Application Details

Research and Development Minigrants for 2017-2018: Application Review

Application Title: Developing screening methodologies to distinguish local hummingbird subspecies

Application ID: #000074

Review Deadline: Jan 27, 2017 11:59:00 PM

Primary Appointment Title: Assistant Professor

Proposal Summary:

Developing screening methodologies to distinguish local hummingbird subspecies

Comments to the Administrator(s):

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ALLISON H. ALVARADO

Assistant Professor of Biology
California State University Channel Islands
One University Drive
Camarillo, CA 93012

Phone: (805) 437-2055
Fax: (805) 437-8895
Email: allison.alvarado@csuci.edu

EDUCATION

University of California **Los Angeles, CA**

Ph.D. 2011 - Department of Ecology and Evolutionary Biology
Dissertation title: Evolutionary dynamics across a migratory divide: testing the causes and consequences of divergence in hermit thrushes, *Catharus guttatus*. Advisor: Dr. Tom Smith.

Reed College **Portland, OR**

B.A. 1998 - Biology. Honors thesis research: Plasticity of growth and developmental rates in *Bombina orientalis*. Advisor: Dr. Robert Kaplan

Spelman College **Monte Verde, Costa Rica**

Field Studies in Costa Rica. Spring, 1996. Independent research: Temporal variation in resource allocation to hummingbird pollinator attraction. Advisor: Dr. Alan Masters

PROFESSIONAL EXPERIENCE

2015	Assistant Professor of Biology, California State University Channel Islands
2011-2014	Research Fellow, Center for Tropical Research and Institute of the Environment, UCLA, California.
2002-2011	Graduate Student, Dept. of Ecology and Evolutionary Biology, UCLA, California.
2005-2008	National Science Foundation Graduate Research Fellow, UCLA, California.
2003-2005	Ford Foundation Pre-doctoral Fellow, UCLA, California.
2004	Ecological Research Expedition Participant (UCLA). Conservation and outreach in the Chocó rain forest of Ecuador.
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2000	Research Assistant, Alaska Bird Observatory, Fairbanks, Alaska.
1999-2000	Research Assistant, Univ. of Chicago Fairy Wren Project, Queensland, Australia.
1999	Research Intern, USGS-BRD: Palila Restoration Project, Mauna Kea, Hawaii.
1997-1998	Independent Research, Howard Hughes Medical Institute Fellowship, Oregon.
1997	Independent Research, National Science Foundation Research Experience for Undergraduates Fellowship, Rocky Mountain Biological Lab, Gothic, Colorado.

TEACHING EXPERIENCE

Assistant Professor. **California State University Channel Islands**. Fall '15 – Fall '16

*** Ecology and the Environment** (Lecture and Lab), Fall '15, Spring and Fall '16

*** Principles of Organismal and Population Biology** (Lab), Fall '15, Spring '16

*** Independent Research,** Fall '15 – Fall '16

Lecturer. **California State University Channel Islands**. Spring '13 – Spring '15.

*** Ornithology** (Lecture and Lab), Spring '13.

*** Quantitative Methods in Biology**, Fall '13, Spring '13 & '14.

*** Principles of Organismal and Population Biology** (Lab), Fall '13, Spring '13-'15.

*** Ecology and the Environment** (Lab), Spring '15.

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*** Conservation Biology** (Lecture and Discussion), Summer '11.

Life Sciences Core Curriculum

*** Ecology, Evolution, & Biodiversity** (Lecture), Winter '12, Summer '12 & '13.

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*** Tropical Ecology. UCLA Field Biology Course in Kenya, Africa *** Fall '07. Led 24 undergraduate students through the development and execution of group research projects in at Mpala Research Station. *** Conservation Biology *** Winter '09. Led discussion on local and global conservation topics. *** Ecology, Evolution, & Biodiversity *** Winter '06. Led laboratory activities for introductory biology students.

Biology Outreach Teacher (Grades K-6), **Science outreach program targeting underprivileged elementary schools,** Portland, OR. 1997-1998.

GRANTS & FELLOWSHIPS

IRA Grant from CSUCI: $1,451

Student Research Grants from SRSC at CSUCI: $1,132

UCLA Lida Scott Brown Fund: Avian Biology Research Grants. 2006-2010. **$19,000**

American Ornithologists' Union Alexander Wetmore Award. 2005. **$5,500**

Explorer's Club Research Grant. 2005. **$1,000**

GRANTS & FELLOWSHIPS CONTINUED

Hispanic Scholarship Fund Southern California Golf Classic Scholar. 2004, 2005. **$1,600**

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SERVICE

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Ornithology Team Leader - National Geographic BioBlitz. Santa Monica Mountains National Recreation Area. 2009.

PUBLICATIONS

2014. **Alvarado, AH**, Fuller, TL & TB Smith. Integrative tracking methods elucidate the evolutionary dynamics of a migratory divide. *Ecology and Evolution* 4(17): 3546-3569.

2013. Rundel, CW, Wunder, MB, **Alvarado, AH**, Ruegg, KC, Harrigan, R, Schuh, A, Kelly, JF, Seigel, RB, DeSante, DF, Smith, TB & J. Novembre. Novel statistical methods for integrating genetic & stable isotope data to infer individual-level migratory connectivity. *Molecular Ecology* 22: 4163-4176.

2003. Karubian, J & **Alvarado, AH.** Testing the function of petal-carrying in the red-backed fairy-wren, *Malurus melanocephalus*. EMU 103: 87-92.

TECHNICAL REPORTS

2015. **Alvarado, AH.** Effects of Brown-headed cowbirds on parasitism rates and fecundity in least Bell's vireo on the Santa Clara River. Submitted to USFWS Office, Ventura.

MANUSCRIPTS (*IN PREPARATION*)

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2015. **Alvarado, AH** & KC Ruegg. Contrasting evolutionary implications of short- vs. long-distance migration in songbirds with migratory divides. *In prep.*

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2015. **Alvarado, AH.** Cline analysis of morphological, genetic, and ecological variation across a secondary contact zone in British Columbia. *In prep*.

PRESENTATIONS AND POSTERS

2016. Daniels, K. **Alvarado, AH,** and B Hartman. Allen's hummingbird distribution and range expanison in the Channel Islands and adjacent mainland. **Poster** presented at SAGE conference.

2014. **Alvarado, AH.** Marker Madness: Decoding the Molecular Tools Applied to Conservation Genetics. **Invited talk** at *US Fish and Wildlife Service*, Ventura, CA.

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WORKSHOPS & TRAINING

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Project Title: Developing screening methodologies to distinguish local hummingbird subspecies

Summary: Developing screening methodologies to distinguish local hummingbird subspecies

Project goals and outcomes:

The overarching theme of my research program is to study the evolutionary mechanisms that generate biodiversity. Although the *patterns* of biodiversity around the globe are well known, the *processes* responsible for creating new species are complex and less well-understood. The area surrounding CI is a natural laboratory for investigating the process of speciation. The southern California mainland and nearby Channel Islands are biodiversity hotspots, with high species richness and endemism (i.e. species found no other place in the world). Increasing our knowledge about how our local species are generated has important implications for the conservation of these biological treasures. Especially given the environmental uncertainty we face in the 21st century, now more than ever do we need to understand and protect the mechanisms of speciation (i.e. the evolutionary potential) as well as the species themselves.

My research integrates the study of speciation mechanisms and the conservation of "neotropical migrants," which are birds that breed here in North America and typically spend winter in the neotropics. For example, to investigate divergence of species (e.g. timing of lineage splitting and contemporary isolating mechanisms), I identify genetic and isotopic signatures specific to different regions and subspecies (Alvarado et al. 2014). These unique intrinsic genetic and isotopic markers can be utilized to track bird movements across large distances (such as between breeding and wintering grounds) (Rundel et al. 2013).

The specific study system that is the focus of this proposal is the Allen's hummingbird (*Selasphorus sasins*), which breeds in California. There are two subspecies: the nominate subspecies (*S. s. sasins*) has always bred on the mainland, while the other subspecies (*S. s. sedentarius*) originally diverged on the Channel Islands (Clark and Mitchell 2013). These two subspecies have very different life histories; *S. s. sasins* (the mainland subspecies, hereto referred to as the "migratory subspecies") over-winters in central Mexico, whereas *S. s. sedentarius* (the island subspecies, hereto referred to as the non-migratory subspecies) stopped migrating (hence the name). Although divergence of an island endemic is a fascinating and productive research topic, it is just the beginning of this story!

The non-migratory subspecies colonized the mainland at the Palos Verdes Peninsula from the Channel Islands in the 1960's and has been expanding its geographic range over the past several decades. During the spring semester of 2016, my research team used citizen science data from eBird (an online database of bird sightings) to generate an updated map documenting this range expansion. We found that the non-migratory subspecies has *potentially* expanded its range into the breeding range of the migratory subspecies. We presented this research as a poster at the SAGE conference in May 2016 and as a talk at

the Channel Islands Research Symposium in October 2017. Since the two subspecies are difficult to differentiate based on morphology, we used presence during winter to identify the current range of the non-migratory subspecies. However, we need to confirm that the *breeding* range of the non-migratory subspecies overlaps with that of the migratory subspecies. We hypothesize that the two subspecies can be distinguished based on distinct isotopic signatures. Since Allen's hummingbirds undergo a complete molt during winter, their feathers likely incorporate different amounts of stable isotope ratios that reflect the location where they were grown. Since percentages of these elements vary with latitude (Hobson 2005), we predict that the signature found within feathers grown in southern California vs central Mexico will vary between the non-migratory and migratory subspecies, respectively.

Specifically, our objective is to develop a screening tool to separate the two subspecies of Allen's hummingbirds. To do so, we must characterize the isotopic composition of feathers in the two *nonbreeding* populations of Allen's hummingbirds to establish the pattern for known-origin birds. During the nonbreeding season (fall of 2017), we will collect feathers in southern California and our collaborators will collect feathers in Mexico. We will then quantify the levels of three stable isotopes, and run analyses to determine whether the two populations have a distinct signature. If the isotopes do show a unique pattern, this technique can be used a screening tool to identify the subspecies of breeding birds in the contact zone. If the isotopes do not show a unique signature on their own, we will combine the isotopic data with additional markers such as genetic data to accomplish this goal. Once this is achieved, in the next phase of the project, we will begin studying breeding hummingbirds in Ventura and Santa Barbara counties to identify the extent of overlap and potential for hybridization between the two subspecies in the area. This will provide a snapshot into processes that influence patterns of biodiversity in the region.

Research plan and methodology:

As stated above, I will begin this part of the project by sampling hummingbirds in the two locations. This involves using nets or modified feeders to trap the hummingbirds, removing a feather once the bird is captured, and immediately releasing the unharmed bird back into the wild. I have been doing this type of feather sampling of passerine birds for the past fourteen years. I have obtained the necessary training to sample hummingbirds and I am in the process of finalizing all appropriate federal and state permits. I have also been working with collaborators in Mexico and have been acquiring feather samples from them for use in isotopic analysis for the past decade.

Once the feather samples (thirty from each location) are obtained, they will be cleaned and prepared in my lab at CI following the methodology of Paritte and Kelly (2009). At a collaborator's lab at UCLA, the feathers will be further processed using a high-temperature elemental analyzer interfaced with a stable-isotope mass spectrometer. The samples will be then be run through an electrostatic analyzer to determine nitrogen and

hydrogen content and abundance. This data set will then be analyzed using isoscatR (Rundel et al. 2013), which is a model developed by me and my colleagues at UCLA.

Professional development benefits for faculty:

This project, which will determine the extent to which stable isotopes can be used to screen for Allen's hummingbird subspecies, is a required next step in the development of a research program I am initiating as a new faculty member at CI. Ultimately, this research on Allen's hummingbird subspecies will likely lead to additional projects investigating the evolutionary dynamics of this proposed hybrid zone and potential drivers of speciation. For example, once the development of this study system is farther along, I can apply for extramural funding to test the hypothesis that there is reproductive isolation due to temporal variation in the onset of breeding (e.g. the non-migratory subspecies forms mating pairs prior to the return of the migratory subspecies).

Benefits to the University, School, Program, and the applicant's teaching:

I will involve multiple undergraduate research students in the data collection and analysis process. For example, through my Biol 494 research course, students will learn techniques for capturing and sampling hummingbirds, and they will assist in the processing of the feathers and data analysis. Furthermore, this research will be presented and discussed in my relevant courses, such as Ornithology (Biol 451) and Ecology and the Environment (Biol 433).

Dissemination plan:

I intend to disseminate this research into a peer-reviewed journal such as *Functional Ecology* or *Methods in Ecology and Evolution*.

Project timeline:

Field work will be conducted during the fall semester of 2017 (since the nonbreeding season for hummingbirds is earlier than the typical "overwintering" time period for songbirds). Feather processing and isotope analysis will be conducted during spring of 2018, and the manuscript will be written and submitted during summer of 2018.

Project assessment:

Success will be achieved upon completing the data analysis and determining regarding whether isotopes can be used for screening subspecies or whether additional markers will be need to included. Either way, the intended product will be publication of the research in a peer-reviewed journal.

Budget:

Reassigned time (3 units) for PI:	$6,000
Supplies & instruments to conduct field work:	$1,600
Reagents and sample runs:	$1,200
TOTAL:	$8,800

Time to conduct the field work and train students will require reassigned time of 3 units during the fall semester of 2017 and will cost $6,000. The supplies we will need to purchase in order to conduct this field work are nets and custom traps as well as tools specifically used for making our own hummingbird leg bands, costing $1,600. This equipment will become property of the university and can be used for ongoing research and class demonstrations. Finally, the cost of the lab component for this project is $1,200.

Research and Development Minigrants for 2017-2018: Review Form

Routing Step: Initial Committee Review

Application Title: Developing screening methodologies to distinguish local hummingbird subspecies

Application ID: #000074

Review Deadline: Jan 27, 2017 11:59:00 PM

***Project Goals and Outcomes:**

The proposal sets clear goals and outcomes for the project, and it explains the steps that will be taken to realize project goals.

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Rating Scale 1 (1 weakest to 11 strongest):

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***Research Plan and Methodology:**

The proposal conveys a complete and well thought-out plan for the project that describes the activities of all individuals involved in the project. If support is requested for student research assistance, the proposal must also include a description of their role in the project and how the faculty

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Rating Scale 2 (1 weakest to 11 strongest):

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***Professional Development Benefits for the Faculty:**

The proposed makes clear how the project will advance each individual applicant's or research, scholarship, creative activity, or innovation in teaching. The proposal discusses whether the applicant(s) intend to pursue external funding and identifies those external funding opportunities.

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Rating Scale 3 (1 weakest to 11 strongest):

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***Project Benefits:**

To what extent does the proposed qualify for special consideration (e.g., applicant is

probationary, applicant has not had minigrant funding in the past, applicant has been especially successful in the use of past minigrant funding, project scope is particularly ambitious but realizable).

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Rating Scale 4 (1 weakest to 11 strongest):

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***Dissemination Plans:**

The level and type of dissemination is appropriate for the project, its goals, and its outcomes.

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Rating Scale 5 (1 weakest to 11 strongest):

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***Project Timeline:**

The project goals and objectives are attainable within the timeline of the proposal.

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Rating Scale 6 (1 weakest to 11 strongest):

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***Project Assessment:**

The proposal describes how the product(s) of the project will be assessed and evaluated to determine the degree of success achieved.

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Rating Scale 7 (1 weakest to 11 strongest):

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***Project Budget:**

The proposed budget is reasonable in the context of the project description, and the project costs are necessary to achieve project goals and outcomes.

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Rating Scale 8 (1 weakest to 11 strongest):

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***Other considerations:**

To what extent does the proposed qualify for special consideration (e.g., applicant is probationary, applicant has not had minigrant funding in the past, applicant has been especially successful in the use of past minigrant funding, project scope is particularly ambitious but realizable).

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Rating Scale 9 (1 weakest to 11 strongest):

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