Application for the College Academy of Research, Scholarship and Creative Activity, February 24, 2014, College of Arts and Sciences, Mathematics and Natural Sciences Division

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Jaguar Conservation in Southern Belize: Prospects and Challenges in a Mayan Cultural Ecological Landscape

Abstract: Belize is a critical landscape for the conservation of jaguars (*Panthera onca*) in Central America. Within Belize itself, the Toledo District, located in the southern quarter of the country, presents a unique conservation challenge in the overall efforts to protect the largest carnivore in the Americas because it is home to more than 30 Mayan villages, whose inhabitants practice slash and burn agriculture. However, even though forests in heart of the District are impacted by slash and burn agriculture, the principle investigator's (PI) preliminary field investigations in two Mayan villages in June 2013 indicates that jaguars and other cats continue to both pass through the District and reside permanently around villages that contain remnant forested corridors and "islands." However, little is known about specific jaguar numbers, the spatial dynamics of movement, critical habitat, and human-jaguar conflicts. With the assistance of university students and local Mayan villagers, this project will begin the process of collecting baseline data on jaguars in southern Belize, which will in turn help conservation planners (including the PI) design community-based conservation efforts to help safeguard the regional jaguar population and better connect isolated populations.

Research Purpose and Objectives

Southern Belize has not been the focus of any cat conservation efforts or research to date. Thus literally and figuratively, a large blank spot exists in the overall Belizean jaguar conservation map, a critical country for jaguar conservation in Central America given the level of environmental degradation occurring in surrounding countries. It stands to reason that if the spatial dynamics of jaguar populations in southern Belize are better understood, populations in protected areas found both to the north and south will be less isolated and more secure as well. Enlisting the help of both local Mayan villagers and university students, this project seeks to create a long-term jaguar-monitoring program in southern Belize. As a result of this research, University of Alabama students who enroll in the PI's Belize field course will assist in baseline data collection on jaguars and gain a better understanding of the challenges of conservation in the developing world. Initial data collection fieldwork will take place in the summers of 2014 and 2015. External funding will be sought in the future to continue the monitoring program beyond the life of this grant.

Objective 1: Collect base-line data on jaguar numbers and other cats using camera traps, track plot methods, trail monitoring, and interviews with Mayan villagers.

Objective 2: Identify critical habitat for jaguars proximate to Mayan villages in the Toledo District using camera traps, track plot methods, and interviews with Mayan villagers.

Objective 3: Map critical jaguar habitat using GIS and remote sensing to create a database for local and national Belizean conservation organizations.

Objective 4: Incorporate long-term jaguar monitoring program into a university environmental field course taught annually by the PI through Capstone International. Students will learn to identify cat species and individual cats using camera traps and track plot methods.

Research Significance

Little is known about specific jaguar numbers or critical habitat around Mayan villages in the Toledo District in southern Belize. However, the PI's research in June 2013 indicates that jaguars and other cats continue to inhabit the altered landscape. There are no formal protected areas in close proximity to most Mayan villages, so cat research and conservation must be carried out in conjunction with local people using a community-based approach. The proposed project will address this need by collecting population data on cats, identify critical habitat, mapping this habitat, and conducting interviews with villagers who are familiar with jaguars and other cats (i.e farmers and hunters).

Methods

Direct Jaguar Survey Methods:

Direct methods include closed population capture-recapture analysis of camera-trap data using Moultrie Outfitter No-Glow C-50 5MP Scouting Camera. Track plots and trail investigations will also be established to help estimate jaguar numbers. Ten camera traps will be placed in appropriate locations based on interviews and field inspections. Site selection will also follow the protocol as outlined by Silver (et al. 2004). Ten track plots will also be created and monitored near the focal villages along roadways (Length = 1.5m X dirt road width $\approx$ 4m).

Indirect Jaguar Survey Methods:

First, questionnaires about jaguars and other cats will be administered in three Mayan villages. The PI and a Mayan field assistant from each village will administer surveys. The first set of study villages includes Blue Creek, San Jose, and San Antonio. These villages have been selected because of their familiarity to the PI, and because the preliminary study in 2013 took place in Blue Creek and San Jose. Therefore, the PI has some preliminary data on which to build a larger study, and has already identified two Mayan field assistants. Blue Creek also hosts the PI's field course. Questions will focus on encounters with jaguars and other cats during the past three years, the location of these encounters, critical habitat for jaguars, and the perception of cats and cat conservation. Interviews will help determine presence/absence of jaguars and other cats, as well as gage the interest in cat conservation and related ecotourism opportunities. After investigating jaguar numbers around Blue Creek, San Jose, and San Antonio, the study will expand to three other villages in the Toledo District using the same methods.

Research Outcomes and Future Funding

Research outcomes include future grants, publications, and student participation. The PI has had preliminary discussions about future funding with the National Geographic Society's Committee for Research and Exploration and Panthera, an international cat conservation organization based in New York City. Both have expressed interest in the project and have encouraged the PI to submit a full proposal after more data is acquired. And as mentioned above, UA students enrolled in the PI's field class will participate in the project through data collection, and potentially, student-lead research projects related to the topic.

Budget and Budget Justification

All items requested in this proposal are critical to carrying out the research. Plane tickets and per diem will cover travel and day-to-day costs, and funds sought for camera traps are essential for field identification of jaguars. While in Belize the PI will stay with Mayan families. This minimizes costs and helps the PI gain greater access to the community. Any other equipment needed such as notebooks, flashlights, etc. will be covered by my professional development funds or are already owned by the PI. The PI is not requesting any summer salary. Funds for a Mayan field assistant is necessary because that individual spends valuable time away from other economic activities to assist the project.

Budget

Two airline tickets to Belize City from Birmingham: $800 x 2 = $1,600

Field per diem and in-country travel expenses: $20 per day x 50 days = $1000

Moultrie Outfitter No-Glow C-50 5MP Scouting Camera: 10 cameras x $200 = $2,000

Mayan field assistant expenses: $10 per day x 30 days = $300

Total funds requested: $4,900

Selected Bibliography

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Foster, R. J., Harmsen, B. J. and Doncaster, C. P. (2010). Habitat Use by Sympatric Jaguars and Pumas Across a Gradient of Human Disturbance in Belize. *Biotropica* 42: 724–731.

Karanth, K.U. (1995). Estimating tiger (*Panthera tigris*) populations from camera-trap data using capture- recapture models. *Biological Conservation* 71: 333–338.

Kelly, M.J. (2008). Design, evaluate, refine: camera trap studies for elusive species. *Animal Conservation* 11: 182-184.

Maffei, L., Noss, A. J., Silver, S., and M.J. Kelly. (2010). Remote Camera survey design and data analysis for jaguars, pp. 119-149. In: *Camera Traps in Animal Ecology: Methods and Analysis*. A.F. O'Connell, Jr. editor. Springer-Verlag.

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Rabinowitz, A. R. & Nottingham, B. G. Jr. (1986). Ecology and behaviour of the jaguar (Panthera onca) in Belize, Central America. *Journal of Zoology* 210: 149–159.

Scognamillo, D., Maxit, I.E., Sunquist, M.E., Polisar, J., 2003. Coexistence of jaguar (Panthera onca) and puma (Puma concolor) in a mosaic landscape in the Venezuelan llanos. *Journal of Zoology* 259, 269–279.

Silver, S.C., Ostro, L.E., Marsh, L.K., Maffei, L., Noss, A.J., Kelly, M.J., Wallace, R.B., Gomez, H., Ayala, G. (2004). The use of camera traps for estimating jaguar (*Panthera onca*) abundance and density using capture/recapture analysis. *Oryx* 38 (2): 148-154.

Steinberg, M.K. 1998. Political ecology, cultural change, and their impact on swidden-fallow agroforestry practices among the Mopan Maya in southern Belize. *The Professional Geographer* 50(4): 407-417.

Steinberg, M.K. 1998. Mopan Maya forest resources. *Geographical Review* 88(1): 131-137.

Wallace, R.B., Gomez, H., Ayala, G., and Espinoza, F. (2003). Camera trapping capture frequencies for jaguar (*Panthera onca*) in the Tuichi Valley, Bolivia. *Mastozoologia Neotropical* 10(1): 133-139.

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Books, Edited Volumes, and Edited Journals

A Brook Trout Pilgrimage. Under contract with the University of New Mexico Press. Submitted, summer 2012.

Audubon's Birds: Landscape Reflections and Environmental Change. Under contract with Louisiana State University Press.

Stalking the Ghost Bird: The Elusive Ivory-Billed Woodpecker in Louisiana. Louisiana State University Press. 2008. ISBN 9780807133057.

Dangerous Harvest: Drug Plants and the Transformation of Indigenous Landscapes. 2004. Co-edited with J.J. Hobbs and K. Mathewson. Oxford University Press. ISBN 0195143191.

Cultural and Physical Expositions: Geographic Studies in the Southern U.S. & Middle America. 2002. Co-edited with P. Hudson. Geoscience Publications. ISBN 0938909061.

Guest editor for a special issue of *Geoforum*, "Geographers in Guatemala: Fieldwork in a Conflicted Landscape." 2006, 37(1): 1-154.

Guest editor for a special issue of *Geographical Review*, Avifaunal Research and Geography: Current Linkages and Future Directions. 2010, 100(2): iii-289.

Refereed Publications

Steinberg, M.K., K. Kinney, and M.J. Taylor. In press. Deforestation in and around El Cielo Biosphere Reserve, Tamaulipas Mexico: A 40-Year Review Using Remotely Sensed and Ethnographic Data. *The Professional Geographer.*

Taylor, M.J., and M.K. Steinberg. 2011. Controlling People and Space, in J. Dym and K. Offen (Eds.) *Mapping Latin America*, University of Chicago Press. Chapter 48, pp. 254-257.

Steinberg, M.K. 2010. Audubon Landscapes in the South. *Mississippi Quarterly: The Journal of Southern Cultures.* 63(1-2): 313-330.

Steinberg, M.K., J. Sugishita, and K. Kinney. 2010. Land Use Changes and Conservation of the Hawaii 'Amakihi. *Geographical Review* 100(2): 204-215.

Steinberg, M.K. 2010. Was the Bachman's Warbler a Cultural Ecological Dependent Species? *Southeastern Geographer*. 50(2): 272-281.

Steinberg, M.K. 2009. Highland Forest Habitat Preference by Endemic Hawaiian Honeycreepers: A Preliminary Assessment. *Yearbook of the Pacific Coast Geographers* 71: 54-66.

Steinberg, M.K. 2005. Mahogany (*Swietenia macrophylla*) in the modern Maya lowlands: implications for past land use and environmental change? *Journal of Latin American Geography*. 4(1): 127-134.

Research Funding/Awards

2013 Tarpon and Bonefish Trust ($25,000). Funding to support creation of a GIS database and associated maps of critical sport fishing grounds in Belize.

2013 U.S. Fish and Wildlife Service (pending). Funding ($42,000) sought to support project that investigates impacts of sea level rise and storm surges on swallow tailed kite habitat on the Gulf Coast. With the Center for Birds of Prey.

2012 Biodiversity Research Institute. Funding ($15,000) to continue assessment of resplendent quetzal populations in highland Guatemala.

2009 Research Grant's Committee, University of Alabama ($5,000). The Conservation Status of the Resplendent Quetzal in Guatemala.

2008 Vermont Law School 2009 Summer Scholarship Recipient. Provided funding for participation in a two-week environmental law seminar at the Vermont Law School on endangered species.

2006 Shipman Estate, Ltd., Hawaii. Grant ($62,000) to inventory land holdings in east Hawaii using GIS.

2006 National Science Foundation's Science, Engineering, Technology and Mathematics (STEM) program at the University of Hawaii to support ($4,300) geography club's field trip to the Channel Islands for a work/study program.

2006 College of Arts and Science grant ($1,500) for participation in GIS/RS and Endangered Species workshop through the Smithsonian Institute.

2005 College of Arts and Science travel grant ($2,700) to attend AAG national meeting in Chicago.