

Faculty Grants for International Connections

Application from:
Robert K. Booth, Associate Professor
Earth & Environmental Sciences
rkb205@lehigh.edu

Location, Host, and Synopsis: This proposal seeks funds to support a two-week trip to meet with Dr. Jaime Escobar, Associate Professor in the Department of Civil and Environmental Engineering and Director of the Institute for Sustainable Development at the Universidad del Norte, in Barranquilla, Colombia. Dr. Escobar is also a research associate at the Smithsonian Tropical Research Institute (STRI) in Panama. We will explore research opportunities focused on the paleoecology and climate-sensitivity of high altitude Andean ecosystems (i.e., Paramo ecosystems) in Colombia and elsewhere in Latin America, collect preliminary field data to demonstrate proof-of-concept in support of proposal development, discuss collaborative graduate student training and mentorship, and explore the potential for developing summer undergraduate research experiences in Panama (STRI biological field stations).

Goals and Rationale: The proposed visit will serve to 1) build a professional and personal relationship between myself and Dr. Escobar, a leading paleoecologist in South America, 2) explore topics and develop research strategies to pursue questions of mutual interest in the Neotropics, 3) collect and analyze pilot data critical to demonstrating the proof-of-concept needed for successful proposal development, and 4) discuss possibilities of graduate student collaborative training and mentorship, as well as potential undergraduate opportunities that might exist through Dr. Escobar's dual appointment with the STRI Institute in Panama.

The Paramo is an extremely biodiverse ecosystem (one of 25 global biodiversity hotspots) located above the tree line and below the permanent snowline in the Andes of tropical South America and the highlands of Costa Rica. Up to 60% of its plant species are endemic, found nowhere else in the world, and together with the surrounding Andean forest the region is home to 50% of the plant diversity found in mountain ecosystems. In addition to their high conservation value, the Paramo and its watersheds store and supply critical water resources to major Andean rivers and cities; however, how the hydrology and ecology of these systems will respond to climate change is unclear. High-altitude tropical ecosystems such as the Paramo are expected to experience very high rates of temperature change in the coming decades, with stronger and longer dry seasons. Knowledge of how the hydrology and ecology of these ecosystems may respond to these anticipated changes is critically needed to assess model projections, forecast climate-induced ecological and hydrological impacts, and assist in risk assessment and adaptive management efforts. This new collaboration will focus on understanding the ecological and hydrological sensitivity of the Paramo ecosystem and their watersheds through investigating the long-term environmental history of the region. Furthermore, Universidad del Norte has a new Geology Program with 50 new freshman students that will begin their studies during Spring 2016, a new PhD program in Natural Sciences and a new master degree in Ecology. This collaboration will provide exciting opportunities for collaborative and interdisciplinary mentorship of graduate students, and potentially a foundation for the development of international experiences for Lehigh graduate and undergraduate students in culturally and ecologically diverse Latin America.

Expected Outcomes: The proposed visit will support the goals of the Office of International Affairs by expanding Lehigh's internationalization efforts in Latin America at one of the top five universities in Colombia, increasing the international visibility and footprint of the EES department and its paleoecological research efforts, and facilitating the development of competitive research

proposals to external agencies in both the US and Colombia aimed at addressing climate change issues in the Neotropics. Short-term goals include developing our research ideas and approaches, becoming familiar with Paramo ecosystems and potential study sites, exploring models for collaborative graduate student mentoring, discussing undergraduate opportunities at STRI, and collecting pilot data from Paramo peatlands. Long-term goals will include the development of proposals to fund larger-scale research projects and support graduate students, and the publication of long-term records of hydrological and ecological change from Paramo peatlands.

Nature of Interactions: The proposed two-week visit will consist of two components, including one week spent visiting with Dr. Escobar and his research group in Barranquilla and one week conducting fieldwork near Manizales. While in Barranquilla, we will develop our research ideas and outline concrete plans to move our collaboration forward. We will also discuss models for collaborative graduate training (e.g., graduate student exchanges, degree locations) and undergraduate experiences (likely through the STRI in Panama given safety considerations in Colombia). I will work with Dr. Escobar’s group to process and analyze previously collected peatland samples in his laboratory. The other week will be spent doing fieldwork near Nevado del Ruiz Volcano, collecting samples from peatlands to demonstrate the utility and potential of our paleohydrological approaches.

Pre-trip planning: I have had considerable correspondence with Dr. Escobar via email since October of 2015 (see emails). Furthermore, I have examined some peatland core samples that he previously collected to assess the preservation of testate amoebae (our proposed paleohydrological indicator) in Paramo ecosystems (see emails and invitation letter). These results are very promising, and suggest great potential for the development of paleohydrological records. I am aware that the US Department of State has an active Colombia travel warning; however I will only be visiting the safest areas, and our field site is located just a few miles from the tourist town of Manizales (see email).

Expected Follow-up: Analyses of samples collected during the visit, as well as core samples previously collected by Dr. Escobar, will continue after the visit and provide the baseline preliminary data needed to support the development of a competitive proposal to NSF (Paleo Perspectives on Climate Change and/or Ecosystem Science Programs). In addition, we envision collaborating on the development of several journal publications reporting our results, particularly since application of our scientific approaches will be new to the region and these ecosystems. Additional funding will be pursued in Colombia as well (e.g., Universidad del Norte internal funding, Colciencias). Dr. Escobar will also work to secure funding for a follow-up visit to Lehigh to develop our collaboration further and spend some time in my lab learning testate amoeba taxonomy and techniques of paleohydrological reconstruction. If additional funding can be secured, I will host graduate students from Universidad del Norte for extended visits in my lab.

Budget and proposed dates of trip: January 2017.

Round trip airfare, Allentown to Bogota	\$ 600
Airfare, Bogota-Manizales-Bogota*	\$200
Airfare, Bogota-Barranquilla-Bogota*	\$ 185
Car rental and gas for fieldwork in Manizales	\$ 1500
Hotel and meals (15 days @ \$110/day)	\$ 1650
Total requested	\$ 4135

*Dr. Escobar will accompany me on these trips, and will fund his own airfare.

Invitation letter



January 25, 2016
Barranquilla, Colombia

Dear Dr. Robert Booth

I am writing to extend an official invitation to you to spend time with me at Universidad del Norte, Colombia. I have been working on the paleoecology and hydrology of Paramo ecosystems for more than four years now. Your expertise on testate amoebae as paleohydrological indicators will greatly complement our research efforts.

The paramo is a discontinuous high-altitude ecosystem distributed in belts between 11°N and 8° S latitude in the Andes of northern South America and the highlands of Costa Rica, Central America. Under undisturbed conditions, the paramo is a natural "water factory." It absorbs moisture from rain and fog, stores it in soils and plants (e.g. cushion plants), and releases it slowly during drier periods. Today, the paramo is an important source of water for humans and some lowland tropical ecosystems. Despite the hydrological importance of the paramo, relatively little is known about the limnological histories of its water bodies or their resilience to climate and environmental changes. We have initiated a series of "paleo" studies in the high Andean ecosystems of the Central Cordillera, Colombia, in an effort to understand the long-term ecological and hydrological dynamics of these ecosystems. Your expertise on testate amoebae will help us advance our understanding of this unique tropical ecosystem.

Furthermore, during your visit we will discuss the possibility of undergraduate and graduate students interchange. Universidad del Norte is one of the top 5 private Universities in Colombia with more than 10,000 undergraduate students and 6,000 graduate students. The University has 38 research groups, 158 international agreements and in 2014 it registered 619 outgoing abroad students and incoming international students. I am also a research Associate at the Smithsonian Tropical Research Institute. During your visit we will also discuss the possibility of creating a summer field research program at the Smithsonian Tropical Research Institute for both Lehigh and Uninorte students.

I look forward to the possibility of building a long-lasting academic and research relationship between our Universities. Please keep me posted about anything else I can do to facilitate your visit.

Sincerely

Jaime H. Escobar.

Jaime Escobar, PhD
Associate Professor
Universidad del Norte

Selected correspondence

On Oct 4, 2015, at 4:59 PM, Jaime Humberto Escobar Jaramillo <jhescobar@uninorte.edu.co> wrote:

Dear Dr. Booth

I am writing to you to ask you about the possibility of applying for a Fulbright Grant to work with you for 6 months at Lehigh. I have sediment samples from two very well dated peat cores from highland Colombia. There are testate rhizopods on surface samples and I expect to see some downcore. The "Paramo" ecosystem provides water to lowland ecosystems and major cities in Colombia. Nobody has worked with testate rhizopods in Colombia and I think it will be a great project for the Fulbright to see if these microorganisms serve as past water table indicators in the Neotropics.

At the moment I am an Assistant Professor at the Department of Civil and Environmental Engineering and Director of the Institute for Sustainable Development at Universidad del Norte, Barranquilla, Colombia. I am also a Research Associate at the Smithsonian Tropical Research Institute and Associate Editor of the Journal of Paleolimnology. I obtained a M.sc at the Department of Geological Sciences and a Ph.D at the School of Natural Resources and the Environment at the University of Florida. For my master project I studied the utility of testate rhizopods as bioindicators of past environmental conditions in Florida Lakes. My Ph.D research focused on a high-resolution reconstruction of lowland Central American climate during the last deglaciation, Last Glacial Maximum, and MIS3 using stable isotopes on biogenic carbonates. After 9 months as a postdoctoral researcher at the Smithsonian Tropical Research Institute in Panama I returned to Colombia with my family. My wife, Dr. Natalia Hoyos is a geologist by training with a PhD on physical Geography.

My research focuses on environmental/climate history in tropical and sub-tropical watersheds. I employ methods from aquatic ecology, biogeochemistry, and micropaleontology and often collaborate with researchers from geology, geography, chemistry, archaeology, sociology, and engineering. Several specific questions interest me. (1) What are the various forcing mechanisms of tropical environmental and climate change on different time scales? (2) What is the timing, rate, and structure of tropical climate and environmental change on different time scales? (3) How do tropical ecosystems and societies respond to natural and human-induced environmental and climate change?

I am attaching a copy of my CV. Here is the webpage with the Fulbright Grant information (spanish)

<http://www.fulbright.edu.co/beca-investigador-visitante-colombiano>

Best

Jaime

On Oct 29, 2015, at 6:02 PM, Jaime Humberto Escobar Jaramillo <jhescobar@uninorte.edu.co> wrote:

Hi Bob.

Hope you are doing ok. I have some not very good news. I might not get the letter of support from my University here in Colombia to apply for the Fulbright grant. I have been here at the University only 3 years and the administration does not feel good about me going away for 6 months!!!! The testate amoebae collaboration with you still goes on!!!! We just need to rethink the logistics of the work. Here are some answers to your comments

Paramo del Ruiz: (El Triunfo mire)

El Triunfo mire is located in the Central Cordillera of the Colombian Andes at 3,600 masl, (4.98077 N, 75.33164 W) near the El Nevado del Ruiz Volcano. The mire today has a 50 cm water column. It is the headwaters of the Aguacaliente creek, a tributary of the Gualí River that ultimately joins the Magdalena River. El Triunfo mire resides in a depression created by late Quaternary glacial activity that is surrounded by escarpments of andesitic and basaltic volcanic deposits. The mire is fed by direct precipitation and runoff and constitutes an area of hydrologic recharge. It is bounded by paramo vegetation above the 3,800 masl and by Andean forest below the 3,800 masl. Potato agriculture and dairy cattle ranching are the primary human activities occurring in the watershed today, resulting in a moderately disturbed ecosystem.

In 2012, a 7-m sediment core was collected with a Russian-type corer. Each 50-cm segment was sealed in plastic wrap and transported to the Institute for Stratigraphic Research, Universidad de Caldas (Manizales) for further analyses. Eleven radiocarbon dates from organic sediment taken at increasing depths down core show good stratigraphic order with no reversals. The basal part of the core is dated at 5,150 calibrated years Before Present (cal yr BP). Lower accumulation rates are seen for the bottom of the record between 700 and 400 cm while higher sedimentation rates characterize the upper core from 400 to 0 cm. The core is composed of a mixture of peat and lapilli between 700 and 400 cm and peat between 400 and 350 cm. Between 350 and 100 cm peat and lapilli as well as beds and lamina of lapilli are the main components. The upper 100 cm are composed mainly of peat and a discrete lapilli layer at 48 cm.

There is a palinology paper submitted to The Holocene but I am not a coauthor on it. I am working on another paper with some colleagues that contain diatom data every 10 cm and geochemistry data (TC, TN, TOC, d13C and d15N) every 2cm. There is also data on several metals and lead isotopes from selected depths. I still need to go to the field again and collect some rocks around the drainage basin as we don't have a clear history of the lead record.

Paramo de Frontino: The Llano Grande mire

There is a lot of pollen work done on this site, including several PhD thesis. Unfortunately very little has been published. See thesis attached. The age model is very robust and I have full access to core 9. There is no isotope data for any of the cores taken at the mire. I have the resources to do isotope work d13C and d15N on bulk and also some other basics such as TC, TN, and TOC.

I have been working with Broxton Bird (sedimentologist and isotope geochemistry, IUPUI) for the last couple of years in the Andes of Colombia. We just submitted a proposal to NSF and if granted next year there will be money to do some isotope work on biolipids from these two cores, some little money for testate amoebae lab work (slides preparation) and money to go and core more lakes on the Eastern and Central Cordilleras of Colombia. There will be no money for students to work on the testate rhizopods.

How do you think we should proceed? I have a couple of possibilities

I could look around for some other funding and visit you for a month or so during summer next year to prepare samples and start discussing things. I don't want to wait however until next summer

I could invite you to Colombia early next year and we could work on slides preparation and do some microscope work

I could send you some sediment samples right away so that you can prepare some slides and send them back to Colombia so we can start the counting back here. I could fly you down here next year to start discussing findings

Any other ideas?

best

Jaime

Hi Jaime,

I processed eight of the samples yesterday, and quickly scanned them to assess testate amoeba abundance and preservation. The good news is that there are testate amoebae in most of these samples, and abundances are likely high enough to allow the collection of quantitative community data for many of them. Here is a quick summary, based on just scanning each sample for about 5 minutes:

Nevado del Ruiz

68cm: *Centropyxis cassis* type (abundant), *Centropyxis platystoma* type, *Assulina muscorum*. Tests abundant enough for quantitative analyses.

280cm: *Euglypha tuberculata*, *Centropyxis platystoma* type, *Centropyxis cassis* type, *Centropyxis aculeata* type, *Nebela tubulosa* type, *Assulina muscorum*, *Diffflugia lucida* type. Great diversity and preservation, with tests abundant enough for quantitative analyses.

426cm: *Cyclopyxis arcelloides* type, *Nebela tubulosa* type, *Assulina muscorum*, *Nebela* sp. fragments. Preservation seems adequate, and abundances are likely sufficient for quantitative analysis although counting may take some time.

Frontino

22cm: Only saw a *Habrotrocha* (rotifer). These are often in association with testates, but I did not see any in my quick scan. This suggests that while testates may be present, they are unlikely in high enough abundance for quantitative analyses.

77cm: *Amphitrema flavum* (abundant!), *Diffflugia pristis* type. Sphagnum leaves on slide. Very interesting, as *A. flavum* is a really good paleohydrological indicator in northern peatlands.

181cm: *Centropyxis aculeata* type. Tests are likely not in high enough abundance for quantitative analyses, at least not without considerable time investment.

298cm: Only saw a *Habrotrocha* (rotifer). Also some Sphagnum leaves. Unlikely that tests are in high enough abundance for quantitative analyses.

799cm: Lots of Cladoceran exoskeletons suggesting a more limnetic environment. No tests observed in my quick scan. This suggests that while testates may be present, they are unlikely in high enough abundance for quantitative analyses.

In summary, I think there is some potential here and the project is worth pursuing if we can obtain a little funding. The assemblages from Nevado del Ruiz suggest somewhat minerotrophic conditions, although the testate amoebae are diverse and abundant enough for analyses. The assemblages from Frontino are a bit more mixed, with some samples lacking sufficient tests for analyses. However, the sample with abundant *Amphitrema flavum* is very interesting. Perhaps trying to first focus on the recent portion (~upper meter) of this core?

What do you think the potential is for developing a modern surface-sample calibration dataset from the region? Are there enough of these sort of sites?

-Bob

Hi Bob,

These are great news!!!!

I think there are several places where we could collect samples for a modern calibration. The two sites you looked at are very distant from each other. I could talk to some friends that know these two regions very well to see if they know of any other places we could visit. The Nevado del Ruiz site is very close to a medium size city and fieldwork will be very, very easy to do. The Paramo the Frontino will be a more difficult field campaign. How many sites do you think will be good enough? We could collect several samples from one site to look at the relation of different species to the plant community and the humidity of the soil. I am attaching a photo of the Nevado del Ruiz site.

How much money do you think we will need to get this project started? I could apply for some internal university funding or small national grants (max. 6k US). How do you want to proceed with the lab work (sample prep and counting)? Do you think it is worth having a student looking at these samples that we could both co-advise? Do you want to do the counting? I could do some counting as well with your help as I am not familiar with the non-lake taxonomy. Any of these options would be fine with me.

As I said before I have some money to fly you down for a week and visit the Nevado del Ruiz site (very safe place!!! I am aware of the bad reputation Colombia has but I have American colleagues that visit all the time). We could prepare some samples here as well during your visit.

Let me know what you think

Best

Jaime

On Jan 7, 2016, at 8:56 PM, Jaime Humberto Escobar Jaramillo <jhescobar@uninorte.edu.co> wrote:

Hi Bob,

1. I think two weeks is good time to do all the activities you mention on the mail (fieldwork and some preliminary lab work)
2. I am out of my office until next Tuesday but I will work on a strong letter early next week. I will also work on the budget and send it to you. Proposals are very short so I will be very strong on the importance of your visit for the Project and future collaboration.
3. I have some funding that we could use at least to pay for your international ticket. I will see how I can look for some more internal University funding.
4. I think for now is better if I send to you some more samples. After your visit we can discuss future plans for preparing samples and counting
5. I have a Colombian student that work with me on his master. He wants to go for a PhD but we are looking for funds. He is interested in testate rhizopods and is a little familiar with testate taxonomy. We have a new undergraduate geology program. I am also a research associate at the Smithsonian in Panama where we could, in the future, organize an undergraduate summer program for undergraduates. I think there is a lot of potential for future undergraduate collaboration. I would mention this in my letter as well.

I think you should also ask if you can apply to this grant to visit a country with a travel warning issued by the US State Department. I think, however, the US Department warning is a little bit exaggerated.

Anyways, I have done a lot of fieldwork here in Colombia with Mark Brenner (UF) and Broxton Bird (IUPUI). Both have come with their own internal university funding but they are not allow to bring students.

Best

Jaime

2016-01-07 10:18 GMT-05:00 Robert K Booth <rkb205@lehigh.edu>:
Hi Jaime,

Awesome picture! I'd definitely like to see this site. Yes, for a preliminary calibration we could focus on the collection of multiple samples from one, or ideally a few sites, measuring water-table depth, pH, and other potentially important environmental determinants in association with each sample. We would probably want ~50 samples to give us a reasonable sample size to assess community-environment relations.

To move this project forward, we will need sufficient funds to support my visit and the associated costs of fieldwork. Would 10 days or two weeks be sufficient to spend time with you and your group, discussing ideas and doing lab work, as well as to conduct a short field campaign to collect the modern calibration samples?

1) Lehigh University offers small grants for building international collaborations. These typically fund ~2 week visits. The details are here: <https://global.lehigh.edu/funding/faculty/grant>. The deadline is January 29th. I would need an invitation letter from you "outlining in concrete terms the proposed joint activities during the faculty member visit to the host institution and host's own expectations." I'll also need your assistance in developing the budget. I attach two recently funded proposals from faculty members in my department to give you a sense of what these proposals look like.

2) Any funding opportunities or funds that you have in hand would be very helpful, and some cost-share could strengthen a proposal to the Lehigh program above.

3) Even before my visit, we could continue to prepare the core samples for analyses, either in your lab or mine. If you are interested in doing this in your lab I could send you our processing protocol. Or you can send 1cm³ samples here.

Do you currently have a student that is interested in taking a project like this on? We should certainly discuss ways that we might co-advise and/or develop graduate student exchanges (visits to each others labs), and potentially develop international experiences for undergraduates in the context of this research. My hope is that we can generate enough preliminary data and explore the major paleoecological/paleoclimatological questions that we could address using testate amoebae in these interesting systems, likely in tandem with other proxies.

Sincerely,
Bob

Hi Bob,

Dont worry about it. I understand. You can tell your wife that just in the last year I have done fieldwork with many american and canadian colleagues in Colombia. Mark Brenner and Jason Curtis (Univ.

Florida), John Smol (Queens University), Broxton Bird (IUPUI), Nigel Wattrus (Large Lake Observatory), Austin Hendy (LA Natural History Museum), Warren Allmon (Cornell University). I wont go to any dangerous place in Colombia (I also have a wife and two little kids!!!!). You can also tell her that we will be doing fieldwork on the "coffee region of Colombia" and hour away from the city of Manizales. This is a place mentioned in the US travel warning as a very safe place for americans. You can also tell her that you will flight to Bogota and we will take another airplane to the city of Manizales so we wont be taking any major roads through the country and we will sleep in a hotel in Manizales everyday. The study site is 5 minutes away from a touristy road that connects the city of Manizles with the Nevado del Ruiz Volcano. I can answer any other question you could both have.

best