more of the indicators presented previously in the application. Please note any challenges or limitations you anticipate in conducting this monitoring or the interpretation of anticipated results.

Nesting success: Breeding pairs will be located; nests will be located, marked, and monitored at least 2d/wk (more frequently where possible) through hatching; broods will be located and monitored at least 2d/wk

through fledging, sources of nest, egg, and/or chick loss will be determined; at selected sites we will measure nesting success, chick provisioning and growth rates, adult foraging ranges, and juvenile dispersal and survival to determine differences in the roles traditional and non-traditional nesting habitats play in sustaining oystercatcher populations, and we will employ traditional radio telemetry and assess the potential of recently developed satellite/GPS telemetry to document patterns of foraging behavior, dispersal and survival. Descriptive nest site, habitat data, disturbance/potential disturbance data will be collected at each site.

Human Disturbances: Nesting sites under the jurisdiction of state agencies and Audubon NC will be posted using standard symbolic fencing methods that are appropriate for beaches or islands, with appropriate buffer distances; sites will be monitored to discourage trespass and associated disturbances; and initial campaign planning will commence to raise public awareness of oystercatchers and other beach-nesting birds and threats to these species from human disturbances.

Distribution and abundance of non-breeding oystercatchers: Sites with suitable habitats associated with Oregon Inlet, Ocracoke Inlet, Back Sound (near Morehead City), Lea-Hutaff Island and associated inlets, Topsail Sound, Middle Sound, Masonboro Sound, Atlantic Intracoastal Waterway, and lower Cape Fear River will be surveyed weekly; locations and # of individuals will be recorded; descriptive data for survey period will be recorded (tide, weather and other environmental conditions, associated species & #s, etc.); selected flocks will be observed to a fixed period to determine disturbances and source(s) of disturbances; potential sources of disturbance will be recorded (pedestrians, boats, dogs, vehicles, etc.) will also be recorded.

Data Management: A secure, online database to manage all banding, re-sight, productivity, and survey/census data for all Atlantic Coast states in coordination with the American Oystercatcher Working Group will be created and implemented.

5. Project Team: List key individuals and describe their qualifications relevant for project implementation.

Dr. Ted Simons, Professor and Assistant Unit Leader, USGS Cooperative Research Unit/ NCSU Department of Zoology; Ted began studying American Oystercatchers on the Outer Banks of North Carolina in 1996. Since then his MS and Ph.D. students have studied various aspects of Oystercatcher breeding and population biology across coastal North Carolina. Ted was a co-founder of the American Oystercatcher Working Group and represented the group at international conferences on Oystercatcher conservation in France and the Netherlands in 2007. On-going research is examining factors affecting nesting success and the population dynamics of Oystercatchers on Cape Hatteras and Cape Lookout National Seashore and the effects of predator removal on Oystercatcher productivity at Cape Lookout National Seashore. B.S. Wildlife Ecology, University of Wisconsin, 1975, M.S. Wildlife Biology, University of Washington, 1979, Ph.D. Wildlife Biology, University of Washington, 1983

Sue Cameron, Waterbird-Shorebird Biologist, NC Wildlife Resources Commission, Sue Cameron has been working in the field of avian conservation for thirteen years. She currently works as a Waterbird Biologist with North Carolina Wildlife Resources Commission and has been involved with management, research and monitoring of American oystercatchers, other shorebirds and colonial waterbirds in NC for six years. Her job with NCWRC focuses on managing state-owned islands for nesting waterbirds, coordinating coast-wide breeding surveys of shorebirds and colonial waterbirds, monitoring reproductive success of beach nesting birds, and working with coastal towns and US Army Corps of Engineers to assess and limit impacts of beach stabilization projects on breeding and non-breeding waterbirds. She holds a Master's in Environmental Management from Duke University and a Bachelor's in Marine Biology from Florida Tech.

Walker Golder, Deputy State Director, Audubon NC. Walker has 23 years of experience with NC colonial waterbirds and shorebirds, waterbird-shorebird conservation, and waterbird-shorebird research and management. He served as Coastal Coordinator of Audubon's NC Coastal Islands sanctuary Program, which focused on protecting nesting sites for waterbirds and shorebirds, from 1989 to 1999, and Deputy State Director of Audubon NC from 1999-present. He oversees Audubon's bird conservation and field programs, which include sanctuaries, Important Bird Areas, research and monitoring initiatives, as well as other initiatives. B.S. Biology, UNC-Wilmington 1985, M.S. Marine Biology UNC-Wilmington 1990.

Tracking Long-Distance Songbird Migration by Using Geolocators

Bridget J. M. Stutchbury,^{1*} Scott A. Tarof,¹ Tyler Done,¹ Elizabeth Gow,¹ Patrick M. Kramer,¹ John Tautin,² James W. Fox,³ Vsevolod Afanasyev³

Until now it has been impossible to track migratory songbirds to their tropical wintering grounds. Songbirds are far too small for satellite tracking, and our current understanding of individual movements comes from brief snapshots of the journey via radar images, opportunistic recaptures of banded individuals, studies of migrants on the ground refueling, and an exceptional study that followed radio-tagged songbirds by airplane (1–4). We tracked songbird migration by mounting light-level geolocators (5, 6) on 14 wood thrushes (*Hylocichla mustelina*) and 20 purple martins (*Progne subis*) breeding in northern Pennsylvania during 2007. The next summer we retrieved geolocators from five wood thrushes and two purple martins and analyzed sunrise and sunset times to reconstruct migration routes and estimate wintering locations (± 300 km).

Rapid long-distance movement occurred in both species, and prolonged stopovers were common during fall migration (Fig. 1). Both purple martins flew south 2500 km to the Yucatan Peninsula in 5 days (500 km/day) and, on the basis of longitude estimates, then had a stopover of 3 to 4 weeks in the region (fig. S1). Four wood thrushes spent 1 to 2 weeks in the southeastern United States in late October before crossing the Gulf of Mexico (Fig. 1C), and two individuals stopped on the Yucatan Peninsula for 2 to 4 weeks before continuing migration (Fig. 1D).

Wood thrushes overwintered in a narrow band from 83.7° to 85.0°W ($\pm 1.4^\circ$) in Honduras or Nicaragua (Fig. 1), suggesting a level of connectivity not previously documented for migratory songbirds. Stable isotope analysis of black-throated blue warbler (*Dendroica carulescens*) feathers, for instance,

showed that individuals wintering on western Caribbean islands originate from the northern portion of the breeding range, whereas those on easterly islands are from southern breeding areas (7).

Overall migration rate was 2 to 6 times more rapid in spring than in fall (table S1). One female martin (Fig. 1A) left the Amazon basin after the night of 12 April and flew about 7500 km in 13 days (577 km/day). Nine days involved migration flights, and 4 days were spent on stopover. Most wood thrushes returned to their breeding territory in only 13 to 15 days (233 to 271 km/day). One wood thrush did not cross the Gulf of Mexico on spring migration and took 29 days to complete the 4600-km overland route (Fig. 1D). Previous studies appear to greatly underestimate the true flight performance of migrating songbirds (4) because spring migration speed has typically been estimated at under 150 km/day.

Alarming long-term declines of migratory songbird species in North America and elsewhere heighten the urgency of mapping migration routes and wintering locations with far greater accuracy than is currently possible with stable isotope analysis (8). Tracking individuals to their wintering areas is essential for predicting the impact of tropical habitat loss and climate change (7, 9). Survival estimates can now be obtained from regions where individuals from a specific breeding population overwinter, improving our understanding of how wintering versus breeding threats drive population fluctuations of migratory songbirds.

References and Notes

- S. Gauthreaux Jr., C. G. Belsler, *Auk* **120**, 266 (2003).
- K. C. Ruegg, T. B. Smith, *Proc. R. Soc. London Ser. B* **269**, 1375 (2002).
- W. Yong, F. R. Moore, *Auk* **114**, 263 (1997).
- M. Wikelski et al., *Nature* **423**, 704 (2003).
- J. P. Croxall, J. R. D. Silk, R. A. Phillips, V. Afanasyev, D. R. Briggs, *Science* **307**, 249 (2005).
- S. A. Shaffer et al., *Proc. Natl. Acad. Sci. U.S.A.* **103**, 12799 (2006).
- D. R. Rubenstein et al., *Science* **295**, 1062 (2002).
- K. A. Hobson, *Auk* **122**, 1037 (2005).
- T. S. Sillett, R. T. Holmes, T. W. Sherry, *Science* **288**, 2040 (2000).
- B. J. M. Stutchbury, *Silence of the Songbirds* (Walker, New York, 2007).
- We thank C. Graziano, R. Kresnik, T. MacIntosh, M. MacPherson, E. Pifer, T. Piraino, S. Puppi, C. Silverio, and C. Stanley for field assistance. For funding, we thank the Natural Sciences and Engineering Research Council of Canada, the National Geographic Society, the Purple Martin Conservation Association, and proceeds from (10).

Supporting Online Material

www.sciencemag.org/cgi/content/full/323/5916/896/DC1

Materials and Methods

Fig. S1

Table S1

References

1 October 2008; accepted 4 December 2008

10.1126/science.1166664

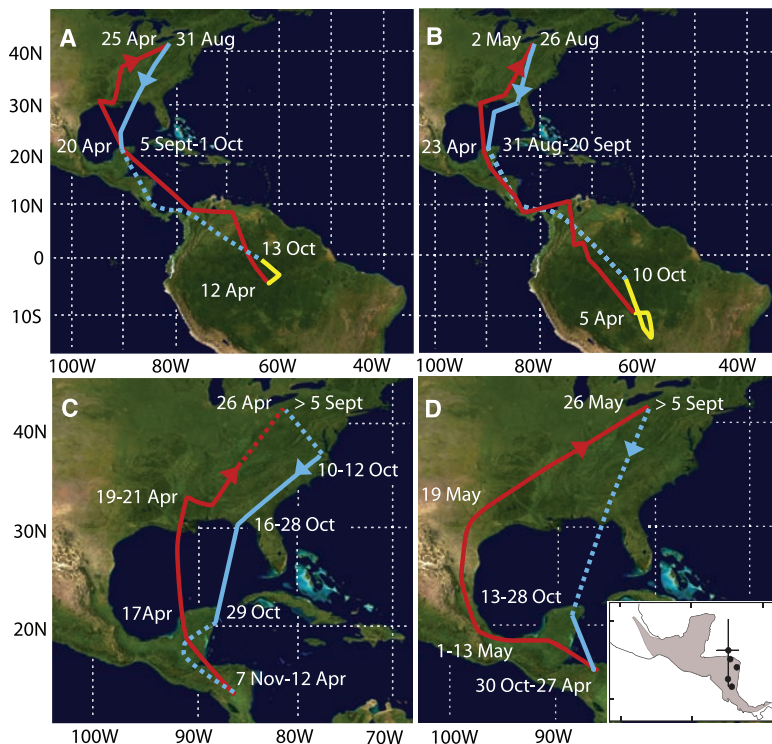


Fig. 1. Interpolated geolocation tracks of individual purple martins (A and B) and wood thrushes (C and D) that bred in northern Pennsylvania, USA (42°N, 80°W). Blue, fall migration; yellow, winter range movements; and red, spring migration. Dotted lines link locations when latitude could not be determined. Inset shows winter territory locations of wood thrush and species winter range (shaded); the standard deviation for one individual is shown.

¹Department of Biology, York University, Toronto, Ontario M3J 1P3, Canada. ²Purple Martin Conservation Association, Tom Ridge Environmental Center, 301 Peninsula Drive, Erie, PA 16505, USA. ³British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 0ET, UK.

*To whom correspondence should be addressed. E-mail: bstutch@yorku.ca