02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

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PI/PD Name: Douglas J Levey

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race:
(Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status:
(Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☐ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.
Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

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Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

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PI/PD Name: Jill E Jankowski

Gender: ☐ Male ☒ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race:
(Select one or more)
☐ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Native Hawaiian or Other Pacific Islander
☒ White

Disability Status:
(Select one or more)
☐ Hearing Impairment
☐ Visual Impairment
☐ Mobility/Orthopedic Impairment
☐ Other
☐ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

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PI/PD Name: Scott K Robinson

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race:
(Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☒ White

Disability Status:
(Select one or more)
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- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☐ None

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List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:

Eugene W. Schupp. Utah State University. schupp@cc.usu.edu
Helene C. Muller-Landau. University of Minnesota. hmuller@umn.edu
Angela Moles. University of New South Wales. a.moles@unsw.edu.au

REVIEWERS NOT TO INCLUDE:

Not Listed

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 08-1	FOR NSF USE ONLY
NSF 08-564 11/21/08	NSF PROPOSAL NUMBER
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)	
DEB - Ecology, DEB - POP & COMMUNITY ECOL CLUSTER	0909861

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
11/21/2008	1	08010000 DEB	1182	969663814	09/02/2009 9:48am S

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)	SHOW PREVIOUS AWARD NO. IF THIS IS	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)
596002052	☐ A RENEWAL ☐ AN ACCOMPLISHMENT-BASED RENEWAL	

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE	ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE
University of Florida	University of Florida 1 University of Florida Gainesville, FL. 326112002
AWARDEE ORGANIZATION CODE (IF KNOWN) 0015354000	
NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE	ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE
PERFORMING ORGANIZATION CODE (IF KNOWN)	

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions) ☐ SMALL BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS ☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Dissertation Research: Using hummingbirds to test the link between bird and plant distributions in tropical montane rainforest**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 11,287	12 months	05/21/09	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

- ☐ BEGINNING INVESTIGATOR (GPG I.G.2)
- ☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C)
- ☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
- ☐ HISTORIC PLACES (GPG II.C.2.j)
- ☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.D.1)
- ☐ VERTEBRATE ANIMALS (GPG II.D.5) IACUC App. Date ________ PHS Animal Welfare Assurance Number ________
- ☐ HUMAN SUBJECTS (GPG II.D.6) Human Subjects Assurance Number ________ Exemption Subsection ________ or IRB App. Date ________
- ☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j) ________
- ☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT	PI/PD POSTAL ADDRESS
Department of Zoology	P. O. Box 118525 Gainesville, FL 326118525 United States
PI/PD FAX NUMBER 352-392-3704	

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME Douglas J Levey	PhD	1986	352-392-9169	dlevey@zoo.ufl.edu
CO-PI/PD Jill E Jankowski	MS	2004	352-392-3516	jjankow2@ufl.edu
CO-PI/PD Scott K Robinson	DPhil	1984	352-392-1721	srobinson@flmnh.ufl.edu
CO-PI/PD				
CO-PI/PD				

Electronic Signature

CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 08-1). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be dislosed to NSF.

Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF Grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME Brian E Prindle	Electronic Signature	Nov 21 2008 10:48AM

TELEPHONE NUMBER	ELECTRONIC MAIL ADDRESS	FAX NUMBER
352-392-3516	prindle@ufl.edu	352-846-1839

*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED.

Directorate for Biological Sciences
Division of Environmental Biology
Ecology

Proposal Classification Form
PI: Levey, Douglas / Proposal Number: 0909861

CATEGORY I: INVESTIGATOR STATUS (Select ONE)

- ☐ Beginning Investigator - No previous Federal support as PI or Co-PI, excluding fellowships, dissertations, planning grants, etc.
- ☐ Prior Federal support only
- ☐ Current Federal support only
- ☑ Current & prior Federal support

CATEGORY II: FIELDS OF SCIENCE OTHER THAN BIOLOGY INVOLVED IN THIS RESEARCH (Select 1 to 3)

☐ Astronomy	☐ Engineering	☐ Psychology
☐ Chemistry	☐ Mathematics	☐ Social Sciences
☐ Computer Science	☐ Physics	☑ None of the Above
☐ Earth Science		

CATEGORY III: SUBSTANTIVE AREA (Select 1 to 4)

☐ BIOGEOGRAPHY	☐ Decomposition	☐ Molecular Evolution
☐ Island Biogeography	☐ Biogeochemistry	☐ Methodology/Theory
☐ Historical/ Evolutionary Biogeography	☐ Limnology/Hydrology	☐ Isozymes/ Electrophoresis
☐ Phylogeography	☐ Climate/Microclimate	☐ Nucleic Acid Analysis (general)
☐ Methods/Theory	☐ Whole-System Analysis	☐ Restriction Enzymes
☐ CHROMOSOME STUDIES	☐ Productivity/Biomass	☐ Nucleotide Sequencing
☐ Chromosome Evolution	☐ System Energetics	☐ Nuclear DNA
☐ Chromosome Number	☐ Landscape Dynamics	☐ Mitochondrial DNA
☐ Mutation	☐ Chemical & Biochemical Control	☐ Chloroplast DNA
☐ Mitosis and Meiosis	☐ Global Change	☐ RNA Analysis
☑ COMMUNITY ECOLOGY	☐ Climate Change	☐ DNA Hybridization
☐ Community Analysis	☐ Regional Studies	☐ Recombinant DNA
☐ Community Structure	☐ Global Studies	☐ Amino Acid Sequencing
☐ Community Stability	☐ Forestry	☐ Gene/Genome Mapping
☐ Succession	☐ Resource Management (Wildlife, Fisheries, Range, Other)	☐ Natural Products
☐ Experimental Microcosms/ Mesocosms	☐ Agricultural Ecology	☐ Serology/Immunology
☐ Disturbance	☐ EXTREMOPHILES	☐ PALEONTOLOGY
☐ Patch Dynamics	☐ GENOMICS (Genome sequence, organization, function)	☐ Floristic
☐ Food Webs/ Trophic Structure	☐ Viral	☐ Faunistic
☐ Keystone Species	☐ Microbial	☐ Paleoecology
☐ COMPUTATIONAL BIOLOGY	☐ Fungal	☐ Biostratigraphy
☑ CONSERVATION & RESTORATION BIOLOGY	☐ Plant	☐ Palynology
☐ DATABASES	☐ Animal	☐ Micropaleontology
☐ ECOSYSTEMS LEVEL	☐ MARINE MAMMALS	☐ Paleoclimatology
☐ Physical Structure	☐ MOLECULAR APPROACHES	☐ Archeozoic
		☐ Paleozoic
		☐ Mesozoic

- ☐ Cenozoic
- ☐ POPULATION DYNAMICS & LIFE HISTORY
- ☐ Demography/ Life History
- ☐ Population Cycles
- ☐ Distribution/Patchiness/ Marginal Populations
- ☐ Population Regulation
- ☐ Intraspecific Competition
- ☐ Reproductive Strategies
- ☐ Gender Allocation
- ☐ Metapopulations
- ☐ Extinction
- ☐ POPULATION GENETICS & BREEDING SYSTEMS
- ☐ Variation
- ☐ Microevolution
- ☐ Speciation
- ☐ Hybridization
- ☐ Inbreeding/Outbreeding
- ☐ Gene Flow Measurement
- ☐ Inheritance/Heritability
- ☐ Quantitative Genetics/ QTL Analysis
- ☐ Ecological Genetics
- ☐ Gender Ratios
- ☐ Apomixis/ Parthenogenesis
- ☐ Vegetative Reproduction
- ☑ SPECIES INTERACTIONS
- ☐ Predation
- ☐ Herbivory
- ☐ Omnivory
- ☐ Interspecific Competition
- ☐ Niche Relationships/ Resource Partititioning
- ☑ Pollination/ Seed Dispersal
- ☐ Parasitism
- ☐ Mutualism/ Commensalism
- ☐ Plant/Fungal/ Microbial Interactions
- ☐ Mimicry
- ☐ Animal Pathology
- ☐ Plant Pathology
- ☐ Coevolution
- ☐ Biological Control
- ☐ STATISTICS & MODELING
- ☐ Methods/ Instrumentation/ Software
- ☐ Modeling (general)
- ☐ Statistics (general)
  - ☐ Multivariate Methods
  - ☐ Spatial Statistics & Spatial Modeling
  - ☐ Sampling Design & Analysis
  - ☐ Experimental Design & Analysis
- ☐ SYSTEMATICS
- ☐ Taxonomy/Classification
- ☐ Nomenclature
- ☐ Monograph/Revision
- ☐ Phylogenetics
- ☐ Phenetics/Cladistics/ Numerical Taxonomy
- ☐ Macroevolution
- ☐ NONE OF THE ABOVE

CATEGORY IV: INFRASTRUCTURE (Select 1 to 3)

COLLECTIONS/STOCK CULTURES

- ☐ Natural History Collections
- ☐ DATABASES

FACILITIES

- ☐ Controlled Environment Facilities
- ☐ Field Stations
  - ☐ Field Facility Structure
  - ☐ Field Facility Equipment
- ☐ LTER Site
- ☐ INDUSTRY PARTICIPATION
- ☐ Technique Development

TRACKING SYSTEMS

- ☐ Geographic Information Systems
- ☐ Remote Sensing
- ☑ NONE OF THE ABOVE

CATEGORY V: HABITAT (Select 1 to 2)

TERRESTRIAL HABITATS

- ☐ GENERAL TERRESTRIAL
- ☐ TUNDRA
- ☐ BOREAL FOREST
- ☐ TEMPERATE
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Rain Forest
  - ☐ Mixed Forest
  - ☐ Prairie/Grasslands
  - ☐ Desert
- ☐ SUBTROPICAL
  - ☐ Rain Forest
  - ☐ Seasonal Forest
  - ☐ Savanna
  - ☐ Thornwoods
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Desert
- ☐ TROPICAL
  - ☑ Rain Forest
  - ☐ Seasonal Forest
  - ☐ Savanna
  - ☐ Thornwoods
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Desert
- ☐ CHAPPARAL/ SCLEROPHYLL/ SHRUBLANDS
- ☐ ALPINE
- ☑ MONTANE
- ☐ CLOUD FOREST
- ☐ RIPARIAN ZONES
- ☐ ISLANDS (except Barrier Islands)
- ☐ BEACHES/ DUNES/ SHORES/ BARRIER ISLANDS
- ☐ CAVES/ ROCK OUTCROPS/ CLIFFS
- ☐ CROPLANDS/ FALLOW FIELDS/ PASTURES
- ☐ URBAN/SUBURBAN
- ☐ SUBTERRANEAN/ SOIL/ SEDIMENTS
- ☐ EXTREME TERRESTRIAL ENVIRONMENT
- ☐ AERIAL

AQUATIC HABITATS

- ☐ GENERAL AQUATIC
- ☐ FRESHWATER
  - ☐ Wetlands/Bogs/Swamps
  - ☐ Lakes/Ponds
  - ☐ Rivers/Streams
  - ☐ Reservoirs
- ☐ MARINE
  - ☐ Open Ocean/Continental Shelf
  - ☐ Bathyal
  - ☐ Abyssal
  - ☐ Estuarine
  - ☐ Intertidal/Tidal/Coastal
  - ☐ Coral Reef
  - ☐ HYPERSALINE
- ☐ EXTREME AQUATIC ENVIRONMENT
- ☐ CAVES/ ROCK OUTCROPS/ CLIFFS
- ☐ MANGROVES
- ☐ SUBSURFACE WATERS/ SPRINGS
- ☐ EPHEMERAL POOLS & STREAMS
- ☐ MICROPOOLS (Pitcher Plants, Tree Holes, Other)

MAN-MADE ENVIRONMENTS

- ☐ LABORATORY
- ☐ THEORETICAL SYSTEMS
- ☐ OTHER ARTIFICIAL SYSTEMS

NOT APPLICABLE

- ☐ NOT APPLICABLE

CATEGORY VI: GEOGRAPHIC AREA OF THE RESEARCH (Select 1 to 2)

- ☐ WORLDWIDE
- ☐ NORTH AMERICA
  - ☐ United States
    - ☐ Northeast US (CT, MA, ME, NH, NJ, NY, PA, RI, VT)
    - ☐ Northcentral US (IA, IL, IN, MI, MN, ND, NE, OH, SD, WI)
    - ☐ Northwest US (ID, MT, OR, WA, WY)
    - ☐ Southeast US (DC, DE, FL, GA, MD, NC, SC, WV, VA)
    - ☐ Southcentral US (AL, AR, KS, KY, LA, MO, MS, OK, TN, TX)
    - ☐ Southwest US (AZ, CA, CO, NM, NV, UT)
    - ☐ Alaska
    - ☐ Hawaii
    - ☐ Puerto Rico
    - ☐ Canada
  - ☐ Mexico
- ☐ CENTRAL AMERICA (Mainland)
  - ☐ Caribbean Islands
  - ☐ Bermuda/Bahamas
- ☐ SOUTH AMERICA
  - ☐ Eastern South America (Guyana, Fr. Guiana, Suriname, Brazil)
  - ☐ Northern South America (Colombia, Venezuela)
  - ☐ Southern South America (Chile, Argentina, Uruguay, Paraguay)
  - ☑ Western South America (Ecuador, Peru, Bolivia)
- ☐ EUROPE
  - ☐ Eastern Europe
  - ☐ Russia
  - ☐ Scandinavia
  - ☐ Western Europe
- ☐ ASIA
  - ☐ Central Asia
  - ☐ Far East
  - ☐ Middle East
  - ☐ Siberia
  - ☐ South Asia
  - ☐ Southeast Asia
- ☐ AFRICA
  - ☐ North Africa
  - ☐ African South of the Sahara
    - ☐ East Africa
    - ☐ Madagascar
    - ☐ South Africa
    - ☐ West Africa
- ☐ AUSTRALASIA
  - ☐ Australia
  - ☐ New Zealand
  - ☐ Pacific Islands
- ☐ ANTARCTICA
- ☐ ARCTIC
- ☐ ATLANTIC OCEAN
- ☐ PACIFIC OCEAN
- ☐ INDIAN OCEAN
- ☐ OTHER REGIONS (Not defined)
- ☐ NOT APPLICABLE

CATEGORY VII: CLASSIFICATION OF ORGANISMS (Select 1 to 4)

- ☐ VIRUSES
  - ☐ Bacterial
  - ☐ Plant
  - ☐ Animal
- ☐ PROKARYOTES
  - ☐ Archaebacteria
  - ☐ Cyanobacteria
  - ☐ Eubacteria
- ☐ PROTISTA (PROTOZOA)
  - ☐ Amoebae
  - ☐ Apicomplexa
  - ☐ Ciliophora
  - ☐ Flagellates
  - ☐ Foraminifera
  - ☐ Microspora
  - ☐ Radiolaria
- ☐ FUNGI
  - ☐ Ascomycota
  - ☐ Basidiomycota
  - ☐ Chytridiomycota
  - ☐ Mitosporic Fungi
  - ☐ Oomycota
  - ☐ Zygomycota
- ☐ LICHENS
- ☐ SLIME MOLDS
- ☐ ALGAE
  - ☐ Bacillariophyta (Diatoms)
  - ☐ Charophyta
  - ☐ Chlorophyta
  - ☐ Chrysophyta
  - ☐ Dinoflagellata
  - ☐ Euglenoids
  - ☐ Phaeophyta
  - ☐ Rhodophyta
- ☐ PLANTS
  - ☐ N0N-VASCULAR PLANTS
    - ☐ BRYOPHYTA
      - ☐ Anthocerotae (Hornworts)
      - ☐ Hepaticae (Liverworts)
      - ☐ Musci (Mosses)
  - ☐ VASCULAR PLANTS
    - ☐ FERNS & FERN ALLIES
    - ☐ GYMNOSPERMS
      - ☐ Coniferales (Conifers)
      - ☐ Cycadales (Cycads)

- ☐ Ginkgoales (Ginkgo)
- ☐ Gnetales (Gnetophytes)
- ☐ ANGIOSPERMS
- ☐ Monocots
- ☐ Arecaceae (Palmae)
- ☐ Cyperaceae
- ☐ Liliaceae
- ☐ Orchidaceae
- ☐ Poaceae (Graminae)
- ☑ Dicots
- ☐ Apiaceae (Umbelliferae)
- ☐ Asteraceae (Compositae)
- ☐ Brassicaceae (Cruciferae)
- ☐ Fabaceae (Leguminosae)
- ☐ Lamiaceae (Labiatae)
- ☐ Rosaceae
- ☐ Solanaceae

☐ ANIMALS

- ☐ INVERTEBRATES
- ☐ MESOZOA/PLACOZOA
- ☐ PORIFERA (Sponges)
- ☐ CNIDARIA
- ☐ Hydrozoa (Hydra, etc.)
- ☐ Scyphozoa (Jellyfish)
- ☐ Anthozoa (Corals, Sea Anemones)
- ☐ CTENOPHORA (Comb Jellies)
- ☐ PLATYHELMINTHES (Flatworms)
- ☐ Turbellaria (Planarians)
- ☐ Trematoda (Flukes)
- ☐ Cestoda (Tapeworms)
- ☐ Monogenea (Flukes)
- ☐ GNATHOSTOMULIDA
- ☐ NEMERTINEA (Rynchocoela) (Ribbon Worms)
- ☐ ENTOPROCTA (Bryozoa) (Plant-like Animals)
- ☐ ASCHELMINTHES
- ☐ Gastrotricha
- ☐ Kinorhyncha
- ☐ Loricifera
- ☐ Nematoda (Roundworms)
- ☐ Nematomorpha (Horsehair Worms)
- ☐ Rotifera (Rotatoria)
- ☐ ACANTHOCEPHALA (Spiny-headed Worms)
- ☐ PRIAPULOIDEA
- ☐ BRYOZOA (Ectoprocta) (Plant-like Animals)
- ☐ PHORONIDEA (Lophophorates)
- ☐ BRACHIOPODA (Lamp Shells)
- ☐ MOLLUSCA
- ☐ Monoplacophora
- ☐ Aplacophora (Solenogasters)
- ☐ Polyplacophora (Chitons)
- ☐ Scaphopoda (Tooth Shells)
- ☐ Gastropoda (Snails, Slugs, Limpets)
- ☐ Pelecypoda (Bivalvia) (Clams, Mussels, Oysters, Scallops)
- ☐ Cephalopoda (Squid, Octopus, Nautilus)
- ☐ ANNELIDA (Segmented Worms)
- ☐ Polychaeta (Parapodial Worms)
- ☐ Oligochaeta (Earthworms)
- ☐ Hirudinida (Leeches)
- ☐ POGONOPHORA (Beard Worms)
- ☐ SIPUNCULOIDEA (Peanut Worms)
- ☐ ECHIUROIDEA (Spoon Worms)
- ☐ ARTHROPODA
- ☐ Cheliceriformes
- ☐ Merostomata (Horseshoe Crabs)
- ☐ Pycnogonida (Sea Spiders)
- ☐ Scorpionida (Scorpions)
- ☐ Araneae (True Spiders)
- ☐ Pseudoscorpionida (Pseudoscorpions)
- ☐ Acarina (Free-living Mites)
- ☐ Parasitiformes (Parasitic Ticks & Mites)
- ☐ Crustacea
- ☐ Branchiopoda (Fairy Shrimp, Water Flea)
- ☐ Ostracoda (Sea Lice)
- ☐ Copepoda
- ☐ Cirripedia (Barnacles)
- ☐ Amphipoda (Skeleton Shrimp, Whale Lice, Freshwater Shrimp)
- ☐ Isopoda (Wood Lice, Pillbugs)
- ☐ Decapoda (Lobster, Crayfish, Crabs, Shrimp)
- ☐ Hexapoda (Insecta) (Insects)
- ☐ Apterygota (Springtails, Silverfish, etc.)
- ☐ Odonata (Dragonflies, Damselflies)
- ☐ Ephemeroptera (Mayflies)
- ☐ Orthoptera (Grasshoppers, Crickets)
- ☐ Dictyoptera (Cockroaches, Mantids, Phasmids)
- ☐ Isoptera (Termites)
- ☐ Plecoptera (Stoneflies)
- ☐ Phthiraptera (Mallophaga & Anoplura) (Lice)
- ☐ Hemiptera (including Heteroptera) (True Bugs)
- ☐ Homoptera (Cicadas, Scale Insects, Leafhoppers)
- ☐ Thysanoptera (Thrips)
- ☐ Neuroptera (Lacewings, Dobsonflies, Snakeflies)
- ☐ Trichoptera (Caddisflies)
- ☐ Lepidoptera (Moths, Butterflies)
- ☐ Diptera (Flies, Mosquitoes)
- ☐ Siphonaptera (Fleas)
- ☐ Coleoptera (Beetles)
- ☐ Hymenoptera (Ants, Bees, Wasps, Sawflies)
- ☐ Chilopoda (Centipedes)
- ☐ Diplopoda (Millipedes)
- ☐ Pauropoda
- ☐ Symphyta (Symphyla)
- ☐ PENTASTOMIDA (Linguatulida) (Tongue Worms)
- ☐ TARDIGRADA (Tardigrades, Water Bears)
- ☐ ONYCHOPHORA (Peripatus)
- ☐ CHAETOGNATHA (Arrow Worms)
- ☐ ECHINODERMATA
- ☐ Crinoidea (Sea Lilies, Feather Stars)
- ☐ Asteroidea (Starfish, Sea Stars)
- ☐ Ophiuroidea (Brittle Stars, Serpent Stars)
- ☐ Echinoidea (Sea Urchins, Sand Dollars)
- ☐ Holothuroidea (Sea Cucumbers)
- ☐ HEMICHORDATA (Acorn Worms, Pterobranchs)
- ☐ UROCHORDATA (Tunicata) (Tunicates, Sea Squirts, Salps, Ascideans)
- ☐ CEPHALOCHORDATA (Amphioxus/Lancelet)
- ☐ VERTEBRATES
- ☐ AGNATHA (Hagfish, Lamprey)
- ☐ FISHES
- ☐ Chondrichthyes (Cartilaginous Fishes) (Sharks, Rays, Ratfish)
- ☐ Osteichthyes (Bony Fishes)
- ☐ AMPHIBIA
- ☐ Anura (Frogs, Toads)
- ☐ Urodela (Salamanders, Newts)
- ☐ Gymnophiona (Apoda) (Caecilians)
- ☐ REPTILIA
- ☐ Chelonia (Turtles, Tortoises)
- ☐ Serpentes (Snakes)
- ☐ Sauria (Lizards)
- ☐ Crocodylia (Crocodilians)
- ☑ AVES (Birds)
- ☐ Passeriformes (Passerines)
- ☐ MAMMALIA
- ☐ Monotremata (Platypus, Echidna)
- ☐ Marsupalia (Marsupials)
- ☐ Eutheria (Placentals)
- ☐ Insectivora (Hedgehogs, Moles, Shrews, Tenrec, etc.)
- ☐ Chiroptera (Bats)
- ☐ Primates
- ☐ Humans
- ☐ Rodentia
- ☐ Lagomorphs (Rabbits, Hares, Pikas)
- ☐ Carnivora (Bears, Canids, Felids, Mustelids, Viverrids, Hyena, Procyonids)
- ☐ Perissodactyla (Odd-toed Ungulates) (Horses, Rhinos, Tapirs, etc.)

☐ Artiodactyla (Even-toed Ungulates) (Cattle, Sheep, Deer, Pigs, etc.) ☐ Marine Mammals (Seals, Walrus, Whales, Otters, Dolphins, Porpoises)	☐ TRANSGENIC ORGANISMS ☐ FOSSIL OR EXTINCT ORGANISMS	☐ NO ORGANISMS

CATEGORY VIII: MODEL ORGANISM (Select ONE)

☑ NO MODEL ORGANISM MODEL ORGANISM (Choose from the list)	☐ Escherichia coli ☐ Mouse-Ear Cress (Arabidopsis thaliana)	☐ Fruitfly (Drosophila melanogaster)

Project Summary

Intellectual merit: Ecologists have long been challenged to understand species distributions and the ecological factors that maintain species range limits. Montane regions have allowed ecologists to study range limits for multiple species simultaneously because habitats and species composition often change abruptly along altitudinal gradients. Tropical montane regions should be key landscapes in this area of research because of their high species diversity and the concentration of range limits at small spatial scales along altitudinal gradients, which offers unprecedented opportunity to study replicated patterns. Also, though not well explored, tropical montane regions have revealed several distinctive patterns of species association, contrary to the long championed individualistic Gleasonian patterns of temperate communities. My dissertation research focuses on two such patterns found in birds: (1) replacements in closely related species along altitudinal gradients and (2) correspondence of bird communities to plant community composition. Because it is difficult to examine mechanisms that limit species distributions when looking at the community level for birds and plants, I have chosen to focus on a particular subset of these communities for which we might expect strong associations along gradients: hummingbirds and flowering plants. Hummingbirds are primarily nectar-feeding birds that serve as important pollinators for flowering plants. In this group, studies have shown many cases of highly specialized plant-pollinator relationships. The highest diversity of hummingbirds is found in the forests of the Andes Mountains in South America, where species often have altitudinal distributions of a few hundred meters. Despite their well-studied specialization to flowering-plants, no one has examined how relationships between hummingbirds and flowering plants may constrain hummingbird species' altitudinal distributions. One enormous advantage of hummingbirds is that they leave a record of which flowers they have visited through the accumulation of pollen on their bills and heads, thus making costly studies that follow hummingbirds as they move through the environment unnecessary. In the proposed project, more than 400 pollen samples already collected from bills of captured hummingbirds along an altitudinal gradient in the Manu Biosphere Reserve of Peru will be identified to compile a list of flowering plants visited by each of 38 species of hummingbirds. These data, combined with data on the occurrence of those hummingbird and flowering-plant species along the same gradient, will be used to address the following hypotheses: (1) range limits in hummingbirds specialized to few flowering-plant species coincide with limits in the distribution of their flowering plants; (2) hummingbirds with broad altitudinal distributions change their use of flowering-plant species with altitude, making them specialists on different flowering-plant species within parts of their range; and (3) hummingbirds specialized to fewer flowering-plant species are constrained to narrower altitudinal ranges compared to generalist hummingbirds. This will be the first study to examine how ranges of one taxonomic group (plants) affect the distribution of another taxon (birds).

Broader impacts: Tropical mountains have been targeted as regions where climate change will have high impacts on flora and fauna. This analysis of flowering-plant specialization and range limits in hummingbirds could reveal potential limitations on this diverse family in their ability to respond to changing temperature regimes. The proposed work represents an ongoing collaboration with the Neotropical Paleoecology Laboratory, directed by Dr. Mark Bush at the Florida Institute of Technology, whose focus has been to develop a reference collection and pollen database for Neotropical flowering plants, with a strong concentration on Andean flora of southeastern Peru. This collaboration has fostered field research experience for an undergraduate student at Florida Tech who worked with me during the collection of pollen samples in 2006. The proposed research will create another undergraduate research position in this lab facility to process the pollen samples and will include a trained palynologist from Cuzco, Peru, to identify the pollen. Any pollen samples new to the Neotropical pollen collection will contribute to a growing online database. Many undergraduate students have already participated in data collection and analysis during the field component of this project from 2005-2008, including eight female Peruvian biology students, one female Colombian undergraduate, as well as two undergraduates and one high school student from the United States. Three of the Peruvian students are completing their "licenciatura" projects using data from this project, under the mentorship of the Co-PI. The proposed research, through additional collaboration with botanists from Dr. Miles Silman's Lab in Wake Forest University, will be used to produce a hummingbird-flowering plant photo guide, featuring hummingbird species for which pollen is being analyzed in this study along with their primary flowering plants in Manu. Another product resulting from this project will be a set of three compact discs of recorded bird species from the montane forests of Manu, which are currently being organized by an undergraduate student. The hummingbird-flowering plant photo guide and compact discs will be invaluable learning resources for researchers beginning investigation with birds of the Peruvian Andes.

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USING HUMMINGBIRDS TO TEST THE LINK BETWEEN BIRD AND PLANT DISTRIBUTIONS IN TROPICAL MONTANE FOREST

Ecologists have long struggled to understand species distributions and the ecological factors that maintain species range limits (Brown *et al.* 1996, Case and Taper 2000, Case *et al.* 2005, Holt and Keitt 2005). An underlying problem is that range limits of different species do not co-occur in space, making it logistically difficult to study mechanisms for more than a few species at a time. Montane regions provide a welcome exception because habitats and species composition often change abruptly along altitudinal gradients, giving ecologists the opportunity to study distributions of many species simultaneously. For example, Whittaker (1967) used tree distributions along temperate altitudinal gradients to test the classic "individualistic" and "community" hypotheses of H.A. Gleason and F.E. Clements, respectively, which described how species are distributed with respect to each other along gradients.

Because of their high species diversity and high density of range limits at small spatial scales, tropical mountain ranges have enormous, mostly untapped potential as study systems for understanding patterns of species distributions. In birds, hundreds of species can inhabit a single tropical mountainside, with many species having altitudinal ranges of only a few hundred meters (Stotz *et al.* 1996). Curiously, few studies have focused on tropical montane regions to address questions of species distributions and range limits (Terborgh 1971, Hernandez *et al.* 2008, Buermann *et al.* 2008).

Besides offering a greater amount of "raw material" of diversity to describe replicated patterns in species distributions, tropical montane communities have often revealed a very different pattern than temperate montane communities. While studies in temperate montane regions have largely concluded that species in a community are distributed individualistically with altitude, as originally proposed by Gleason (Gleason 1939, Whittaker 1956, Peet 1981), studies of montane species in the tropics reveal many situations in which multiple species' range limits co-occur along altitudinal gradients (but see Terborgh 1971, Navarro 1992, Patterson *et al.* 1998). One such case common in birds is that of "species replacement", in which closely related species show adjacent non-overlapping distributions. The classic interpretation of this pattern is that interspecific competition underlies replacements by preventing the coexistence of strong competitors (Terborgh and Weske 1975), although community-wide patterns suggesting competition have rarely been critically assessed or verified experimentally (but see Robinson and Terborgh 1995, Martin and Martin 2001). Alternatively, multiple species may show associated distributions because they are responding to sudden changes in habitat structure or plant communities along the gradient (e.g., ecotones; Terborgh 1985, Navarro 1992, Jankowski *et al. in press*). In these cases, species should have abrupt range limits that coincide with sharp transitional zones in habitat structure or in plant composition. A third explanation is based on specialized plant-animal interactions, which are prominent features of tropical forests (e.g., plant-pollinator relationships; Janzen 1975, Dziedzioch *et al.* 2003). We might expect specialized pollinators, for example, to have altitudinal distributions tightly associated with the distributions of their host plants (Stiles 1975).

For my dissertation, I am documenting patterns of species distributions for a tropical montane bird community in southeastern Peru and investigating several processes that could influence species range limits along a 2600-m altitudinal gradient. I have focused on two hypotheses:

(1) Replacements in closely related species along altitudinal gradients are maintained by competitive interactions between species. For territorial animals such as birds, interspecific competition is often expressed as interspecific territoriality (i.e., territorial defense against individuals of other species). I have used heterospecific playbacks of songs conducted within

territories of species showing altitudinal replacements and measured behavioral responses to test for the presence of interspecific territoriality in these species.

My data support this hypothesis: species respond aggressively to song playbacks of closely related species (i.e., congeners). In many cases, this response is nearly as strong as the individuals' response to conspecific songs (i.e. songs of their own species). Interestingly, the strength of behavioral response of an individual to a congener song playback decreases as one moves away from the zone of replacement along the gradient, suggesting that the development of such behavioral responses requires contact with individuals of the other species (Figure 1).

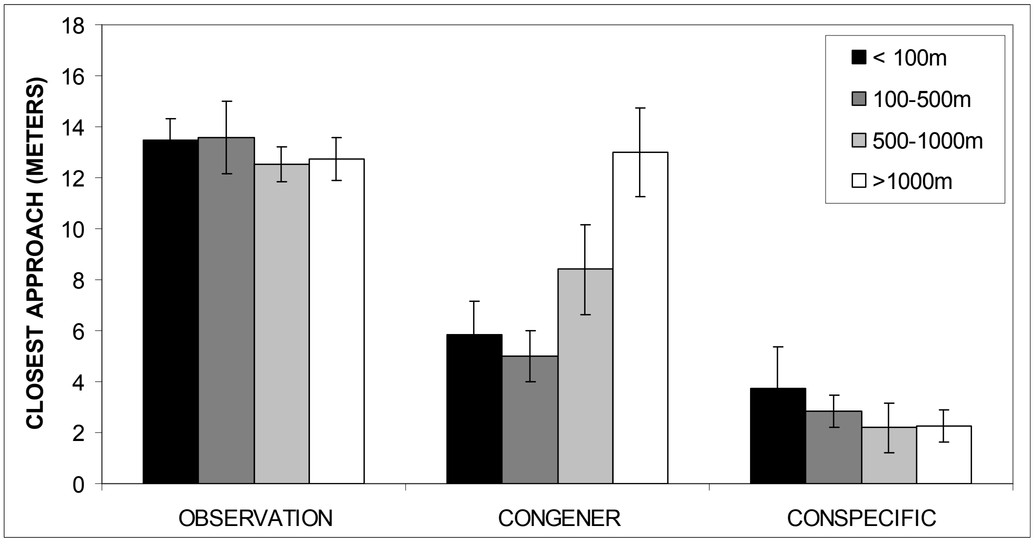

Figure 1. Closest approach to speaker (an aggressive response to song playbacks) in *Henicorhina leucophrys* for an observation period (no stimulus or control) and congener and conspecific song playbacks. The congener song playback used *H. leucosticta*. Bars show categories of distance of the focal territory to the nearest congener territory. When territories are close to the replacement zone, *H. leucophrys* responds very strongly to congener songs, but the strength of response declines with increasing distance from the replacement zone (GLM: $F = 75.8$, $df = 6$, $p<0.0001$; the following variables were significant at the $p<0.02$ level: trial (i.e., observation, congener or conspecific), distance from nearest congener, and interaction between trial and distance).

(2) Bird and plant communities show similar peaks of species turnover, or shared zones of rapid transition, along altitudinal gradients and show high correspondence in species composition. I am using avian censuses that I conducted along this altitudinal gradient, and collaborating with botanists working in the same region, to determine the degree to which elevational changes in plant communities match (and presumably drive) elevational limits of birds. These comparisons include examining patterns in species turnover along the gradient and the community-wide correspondence of these taxa in this landscape — e.g., are sites that are more similar in bird composition also more similar in plant composition? Data to test this hypothesis are currently being analyzed.

These hypotheses are not mutually exclusive because species replacements mediated by interspecific competitive interactions could occur at boundaries between different habitats (e.g., ecotones) along gradients.

The proposed research will focus on a particular subset of birds and plants for which we might expect strong associations between bird and plant distributions along gradients: hummingbirds and flowering plants. In Neotropical birds, hummingbirds are important pollinators for flowering plants and have often developed specialized mutualistic relationships with plant species. It is possible that range limits in this avian foraging guild (i.e., nectarivores) are resource driven, such that distributional limits of specialists should coincide with those of their flowering-plant food resources along the gradient. If any group should show a correspondence between plant and bird distributions, it should be this group. If there are no associations between plants and birds in this group, then there might be little chance of finding these associations in any other group.

Hummingbirds and flowering-plants as a system for examining plant-based distributional limits along gradients

Interactions between birds and plants have been a natural starting point for biologists aiming to understand habitat associations and species distributions because plants provide food resources as well as habitat structure used for foraging and shelter for many species (Cody 1985, Estades 1997, Lee and Rotenberry 2005). Most bird-plant interactions are generalized, and though the community composition of plants and birds may show an overall correspondence, it would be unlikely that the distribution of a given species of bird would closely match that of any single plant species. However, there are specialized relationships that have developed between birds and plants, especially in plant-pollinator systems (e.g., hummingbirds and flowering plants). Such plant-pollinator relationships offer promising avenues to investigate the influence of resource specialization on altitudinal distributions.

Hummingbirds (Family Trochilidae) make up the second largest family of birds in the New World, totaling 328 species, the large majority of which are tropical and montane. They are highly evolved nectarivores, dependent upon carbohydrate-rich nectar of flowering plants for 90% of their energetic requirements, and they serve as important pollinators for a variety of flowering-plant species (Schuchmann 1999). Consequently, flowering plants have evolved colorful flowers to attract their avian mutualists. Likewise, morphological traits of hummingbirds (e.g., bill size and shape) closely match flower morphology, often making them specialized to a limited spectrum of available nectar resources in the environment. Although the hummingbird-flowering plant linkage represents one of the strongest of bird-plant relationships, the degree of specialization of hummingbirds to flowering plants varies remarkably among species, ranging from generalists that feed almost non-selectively on flowers, to coevolved specialists that utilize only a few species of flowering plants, which precisely match the hummingbird's bill and body morphology (e.g., *Ensifera ensifera*, the Sword-billed Hummingbird, and its primary nectar source, *Passiflora mixta*, Lindberg and Oleson 2001; Stiles 1975, Stiles 1985). At the community level, studies of tropical hummingbird pollinator-plant relationships and specialization (mostly from Central America) have classified hummingbirds based on bill and flower morphology (Stiles 1985) or using hummingbird foraging behavior (e.g., traplining hummingbirds versus territorialists; Feinsinger and Colwell 1978). These and other studies report high levels of plant-pollinator coevolution within multiple hummingbird communities in tropical lowland and montane forest. However, no study has examined how this specialization on flowering-plant resources may constrain species distributions in hummingbirds.

The proposed research will determine whether species distributions and range limits in hummingbirds are associated with their flowering-plant resources along an altitudinal gradient in southeastern Peru. Data for this study, collected during my field research along an altitudinal gradient in the Manu Biosphere Reserve, offer a promising new area of investigation of the factors that influence species range limits in birds. Additionally, this research takes a novel approach that overcomes previous difficulties in examining resource specialization in hummingbirds. In particular, prior studies have used observations of hummingbirds at flowering plants in their environments to describe plant-pollinator relationships (e.g., Dziedzioch *et al*. 2003). This approach is problematic, especially in diverse tropical systems, because it requires repeated observations of all species of flowering plants in a region. There is a simple solution—

because hummingbirds carry, on their bills and foreheads, pollen of the flowering plants they visit, one can sample and identify the pollen from captured individuals to determine which flowers are being visited. With this in mind, I collected pollen samples from the bills of captured hummingbirds during mist-netting surveys along the altitudinal gradient. By collaborating with specialists that can identify the pollen grains collected from each individual, I can create a list of flowering-plant species used by each species of hummingbird. These data, combined with distributional information from censuses for the hummingbirds and flowering plants along the gradient will be used to address the following hypotheses:

1) Range limits in hummingbirds that are specialized to few flowering-plant species coincide with limits in the distribution of their flowering plants. For all of the species sampled along the gradient, I will test whether, and how often, the altitudinal range limits of hummingbirds and the range limits of their primary flowering plants coincide, as determined from our censuses of birds and plants in the region.
2) For hummingbird species with broad altitudinal distributions, hummingbirds change their use of flowering-plant species with altitude, making them specialists on different sets of flowering-plant species within parts of their altitudinal range. The capture of each hummingbird during mist-netting can be pinpointed to a specific location along the gradient, so that the use of different flowering plants by individuals of each hummingbird species can be mapped with elevation.
3) Species that are more specialized, or that use fewer species of flowering plants, are constrained to narrower altitudinal ranges compared to generalist hummingbirds. Using data on the number of flowering-plant species utilized and the altitudinal distributions of hummingbirds, I will test whether resource specialization is associated with restricted species distributions.

Data Collection and Analyses

Mist-netting surveys and collection of pollen along the gradient—Hummingbird pollen was collected during mist-netting surveys along the altitudinal gradient in Manu Biosphere Reserve between 850 – 3400m between the months of August and November, 2006 – 2007, falling within the avian montane breeding season. During this time, 42 groups of mist-nets, with ten nets per group, were run for three days each, yielding a total of 9,360 net hours. All netting sites were mapped using a GPS, allowing us to pinpoint the capture location and elevation for each individual to within ±7 meters. At least one netting group was placed every 200m altitude along the gradient. Mist-netting provided almost 1,000 captures of 39 species of hummingbirds and 38 species for which pollen and morphological data could be collected and recorded (Table 1). These species are distributed rather evenly among foothill, middle elevation, and highland sites. Pollen was collected from captured hummingbirds using a slice of slightly adhesive gelatin, which was held with tweezers and rubbed over the entire surface of the bill, forehead and chin. After transferring pollen from the hummingbird to the gelatin, the gelatin was placed on a glass microscope slide, heated with a small flame until the gelatin liquidized, and covered with a glass cover slip to protect the pollen sample from contamination.

Pollen identification—Hummingbird pollen samples will be identified between June – September of 2009 within the Neotropical Paleoecology Laboratory, directed by Dr. Mark Bush at the Florida Institute of Technology, where resources and equipment will allow the most efficient and complete identification of Andean pollen. In this laboratory there is a large reference collection of pollen from the Southeastern Peruvian Amazon and Andes and a Neotropical pollen database for more than 1,000 species. The pollen samples will be processed and remounted onto microscope slides for identification with a transmitted-light microscope.

During this process, exposed pollen grains on the microscope slides will be stained with Safranin in order to highlight the morphological characteristics useful for their taxonomic identification. Using a transmitted-light microscope, all grains present in each sample will be counted. Identification using a scanning electron microscope (SEM) may be necessary for more cryptic samples. Pollen taxa will be identified to genus or species using available literature on the subject (e.g., Roubik and Moreno 1991, Herrera and Urrego 1996, Colinvaux *et al.* 1999, Velásquez 1999) and the database developed by the Neotropical Paleoecology Research Group (Bush and Weng 2007), as well as the modern pollen reference collection of the Paleoecology Laboratory of Florida Institute of Technology.

Table 1. Seventeen most commonly captured hummingbirds along the Manu gradient with corresponding number of pollen samples (i.e., number of individuals sampled) and each species' altitudinal range.

Species	N^o Samples	Altitudinal range	Species	N^o Samples	Altitudinal range
Eutoxeres condamini	51	1100-2000	*Doryfera ludovicae*	17	1100-1500
Phaethornis guy	44	950-1500	*Chalcostigma ruficeps*	16	2530-2700
Adelomyia melanogenys	38	1100-2700	*Coeligena violifer*	16	2460-3375
Heliodoxa leadbeateri	38	1100-1700	*Schistes geoffroyi*	14	1200-1800
Heliangelus amethysticollis	31	2300-3250	*Coeligena torquata*	9	2300-2700
Ocreatus underwoodii	20	950-2000	*Thalurania furcata*	9	880-1340
Coeligena coeligena	19	1100-2460	*Aglaiocercus kingi*	8	1400-2530
Metallura tyrianthina	17	2460-3375	*Threnetes niger*	8	1100-1200
Phlogophilus harterti	17	1100-1500	Other (< 5 samples/species)	46	---

Bird and flowering plant censuses—Data on range limitations in hummingbirds and flowering plants come from censuses that have been conducted along the altitudinal gradient from 2005-2008. For birds, I conducted point counts along the altitudinal gradient during the breeding seasons (August – November) of 2006-2008. In total 225 points were established along trails and transects, averaging 17 points per 200m elevation. Point-count locations were separated by 130m (horizontal distance) and marked with a GPS. Each count lasted ten minutes, during which all birds detected by sight or sound were identified, and their distances from the point were recorded. Counts at each point were repeated four times throughout the breeding season. Point-count data will be combined with mist-netting survey data from the gradient to determine the altitudinal ranges of the hummingbird species sampled. Understory plants were sampled in 2007-2008 across 176 vegetation plots, each measuring 10x10m, placed at each bird point-count location, in which every species >1m high was sampled. Samples are stored and awaiting identification by Peruvian botanical experts in the lab of Dr. Norma Salinas at the Universidad de San Antonio Abad del Cusco (UNSAAC). Data on tree species distributions along the gradient were collected by Peruvian botanists within the labs of collaborators Dr. Norma Salinas and of Dr. Miles Silman at Wake Forest University. A total of 15 1-hectare plots and 12 0.1-hectare plots were established at 250m intervals along the altitudinal gradient. In each plot every stem ≥10cm dbh was identified and counted, and for subplots within each plot, all understory stems >1m were counted and identified (or if field identification was not possible for trees or understory stems, samples were collected and later identified).

Data analysis—Dr. Mark Bush will provide a list of flowering-plant species from the pollen grains identified in each sample for each of the 418 pollen samples collected. The extent to which these samples represent the entire breadth of flowering plants pollinated will then be determined for each species using saturation curves between number of samples and number of additional flowering-plant species detected. We will find many pollen grains per pollen sample, potentially representing many different species of flowering-plants. Seventeen of the captured hummingbird species have eight or more pollen samples, and six species have at least 20 samples, which should allow us to identify a significant proportion of the flowering plants that make up their diets. Five species have 30-50 pollen samples, allowing us to examine changes in the flower use at different elevations within species' ranges. The pollen samples collected are broadly distributed across the altitudinal range for each species, limiting the bias of any single netting site in determining the list of flowering-plant species utilized.

The first hypothesis, that range limits in hummingbirds that are specialized to few flowering-plant species coincide with limits in the distribution of their flowering plants, will be performed in a two step process: (1) a preliminary visual examination by overlaying altitudinal distributions for hummingbirds and their flowering-plants, followed by (2) a logistic regression to predict the probability of occurrence of the hummingbird species along the altitudinal gradient, using the occurrence of flowering-plant species as binary predictor variables (Agresti 1996).

Determining whether hummingbirds vary their use of flowering-plant species at different altitudes will be analyzed by first developing a flowering-plant species list for each hummingbird for different altitudinal zones (e.g., for each 200m zone). A similarity index (e.g., Sorenson's or Morisita-Horn index) will be used to quantify the change in flowering-plant species composition for each hummingbird across these altitudinal zones using the program EstimateS (Colwell 2005). This program offers indices that correct for undersampling biases (and allow sampling biases to be assessed) and standard error estimates for the index, allowing for statistical comparison of similarity values between different altitudinal zones.

The final research question, whether hummingbirds that are specialized on fewer species of flowering-plant species have narrower altitudinal distributions, will be analyzed using a general linear model (GLM) using the program SAS (SAS Institute, 2008). This analysis will be performed for (1) all hummingbird species, (2) species with pollen sample sizes of eight or more, and (3) species with pollen sample sizes of 17 or more. Within these groups, rarefaction sub-sampling will be used to compare hummingbird species that differ in individual pollen sample sizes.

Broader Impacts

Tropical mountains have been targeted as regions where climate change will have high impacts on flora and fauna, forcing species to shift their ranges upslope (e.g., Pounds et al. 1999, Williams et al. 2003, Deutsch et al. 2008, Tewksbury et al. 2008). For conservation initiatives, it is critical to describe the distribution and abundance of species in diverse montane regions to generate a baseline of current species distributions and also identify potential factors that influence species altitudinal range limits. Studies that project how species will shift their ranges in response to different temperature regimes should consider species that may be restricted by not only their allowable physiological responses but by species interactions like competition or specialization to resources. This might be particularly relevant to hummingbirds because of their often strong specializations with flowering plants and because most hummingbird species live in tropical montane areas. Along this altitudinal gradient, for example, 86% of 64 total species have altitudinal range limits above 1000m (9 species have distributions confined to elevations below 1000m, and only 4 species are exclusive to lowland elevations < 500m; Patterson et al. 2006). This study will provide a baseline for future studies to evaluate how climate change affects altitudinal distributions in hummingbirds and the importance of flowering-plant resources in driving range shifts in hummingbirds.

This proposed work represents an ongoing collaboration with the Neotropical Paleoecology Laboratory, directed by Dr. Mark Bush at the Florida Institute of Technology, whose focus has been to develop a reference collection and an online pollen database for

Neotropical flowering plants, with a strong concentration on Andean flora of southeastern Peru. This collaboration has already fostered field research experience for an undergraduate student, Zachariah Peterson, at Florida Institute of Technology, who worked with me during the collection of the pollen samples in Manu Biosphere Reserve in 2006. Dr. Bush and I will create another undergraduate research position in his lab to process the pollen samples. One of my undergraduate assistants, Marcela Salazar, a Colombian student at the University of Florida, is currently working on her honor's thesis with data from my dissertation research under my mentorship, and will be a likely candidate for this position as she builds her research experiences in preparation for graduate school. The pollen identification will be conducted by Bryan Valencia, a trained palynologist from Cuzco, Peru. Any pollen samples that are new to this Neotropical pollen collection will contribute to the lab's database. This is a great example of international collaboration with scientists from the United States providing training and skill development for students at both the beginning and later stages of their research careers.

A product of this research that will be available on the web is a hummingbird-flowering plant photo guide, featuring the hummingbird species in this study for which pollen is being analyzed, along with their primary flowering plants. This research is the result of a multi-lab collaboration with botanists from the lab of Dr. Miles Silman in Wake Forest University and paleoecologists in the Neotropical Paleoecology Lab. Zachariah Peterson has already begun compiling bird and flowering plant photos that were taken during field work with me in Manu in 2006. This hummingbird-flowering plant guide will be especially useful for Peruvian and other Latin American students who are beginning research projects in the Manu Biosphere Reserve, especially for those who are interested in plant-pollinator interactions. Another product resulting from this project will be a set of three compact discs of recorded bird species from the montane forests of Manu Biosphere Reserve, representing foothill, middle- and high-elevation communities (with 99 species per disc). These will be available as a learning resource for researchers interested in studying birds of southeastern Peru. At the University of Florida, songs are currently being organized and edited by an undergraduate student volunteering in our lab.

Throughout my dissertation work, I have been committed to mentoring students from Latin American and from underrepresented groups. During the prior field component of this project (2005-2008), I have trained a variety of biology students with a range of ethnic backgrounds, including eight female Peruvian biology students, two female Colombian undergraduates, as well as two undergraduate students and one high school student from the United States. Field skills acquired in this project include learning to identify tropical birds by sight and sound, mist-netting and measuring birds, recording bird songs using digital equipment, and censusing vegetation plots. Three of the Peruvian students, Rosalbina Butrón Loayza, Natividad Raurau Quisiyupanqui, and Maura Jurado Zevallos, are now completing their "licenciatura" projects using data they collected under my mentorship. Rosalbina is determining whether montane birds inhabiting bamboo patches (*Guadua* sp.), ranging from the Manu foothills to lower cloud forest, are specialized to those habitats; until now, specialization to bamboo communities has been considered a lowland phenomenon (Kratter 1997). Natividad is identifying seeds from fecal samples of birds to determine the range of fruiting trees utilized by different birds along the altitudinal gradient. Maura is planning a study for April 2009 to census a high-elevation bird community during the non-breeding season. She will compare her data with our breeding season dataset of species composition of the same location to determine whether there is temporal variation in this bird community. Finally Marcela, the Colombian undergraduate student mentioned above, is examining the potential for song mimicry between closely related species that show species replacements along altitudinal gradients, as one element of the interspecific territoriality that these species exhibit at their range boundaries.

Within my study region, I have also worked with the Asociación para la Conservación de la Cuenca Amazonica (ACCA) to promote research at the Wayqecha Centro de Investigación (one of the primary field sites in my dissertation data collection). This has involved numerous presentations to Peruvian university students from the Universidad de San Antonio Abad del Cusco (UNSAAC), many of whom are aspiring tropical biologists. I have also presented my work at science workshops for middle and high school children from the nearby towns of Patria and Pilcopata. These presentations are of course in Spanish. I take pride in introducing children to biology, birds, and the enormous species diversity that can be found in their backyards. One of the most gratifying moments was when a young girl who told me that now she wanted to become a biologist when she grew up.

I also take pride in being a role model for Latin American women students, who are beginning the process of scientific investigation in a field where successful women tropical biologists are in short supply. As a woman, I am part of an underrepresented group in the field of tropical biology. I can think of only a couple prominent women biologists who study Neotropical vertebrates and undertake extensive field seasons in remote locations. It has been a challenge, yet very rewarding, to assemble the multi-cultural and multi-national research teams necessary to conduct my dissertation research. The field work alone, which requires months of living in tents and managing food and supplies into remote corners of montane forest, has been a life-changing experience for all involved. Being able to accomplish this in a Peruvian culture that typically looks to males for leadership and often looks down on women's abilities has been an inspiration to women investigators of our research team, both national and international.

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BIOGRAPHICAL SKETCH

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Professional Preparation

Undergraduate
1979 B.A., Earlham College, Richmond, IN
Graduate
1986 Ph.D., University of Wisconsin, Madison, WI
1982 M.S., University of Wisconsin, Madison, WI
Postdoctoral
1987-88 Postdoctoral Fellow. University of Florida, Gainesville, FL

Appointments

1997- Professor, University of Florida
1993-1997 Associate Professor, University of Florida
1988-1993 Assistant Professor, University of Florida

Publications

5 Most Relevant to Proposed Research

Levey, D. J., J. J. Tewksbury, and B. M. Bolker. 2008. Modeling and measuring long-distance dispersal in heterogeneous landscapes. **Journal of Ecology** 96:599-608.

Jahn, A. E., D. J. Levey, J. E. Johnson, A. M. Mamani, and S. E. Davis. 2006. Hacia una interpretación mecánica de la migración de aves en Sudamérica. (Towards a mechanistic interpretation of bird migration in South America) **El Hornero** 21:99-108. (*Invited review*)

Damschen, E. I., N. M. Haddad, J. L. Orrock, J. J. Tewksbury, and D. J. Levey. 2006. Corridors increase plant species richness at large scales. **Science**. 313: 1284-1286.

Levey, D. J., B. M. Bolker, J. J. Tewksbury, S. Sargent, and N. M. Haddad. 2005. Effects of landscape corridors on dispersal by birds. **Science** 309:146-148.

Levey, D.J. Spatial and temporal variation in Costa Rican fruit and fruit-eating bird abundance. 1988. **Ecological Monographs** 58:251-270.

5 Other Significant Publications

McCoy, M.W., K. A. McCoy, and D. J. Levey. 2007. Teaching biodiversity to students in inner-city and under-resourced schools. **American Biology Teacher** 69:473-477.

Jahn, A. E., D. J. Levey, and K. G. Smith. 2004. Reflections across hemispheres: Austral migration is key to a system-wide approach to New World bird migration. **Auk** 121:1005-1013 *(Invited review)*.

Haddad, N., D. R. Bowne, A. Cunningham, B. Danielson, D. J. Levey, and S. Sargent. 2003. Corridor use by diverse taxa. **Ecology** 84:609-615.

Moegenburg, S. M. and D. J. Levey. 2002. Prospects for conserving biodiversity in Amazonian extractive reserves. **Ecology Letters** 5:320-325.

Levey, D. J. and F. G. Stiles. 1995. Variabilidad de recursos, hábitat, y movimientos estracionales en aves Neotropicales: Implicaciones para la evolución de la migración a larga distancia. **Bird Conservation International 4:**109-115.

Synergistic Activities

-A strong commitment to recruiting and mentoring scientists from under-represented groups. In my lab, these have included: Alex Jahn, Ellen Andresen, Maria Barreto, Connie Clark, Marcelino Fuentes, Alejandro Grajal, Rochelle Johnston, Silvia Lomáscolo, Carlos Manchego, Julian Resasco, Christina Romagosa, Stephanie Romañach, Lenny Santisteban, Carla Restrepo, Lynn Svihra, Teri Tamboia, Sophia Wahaj & Pedro Rey Zamora. All NSF REU participants in my lab have been women and three have been minorities. Currently, I am mentoring 2 Hispanic Americans (PhDs), 1 Native American (PhD), and 2 international students (MS/PhD). In 1998 I was given an award from the Univ. of Florida for "*Continuous meritorious contributions to Undergraduate Research*" and in 2005 I became an inaugural member of UF's Academy of Distinguished Teaching Scholars.

-Lead PI of SPICE, an NSF GK-12 program that trains and places UF graduate students into under-privileged middle schools, where they teach science 2 days per week (www.spice.centers.ufl.edu). The goal is to foster children's interest in pursuing STEM disciplines and to help change the culture of graduate education by emphasizing the role of broader impacts in graduate training. My participation in these types of activities contributed to being named "*2001 Teacher-Scholar of the Year*," the University of Florida's highest faculty honor.

-Co-organizer of two International Symposia/Workshops, one on frugivory (Brazil, 2000) and one on bird migration (Chile, 2003). Lead PI on NSF INT-0002432 and INT-0313419, which provided travel funds for >35 scientists, representing a wide range of ages and ethnicities.

-Co-organizer of symposium on NSF GK-12 programs at the 2006 annual meeting of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). I am a member of SACNAS.

-Introduced Evolutionary Medicine into the curriculum at Univ. of Florida and Brown Univ.

-Developed some of the first web-based courses at University of Florida, which led to two University of Florida teaching awards (1993, 1996).

Collaborators and Other Affiliations

Within last 48 months (not including those listed in publications or the following sections)

John Blake (US Forest Service), **B. Bolker** (U. Florida), **Betty Dunckel** (U. Florida), **Tomas Carlo** (U. Washington), **Tom Crisman** (U. Florida), **Brent Danielson** (Iowa State Univ.), **Hank Frierson** (U. Florida), **Mauro Galetti** (University of Sao Paulo, Brazil), **Katheryn Greenberg** (US Forest Service), **L. Jones** (U. Florida), **Ido Izhaki** (Haifa University, Israel), **John Kilgo** (US Forest Service), **Mary Jo Korolly** (U. Florida), **Bernie Machen** (U. Florida), **Carlos Martínez del Rio** (U. of Wyoming), **John Orrock** (Iowa State U.), **R. Quintana** (Alachua Co. Public Schools), **Sandra Russo** (U. Florida)

Graduate and Postdoctoral Advisors

Postdoctoral Advisor: **Bill Karasov** MS and PhD Advisor: **Timothy Moermond**

Thesis Advisor and Postgraduate-Scholar Sponsor

Graduate Students (20 total)

Ellen Andresen (Universidad Nacional Autonoma de Mexico); **Maria Barreto** (Smithsonian Tropical Res. Cent.); **Margaret Byrne** (Veteran's Medical Center, Houston); **Connie Clark** (current Ph.D); **Trevor Caughlin** (current Ph.D); **Alex Jahn** (current, Ph.D); **Jill Jankowski** (current, Ph.D); **Mathew Jones** (NCEAS; Santa Barbara); **Gustavo Londoño** (current, MS); **Silvia Lomàscolo** (CONICET; Argentina); **Kurt Merg** (Wash. State Univ.); **Susan Moegenburg** (Smithsonian Institution, Washington, DC); **Greg Pryor** (Frances Marion Univ.); **Carla Restrepo** (U. of Puerto Rico); **Ivan Samuels** (MS); **Lynn Svihra** (Boca Raton High School); **Patricia Townsend** (U. of Wash.; Ph.D.); **Eric VanderWerf** (USFWS, Honolulu); **Danial Wenny** (IL Nat. Hist. Survey)

Postgraduate-Scholar Sponsor (10 total)

Martin Cipollini (Prof., Berry College, Rome, GA); **Ido Izhaki** (Prof., Haifa U., Haifa, Israel); **Charles Kwit** (current Postdoctoral Fellow); **John McCarty** (Assoc. Prof., Univ. of Nebraska); **Scott Pearson** (Scientist, Div. of Nat. Res., WA); **Pedro Rey** (Prof., U. of Granada, Spain); **Martin Schaefer** (Asst. Prof., U. Freiberg, Germany); **Sarah Sargent** (Allegheny College, Meadville, PA); **Wesley Silva** (Prof., U. of Campinas, Brazil); **Josh Tewksbury** (Asst. Prof., U. of Washington)

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Profession Preparation

Purdue University, Ecology, Evolution and Population Biology w/ Honors, B.Sc. 2002
Purdue University, Ecology, Evolution and Population Biology, M.Sc. 2004
University of Florida, Zoology, Ph.D. expected 2010

Publications (* denotes publications with undergraduates)

Relevant publications

*Jankowski, J. E., Ciecka, A.L, Meyer, N.Y., and Rabenold, K.N. in press. Beta diversity along environmental gradients: Implications of habitat specialization in tropical montane landscapes. *Journal of Animal Ecology*.

Jankowski, J.E. and Rabenold, K.N. 2007. Endemism and local rarity in birds of Neotropical montane rainforest. *Biological Conservation* 138: 453-463.

Other publications

*Levey, D.L., Londoño, G.A., Ungvari-Martin, J., Hiersoux, M.R., Jankowski, J.E., Poulsen, J.R., Stracey, C.M. and Robinson, S.K. Urban mockingbirds quickly learn to identify individual humans. (*Submitted to Proceedings of the National Academy of Sciences*)

Steadman, D.W., Montambault, J.R., Robinson, S.K., Oswalt, S.N., Brandeis, T.J., Londoño, G.A., Reetz, M.J., Schelsky, W.M., Wright, N.A., Hoover, J.P., Jankowski, J.E., Kratter, A.W., Martinez, A.E. and Smith, J. Relative abundance and habitat use of wintering Neotropical migrants and resident landbirds on St. John, U.S. Virgin Islands. (*Submitted to Wilson Journal of Ornithology*)

Synergistic Activities

- Undergraduate training in research (2005-present): I have mentored undergraduate students in the field and lab, training them in methods of data collection and analysis, teaching them how to use the scientific method, and helping them work on independent research projects that they develop, mostly with topics related to my dissertation. Eight of these students are female Peruvians, two are female Colombians (one with U.S. citizenship), and four are undergraduate students from the United States (3 female, 1 male).

- Undergraduate teaching (2006-present): At the University of Florida, I have been a teaching assistant for undergraduate courses, including Avian Biology (multiple semesters; mostly upperclassmen) and Introductory Biology Laboratory (mostly underclassmen). In my teaching, I reach students with a broad range of ethnic backgrounds.

- Workshop leader with ACCA (2006-2007): With the Asociación para la Conservación de la Cuenca Amazonica (ACCA) in Cusco, Peru, I led workshops in science and environmental awareness for children in nearby towns, ages 8 to 14, many of whom have never met or heard of a biologist before. This gave me the unique opportunity to connect children to the nature in their backyards.

- Introducing high school students to scientific study (2007): I have worked with two high school students in the lab, introducing them to scientific investigation and biology, specifically working with microscopes and ectoparasite samples collected from birds during my dissertation work. I brought another high school student to my field site in southeastern Peru and trained him in data collection methods and conducting scientific investigation.

Collaborators and Other Affiliations

Asociación para la Conservación de la Cuenca Amazonica (ACCA), Cusco, Peru
Mark Bush, Florida Institute of Technology
William Haber, Missouri Botanical Gardens
Doug Levey, University of Florida – PhD co-advisor
Kerry Rabenold, Purdue University – Master's advisor and co-author
Scott Robinson, University of Florida – PhD co-advisor
Norma Salinas, Universidad de San Antonio Abad del Cusco
Miles Silman, Wake Forest University

BIOGRAPHICAL SKETCH

Scott K. Robinson
Katharine Ordway Professor
Eminent Scholar
Florida Museum of Natural History
University of Florida
PO Box 117800
Gainesville, FL 32607

srobinson@flmnh.ufl.edu
352-392-1721, ext.509

Professional Preparation

Undergraduate

1973-1978 B.A., Biological Sciences, Dartmouth College, Hanover, NH

Graduate

1978-1984 Ph.D., Biology, Princeton University, Princeton, NJ

Appointments

2004-2007	Chair, Department of Natural History and Assistant Director, Collections and Research, Florida Museum of Natural History
2003-	Affiliate, Departments of Zoology and Wildlife Ecology and Conservation, University of Florida
2003-	Katharine Ordway Professor of Ecosystem Conservation, Florida Museum of Natural History, University of Florida, Gainesville, FL
2001-2003	Chair, Department of Ecology, Ethology, and Evolution (now Animal Biology), University of Illinois, Champaign, IL
1998-2003	Professor, Department of Ecology, Ethology, and Evolution (now Animal Biology),UIUC
1996-1997	Director, Center for Wildlife Ecology, Illinois Natural History Survey, Champaign, IL
1992-1998	Professional Scientist, Center for Wildlife Ecology, Illinois Natural History Survey
1988-2002	Associate Professional Scientist, Center for Wildlife Ecology, Illinois Natural History Survey
1986-1998	Joint Assistant, Associate, and Full Professor, Department of Ecology, Ethology, and Evolution, University of Illinois, Champaign, IL
1984-1988	Assistant Professional Scientist, Center for Wildlife Ecology, Illinois Natural History Survey, Champaign, IL

Representative Publications (undergraduate authors in boldface)

Foster, J.T. and S.K.Robinson. 2007. Introduced birds and the fate of Hawaiian forests. *Conservation Biology* 21:1248-1257.

Hoover, J.P. and S. K. Robinson. 2007. Retaliatory mafia behavior by a parasitic cowbird favors host acceptance of parasitic eggs. *Proceeding of the National Academy of Sciences, USA 104:4479-4483*.

Winfree, R., J. Dushoff, S. K. Robinson, and **D.Bengali.** 2006. A Monte Carlo model for estimating the productivity of a generalist brood parasite across multiple host species. *Evolutionary Ecology Research 8:213-236*

Morse, S. A. and S. K. Robinson. 1999. Nesting success of a migratory songbird in a multiple-use forest landscape. *Conservation Biology* 13:327-337.

Suarez, A. V., K. S. Pfennig, and S. K. Robinson. 1997. Nesting success of a disturbance-dependent songbird on different kinds of edges. *Conservation Biology* 11:928-935.

Representative Tropical Biodiversity Publications

Styrsky, J.N., J.D.Brawn, and S.K.Robinson. 2005. Juvenile mortality increases with clutch size in a neotropical bird. *Ecology* 86:3238-3244.

Russo, S. S.K. Robinson, J. Terborgh. 2004. Size:abundance relationships of an Amazonian Forest bird community: Implications for the energetic equivalence rule. *American Naturalist* 161:267-283.

Van Bael, S.A., J.D. Brawn, and S.K. Robinson. Birds defend trees from herbivores in a neotropical forest canopy. *Proceedings of the National Academy of Sciences, USA 100:8394-8307*

Robinson, W.D., S.K.Robinson, and J.D.Brawn. 2000. Structure and organization of a Panamian forest bird community. *Ecological Monographs* 70:209-236.

Robinson, S. K. and J. Terborgh. 1997. Bird community dynamics along a primary successional gradient of an Amazonian whitewater river. *Ornithological Monographs* 48:637-668.

Synergistic Activities

Head, Department of Ecology, Ethology, and Evolution at the University of Illinois: During my administration we hired 3 women and 2 Hispanics to faculty positions (out of 6 positions), all of whom are thriving.

Editorial Boards: *Conservation Biology*:1995-2001; *Ecology* 1997-2000; *Oecologia* 2003-present; *Biotropica* 2001-2003; Editor, *Florida Field Naturalist,*2006-present

Undergraduate student training: I typically employ 2-10 undergraduates each summer on research projects relating to biodiversity. Three of my undergraduate advisees (Judit Ungvari-Martin, Monique Hiersoux, and Jane Bauer) are currently preparing manuscripts for eventual publication.

International Graduate student training: I have trained several international students, including Muhammed Hussin (MS student from Malaysia, currently a professor in Malaysia), Miguel A. Marini (Ph.D., currently a professor in the Federal University of Brasilia), Leonardo Chapa (Ph.D., currently a professor in San Luis Potosi, Mexico), Juan Bouzat (Ph.D., an Argentinian currently an Assistant Professor at Bowling Green), and Gustavo Londono (a Colombian co-advised with Doug Levey). I currently have an Hispanic American graduate student, Ari Martinez, who works in Bolivia.

I work extensively with various federal (USFS,USFWS, NPS), state(Illinois DNR, Florida FWC), local (Audubon Societies, NRDC), and private agencies(TNC, Environmental Defense) and with the media to promote the conservation of neotropical migratory birds, principally by advising on land management and acquisition.

Speaking on bird conservation at local public schools, Audubon Societies, and other organizations

Collaborators and Other Affiliations

Collaborators and co-editors: Jeff Brawn, Leonardo Chapa-Vargas, Aaron Gabbe, R.M. DeGraaf, Terri .M. Donovan, John Faaborg, Ed Heske, James Herkert, Bob Holt, Solon Morse, Tara Robinson, W. Douglas Robinson, Steve Rothstein, Sabrina Russo, Vicky Saab, Katie Sieving, Dave Steadman, John Terborgh, Frank R. Thompson,III, Sunshine Van Bael

Graduate Advisor: John Terborgh, Duke University

Graduate students: 7 (Ph.D. received last 5 years only): Jeff Foster (postdoc at Smithsonian Institution), Jennifer Nesbitt-Styrsky (research associate at Auburn University), Jeff Hoover (Asst. Prof, Illinois Natural History Survey), Leonardo Chapa (Research Assistant Professor ,IPICYT-San Luis Potosi, Mexico), Sabrina Russo (Asst. Professor, Univ. Nebraska-Lincoln; co-advised by Carol Augspurger), Juan Bouzat (Asst. Prof. Bowling Green State University), Sunshine Van Bael (postdoc, Smithsonian Tropical Research Institute, co-advised by Jeff Brawn)

Current doctoral students: 6: Wendy Schelsky, Gustavo Londono (co-advised with Doug Levey), Ari Martinez, Christine Stracey, Matt Reetz (UF co-advised by Katie Sieving), Jill Jankowski (co-advised by Doug Levey)

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION **University of Florida**				FOR NSF USE ONLY PROPOSAL NO.	DURATION (months) Proposed / Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Douglas J Levey**				AWARD NO.	

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Douglas J Levey - none**	0.00	0.00	0.00	$ 0	$
2. **Jill E Jankowski - none**	0.00	0.00	0.00	0	
3. **Scott K Robinson - none**	0.00	0.00	0.00	0	
4.					
5.					
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	0	
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	0	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				0	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				0	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				668	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ 0 2. TRAVEL 0 3. SUBSISTENCE 0 4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				10,619	
TOTAL OTHER DIRECT COSTS				10,619	
H. TOTAL DIRECT COSTS (A THROUGH G)				11,287	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **(Rate: , Base:)**					
TOTAL INDIRECT COSTS (F&A)				0	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				11,287	
K. RESIDUAL FUNDS				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 11,287	$
M. COST SHARING PROPOSED LEVEL $ 0	AGREED LEVEL IF DIFFERENT $				

PI/PD NAME **Douglas J Levey**	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Brian prindle**	Date Checked	Date Of Rate Sheet	Initials - ORG

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Florida

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Douglas J Levey

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Douglas J Levey - none	0.00	0.00	0.00	$ 0	$
2. Jill E Jankowski - none	0.00	0.00	0.00	0	
3. Scott K Robinson - none	0.00	0.00	0.00	0	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	0	
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	0	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				0	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				0	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				668	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ 0 2. TRAVEL 0 3. SUBSISTENCE 0 4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				10,619	
TOTAL OTHER DIRECT COSTS				10,619	
H. TOTAL DIRECT COSTS (A THROUGH G)				11,287	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				0	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				11,287	
K. RESIDUAL FUNDS				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 11,287	$

M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Douglas J Levey

ORG. REP. NAME*
Brian prindle

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

C ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

Budget Justification

Travel expenses:

I am requesting funds for traveling expenses for three visits to the Neotropical Paleoecology Lab in Melbourne, Florida, to review the progress and results of the pollen identification and consult with Dr. Bush. Melbourne is approximately 180 miles (360 miles round trip) from the University of Florida in Gainesville. Using University of Florida's standard gas mileage costs of $0.44 per mile, and a two-day car rental for approximately $64.20 (subcompact car from Avis with University employee discount) travel expenses would yield $222.60 round trip for a single visit, and $667.80 for all three trips.

Other Direct Costs:

Pollen identification: The primary expense in the proposed project is the identification of pollen samples collected from hummingbirds. The pollen grains in each sample will be identified in the Neotropical Paleoecology Laboratory of Dr. Mark Bush at the Florida Institute of Technology. The costs for pollen analysis include processing expenses for preparing the samples (e.g., chemical solutions used for remounting and staining pollen grains) and lab consulting fees for the identification of the pollen grains. Based on an estimated average of 1-2 hours to process and identify each sample, and the amount of chemicals required, we have estimated a per sample expense of $9 for processing and $15 for identification (also see letter of collaboration from Dr. Bush). For 418 samples, the total cost is $10,032.

Plant sample identification: Half of the plant samples that will be used to determine flowering-plant species altitudinal ranges along the gradient are being stored in the laboratory of Dr. Norma Salinas at the Universidad de San Antonio Abad de Cusco, and require botanical experts within the lab to identify them. This consulting cost for the botanical identification requires $10/day, and with plants from approximately 88 vegetation plots to identify, at an estimated rate of 1.5 plots per day, the total cost would yield $586.67

The total cost of this project comes to $11,286.47.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Douglas Levey

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: International DDIG: What limits recruitment of tropical trees? An experimental test of seed and establishment limitation.

Source of Support: NSF

Total Award Amount: $ 14,990 Total Award Period Covered: 06/01/08 - 05/30/10

Location of Project: Congo

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.50

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Science Partners in Inquiry-based Collaborative Education II (SPICE II)

Source of Support: NSF

Total Award Amount: $ 1,993,026 Total Award Period Covered: 01/01/06 - 12/31/10

Location of Project: Florida

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 2.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Collaborative Research: Effects of corridors and edges on plant populations

Source of Support: NSF

Total Award Amount: $ 181,467 Total Award Period Covered: 10/01/06 - 09/30/10

Location of Project: South Carolina

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.50

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Planning Grant for the Ordway-Swisher Biological Station

Source of Support: NSF

Total Award Amount: $ 20,807 Total Award Period Covered: 09/01/08 - 08/31/09

Location of Project: Gainesville, FL

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.10

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Catalyzing institutional change in STEM education at the University of Florida

Source of Support: NSF

Total Award Amount: $ 1,000,000 Total Award Period Covered: 01/01/09 - 12/31/14

Location of Project: Gainesville, FL

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Summ: 1.00

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

 USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Douglas Levey

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: DISSERTATION RESEARCH: Using hummingbirds to test the link between bird and plant distributions in tropical montane forest

Source of Support: NSF

Total Award Amount: $ 11,287 Total Award Period Covered: 05/21/09 - 05/21/10

Location of Project: Florida, USA

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Jill Jankowski

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: DISSERTATION RESEARCH: Using hummingbirds to test the link between bird and plant distributions in tropical montane forest

Source of Support: NSF
Total Award Amount: $ 11,287 Total Award Period Covered: 05/21/09 - 05/21/10
Location of Project: Florida, USA
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

 USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Scott Robinson

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: DISSERTATION RESEARCH: Using hummingbirds to test the link between bird and plant distributions in tropical montane forest

Source of Support: NSF

Total Award Amount: $ 11,287 Total Award Period Covered: 05/21/09 - 05/21/10

Location of Project: Florida, USA

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

---

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

 USE ADDITIONAL SHEETS AS NECESSARY

FACILITIES, EQUIPMENT & OTHER RESOURCES

FACILITIES: Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies. USE additional pages as necessary.

Laboratory: Florida Institute of Technology, Neotropical Paleoecology Lab, equipped with Scanning Electron Microscope (SEM) and other equipment used for pollen identification, located approximately 180 miles from the University of Florida (see letter of collaboration from Dr. Mark Bush).

Clinical:

Animal:

Computer:

Office:

Other:

MAJOR EQUIPMENT: List the most important items available for this project and, as appropriate identifying the location and pertinent capabilities of each.

Transmitted light microscope
Scanning electron microscope (SEM)

These items are located in the Neotropical Paleoecology Lab at Florida Institute of Technology, directed by Dr. Mark Bush, a specialist in pollen identification.

OTHER RESOURCES: Provide any information describing the other resources available for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual arrangements with other organizations.

FACILITIES, EQUIPMENT & OTHER RESOURCES

Continuation Page:

LABORATORY FACILITIES (continued):

Department of Biological Sciences

50th ANNIVERSARY

Jill Jankowski
University of Florida

Nov. 13th, 2008

Dear Jill,

Your project is an exciting one and we would be happy to continue our collaboration. We have a photographic database of the flowers that the hummingbirds were seen to visit during the 6 weeks that Zach Peterson spent in the field with you, and also the associated pollen types. While this will not be a complete resource it should help with the accuracy of some pollen identifications.

We should be able to provide identifications of pollen from the samples you have collected. I will hire an undergraduate to do the processing and so an additional benefit of your project will be an undergrad at Florida Tech being involved in science. As has been our habit, we especially encourage women and minorities to apply for these positions. The actual pollen identification will be done by one of my graduate students, probably by Bryan Valencia (MS Florida Tech 2006) who is a native of Cuzco, Peru, and has 4 years experience of Andean palynology.

The cost per sample will be $9 for processing and $15 for identification. While some samples will be barren and very quick to do, others will require both light microscopy and SEM to provide an optimum identification, hence this will probably average out at 1-2 hours per sample. We generally have a fixed overhead rate of 15% for this kind of consulting, but this can be waived as DDIG grants cannot carry overhead.

We would provide you with a sample-by-sample analysis of what we find, and photographs of the pollen types. I believe that we could deal with all 300-500 samples during the course of next summer.

With best regards,

Mark B. Bush, Ph.D.
Professor and Interim Head of Department

UNIVERSITY OF FLORIDA

College of Liberal Arts and Sciences
Department of Zoology
Chair, Karen Bjorndal

223 Bartram Hall
P.O. Box 118525
Gainesville, Florida 32611-8525
Tele: (352) 392-1107
Fax: (352) 392-3704

Re: Jankowski, Jill Emily

To Whom It May Concern:

This student has advanced to candidacy for a Ph.D. degree.

Sincerely,

Karen A. Bjorndal
Professor and Chair

Context for Improvement

My dissertation focuses on understanding patterns of species distributions in bird communities along a tropical altitudinal gradient and the factors that maintain altitudinal range limits in groups of species. I have conducted this investigation along an altitudinal gradient in the Manu Biosphere Reserve of southeastern Peru because of this region's high species diversity and the many possible distributional associations across species that could be examined in detail along this gradient. In particular, I am addressing two distinctive patterns found in birds in other tropical montane communities: (1) species replacements, or adjacent non-overlapping altitudinal distributions, between closely related species, presumably maintained by competitive interactions, which I tested experimentally using behavioral responses to song playbacks; and (2) relationships between bird and plant communities, where transitional zones in plant communities along the gradient (e.g., ecotones) might be reflected in associated range limits in bird species' distributions as a response to sudden changes in vegetation. The community-wide correspondence between birds and plants is being tested using avian and plant census data collected from corresponding sites along the gradient.

Because it is difficult to examine mechanisms that limit species distributions when considering all species of birds and plants, I have decided to focus on a subset of these communities for which we might expect strong associations along gradients: hummingbirds and flowering plants. If any group of birds were to show correspondence in their distributions and range limits with plants along gradients, it would be this group. The proposed research takes a novel approach that overcomes previous difficulties in examining resource specialization in hummingbirds. Prior studies have used observations of hummingbirds at flowering plants in their environments to describe plant-pollinator relationships. This approach is problematic, especially in diverse tropical systems, because it requires repeated observations of all species of flowering plants in a region. There is a simple solution—because hummingbirds carry, on their bills and foreheads, pollen of the flowering plants they visit, one can sample and identify the pollen from captured individuals to determine which flowers are being visited. With this in mind, I collected pollen samples from the bills of captured hummingbirds during mist-netting surveys along the altitudinal gradient. By collaborating with specialists that can identify the pollen grains collected from each individual, I can create a list of flowering-plant species used by each species of hummingbird. I will combine the resulting data detailing each hummingbird species' diet with data from the bird and plant censuses already conducted to determine whether hummingbird species' distributions and range limits coincide with those of their flowering plants. Funds from the doctoral dissertation improvement grant, if awarded, would allow the pollen identification to be completed, as the pollen analysis would otherwise be cost prohibitive.

The research programs of my doctoral advisors overlap very little with the proposed research project. While both of my advisors planted their roots in tropical ecology, neither has examined the ecology of species range limits. Dr. Doug Levey's research fits under an umbrella of evolutionary ecology of plant animal interactions and currently focuses on the effectiveness of habitat corridors in conservation and impacts on the spatial ecology of animals, functions of secondary compounds in ripe fruits, the importance of fruiting plants to birds, and the evolutionary ecology of avian migration. Dr. Scott Robinson's research uses theoretical insights of ecology and behavior to address questions of conservation significance in ecosystems of North America and in the tropics. His current research projects address effects of forest and grassland conservation on birds in the American Midwest, effects of urbanization on bird communities, avian brood parasitism, and community organization in tropical forest birds of white sands forest in the Amazon. Neither of my advisors is interested in seeking funding for the required pollen analysis for the proposed research.