Project Title:

Maximizing evolutionary potential under climate change in southern California protected areas.

Proposal by:

Thomas B Smith, Professor
Center for Tropical Research, Institute of the Environment and Sustainability, UCLA
La Kretz Hall, Suite 300, 619 Charles E. Young Dr. E
Los Angeles, CA 90095

310-206-4712
tbsmith@ucla.edu

Scope & Budget:

Location: Southern California
Duration in months: 12
Requested Funding: $82,190.00
Leveraged Funding: $115,646.00

Briefly summarize the goals of the project, what products will result, and how the products support decision-making and conservation delivery for natural resource management within the CA LCC.

In the face of climate change, it is important to protect as much intraspecific morphological and genetic variation as possible, so as to increase the probability that populations can adapt to new climate conditions. Our objective is to transfer to California our previously developed prioritization framework that combines intraspecific genetic and morphological variation with traditionally used indices of biodiversity, and test its general utility for conservation prioritization. We will integrate existing data on intraspecific variation of multiple species in the Santa Monica Mountains National Recreational Area with climate data and space-borne measurements of the environment to identify areas with high intraspecific variation. The deliverables will be: 1) a better understanding of the relationship between biodiversity and environmental variables, 2) maps identifying areas with high amounts of intraspecific variation, 3) an assessment of the general utility of our approach to other LCCs, 4) maps of the projected impacts of climate change on intraspecific variation, and 5) a toolbox of methods as well as environmental data layers that can be used by land managers throughout the California LCC and elsewhere.

For continuing 2010 CA LCC projects, describe the accomplishments and outcomes to date, why additional funds are needed, and what this proposal will add to the project.

NEW PROJECT

Identify which National LCC Performance Measure(s), if any, your project addresses.

3. A population and habitat assessment developed or refined to predict changes in species populations and habitats. 4. A biological planning and conservation design project developed in response to climate change. 6. A conservation genetic project to improve and enhance conservation design and delivery for fish and wildlife populations in response to climate change.

List Partners

The National Parks Service will provide existing morphological and genetic data collected in Santa Monica National Recreation Area, provide logistical support, and contribute in writing papers and reports. Team members: Christy A Brigham, Seth PD Riley, Kathleen Semple Delaney   The Center for Tropical Research, University of California, Los Angeles (UCLA), will carry out all modeling and area prioritization efforts and spearhead the writing of papers and reports. Team members: Thomas B Smith, Wolfgang Buermann, Ryan J Harrigan, Henri A Thomassen

Briefly describe how the project team (main PIs) provides the range of experience, expertise, and organizational capacity needed to accomplish the project. List recent and current projects (names, time-periods, PI time commitments, and total budgets). Also attach 1 page CVs for the principle investigator and/or project leaders per below under additional information.

The PI of this project is Dr. Thomas B. Smith, Director of the Center for Tropical Research and Prof. in the Department for Ecology and Evolutionary Biology, UCLA. Dr. Smith has more than three decades of experience in addressing questions in evolution, ecology, and conservation. He was the PI on a NASA-funded project (NNG04GM27G, $1.2 M) to develop a novel conservation framework to incorporate intraspecific variation in conservation prioritization for implementation in Ecuador. In addition, Dr. Smith has received many grants for work in conservation: Disney Wildlife Conservation Fund - $20,000 to study the long-distance movements of hornbills and the conservation of Central African rainforests (PI); UC MEXUS-CONACYT - $25,000 to assess the impacts of land use and climate change on Mexican biodiversity (PI);NSF EF-0430146 - $1,741,000 to study the effects of deforestation on the prevalence of blood-borne parasites in African rainforest birds (Co-I); Santa Monica Mts Conservancy - $149,071 for conservation work in the Santa Monica Mts. (Co-I); Max Planck Institute for Ornithology - $33,131 for hornbill conservation work (PI); CA Dep. of Fish and Game PO780028 - $30,500 for tricolored blackbird conservation genetics (PI); Disney Wildlife Conservation Fund UCA-08-01, UCA-07-01, UCA-05-01, and UCA-03-01 - $21,710 $22,050 $21,000 and $15,000 for umbrellabird conservation in the Chocó, Ecuador (Co-I); Conservation, Food & Health Information - $27,600 25,012 and 24,990 for conservation training and education in the Ecuadorian Chocó (PI); Disney Wildlife Conservation - $18,000 for hornbill conservation in Cameroon (PI); Wildlife Conservation Society GHS-A-00-06-00005 - $134,248 for evaluating disease transmission pathways and host reservoirs for H5N1 avian influenza in Vietnam (PI); Audubon Society - $6,230 to study population structure in the tricolored blackbird (PI); UCLA Academic Senate Council on Research Faculty Grants - $10,000 to study the effects of deforestation on disease prevalence in Neotropical rainforest birds (PI); CALFED ERP 01-N43 - $832,000 for genetic identification of watershed-dependent species of special concern in the Central Valley (PI); UC MEXUS-CONACYT - $25,000 for conservation genetics of migratory songbirds (Co-I); NSF-Integrated Research Challenge in Environmental Biology DEB 0236165 - $2,619,066 for a cross-disciplinary study of the evolutionary processes that sustain biodiversity (PI).   Dr. Wolfgang Buermann is assistant professor in the Institute of Environment and Sustainability and the Department of Oceanic and Atmospheric Sciences, UCLA. Dr. Buermann is a specialist in remote sensing and climate data, bridging the gap between physical environmental sciences and biology. He has numerous papers on species distribution modeling and studies of the impacts of climate change on biodiversity.   Center for Tropical Research postdocs Dr. Ryan J. Harrigan and Dr. Henri A. Thomassen have ample experience in population genetics and the modeling approaches used here. Dr. Harrigan studies the environmental determinants of occurrence and prevalence of infectious diseases using a variety of spatially explicit statistical techniques. Dr. Thomassen has spearheaded the development of the conservation prioritization framework described in this project, as well as studies of how environmental variables relate to patterns of biodiversity.   Dr. Christy Brigham is a restoration ecologist with Santa Monica Mountains NRA and adjunct professor at California State University Northridge. Her work focuses on the impacts on biodiversity of human disturbance, and on evaluating the ecotypic differentiation in native species to inform restoration and conservation decisions.   Dr. Kathleen Semple Delaney is an ecologist with Santa Monica Mountains NRA, and is the project leader for terrestrial and aquatic herpetofaunal monitoring. Dr. Delaney collected and genotyped the samples that will be used in this study, and was the lead author on a paper which showed fine-scale genetic effects of urbanization on the four focal species in this proposal. Dr. Seth Riley is a wildlife ecologist with the Santa Monica Mountains NRA. His primary interests are in the ecology and conservation of wildlife in fragmented urban habitats. Dr. Riley is also involved in the long-term monitoring of biodiversity and resources in the National Park system.

Project Description

Efforts to prioritize conservation areas have typically relied on indices that include levels of endemism, species richness, and degree of threat[1]. However, it has long been recognized that measures of species richness alone may fail to capture essential evolutionary processes that promote and sustain diversity[2-8]. To avoid extinction in the face of climate change, populations may either move to more favorable habitat, or adaptively respond to changing conditions. With increasing fragmentation of formerly continuous habitat, dispersal to new areas may be severely limited. It is important, therefore, to develop ways of prioritizing regions that include not only areas with high species richness and where species might move, but also regions that contain the maximum amount of adaptive variation within species. A suitable approach to do this is to protect as much intraspecific morphological and genetic variation as possible, so as to increase the probability that one or more populations will be adapted to new climate conditions.

A growing body of evidence suggests that environmental variation plays an important role in shaping distributions of biodiversity across landscapes. Exploiting these relationships between environmental heterogeneity and biodiversity, we recently proposed a novel, integrative approach to incorporate evolutionary processes in conservation prioritization[2,3]. The approach is based on spatially explicit models of intraspecific genetic and phenotypic variation, in combination with species-level data (Figure). Over the course of a ten-year study, we applied our framework to reserves in Ecuador[3] and found that: 1) regions harboring high intraspecific variation overlap between species, 2) reserves based on intraspecific variation were better at capturing Red Listed species than reserves based on species richness, 3) reserves based on species richness do not effectively include areas of high intraspecific variation, and 4) existing reserves perform poorly at capturing intraspecific variation.

Our objective here is to apply this recently developed approach to Southern California, and test its general utility for conservation prioritization. In a partnership between UCLA and NPS, we will integrate existing data on genetic and morphological variation of bird and reptile species in the Santa Monica Mountains (part of a National Recreational Area (NRA)) with climate data and space-borne measurements of the environment to identify areas with high intraspecific variation. The deliverables of this study will be: 1) a better understanding of the relationship between biodiversity and environmental variables in the Santa Monica Mountains and surrounding areas, 2) maps identifying areas harboring high amounts of intraspecific variation across multiple species, 3) an assessment of the general utility of our approach to other LCCs, 4) maps of the projected impacts of climate change on intraspecific variation, and 5) a toolbox of methods, including free software integrated with GIS, that can be used by land managers throughout the California LCC and elsewhere.

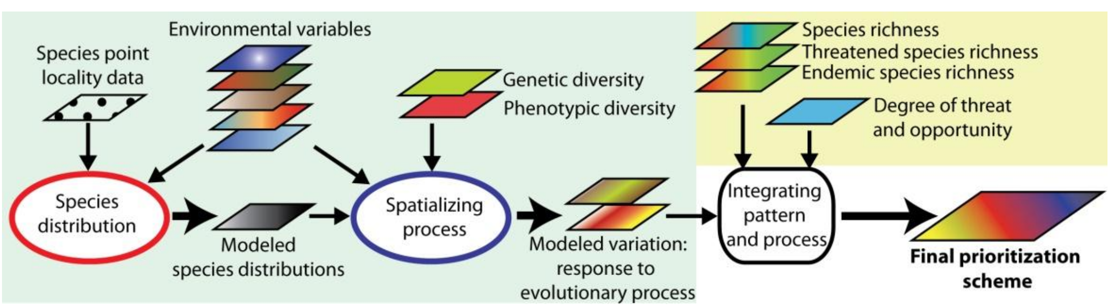

Figure. Flowchart of species distribution and spatially explicit ecological modeling approaches to map intraspecific genetic and morphological variation across the landscape. The tan box represents traditional approaches for protecting patterns of biodiversity; the blue-green box is the recently developed approach for preserving the underlying evolutionary processes generating and maintaining biodiversity. The results are used to prioritize regions for conservation.

CA LCC Priorities Addressed

Exploiting the relationships between environmental heterogeneity and biodiversity, we recently proposed a novel, integrative approach to incorporate evolutionary processes in conservation prioritization[2,3]. This approach responds to the need of conservation decision makers to modify conservation strategies in the face of climate change. It is intended to serve as a standardized framework for conservation planners. The proposed study offers the opportunity to further develop and refine the framework. It will allow conservation planners to identify areas important for conservation based not only on species richness, endemism, or levels of threat, but also on intraspecific variation that is likely to be the most relevant for effective responses of species to climate change. We will also model the potential impacts of future climate changes on genetic and morphological variation in a spatially explicit way, thus identifying areas where impacts may be particularly severe. The selection of important areas will include socio-economic criteria to efficiently protect biodiversity. Methods developed will be freely available to CA LCC and other conservation managers through an interactive website.

CA LCC Criteria Addressed

1. *Applicability to Conservation and Adaptation Decisions* - The importance of the conservation of intraspecific variation has long been recognized by conservation biologists, and is reflected in policy documents identifying focal areas of conservation needs. For instance, the Convention on Biological Diversity specifically includes genetic diversity as an essential part of natural ecosystems to be conserved. However, the implementation of intraspecific variation in conservation strategies has long been stalled by the inability to map intraspecific genetic and morphological variation - a problem that we now have solved.

2. *Ecological or Ecosystem Response to System/Climate Change* - There are many uncertainties with respect to climate change impacts, making it difficult or impossible to predict every effect of climate change on natural populations. Thus, a prudent approach is to maximize the evolutionary potential of populations to respond.

3. *Breadth of Understanding* - The proposed project integrates a range of different fields of research and taxonomic levels, and is applicable to LCCs across California and the United States. We combine climate and remotely sensed environmental variables with data on intraspecific variation in three reptile and one bird species that have different life histories, and occupy a variety of habitat types. This project will contribute to our fundamental understanding of how environmental heterogeneity shapes the patterns of biodiversity.

4. *Accessibility* - The framework developed previously, and refined during the implementation of the proposed project, as well as a comprehensive toolbox and description of methods will be made available for use by LCC and other land managers. Available data will consist of compiled environmental data layers made available through UCLA's Center for Tropical Research web server, as well as information on modeling approaches developed and software downloadable elsewhere.

5. *Scope/Transferability* - The proposed project focuses on Santa Monica Mountains National Recreation Area. It builds on the conceptual framework that we developed to prioritize areas for conservation in Ecuador, taking into account ongoing and future climate change. A next crucial step is the refinement of the framework in order to understand its general utility to other regions under consideration for conservation, and expected to be affected by climate change. Applying our framework to Southern California would make it transferable to other Californian and National LCCs.

6. *Partnerships/Leveraging* - The project is a partnership between researchers at UCLA and NPS, building collaborations and the potential for more extensive future data collections and analyses. We anticipate extending our studies to other areas under the administration of NPS.

7. *Timeliness and Urgency* - Climate change has already been shown to affect biodiversity, and is projected to continue to do so in the future. Phenotypic changes are being observed as a result of environmental change. Impacts in California may be severe, with significant increases in temperature, severe droughts, and changes in the frequency and severity of extremes. Although both conservation planners and policy makers acknowledge the importance of protecting intraspecific variation, few studies have attempted to implement this concept in landscape-level prioritization schemes in a form that managers can use (i.e., maps). It is crucial to extend our previous work to other regions, and test its general applicability. The project is, therefore, very timely, and we anticipate that the framework will be readily adopted by conservation planners. Recent

advances in remote sensing, genotyping, and spatial modeling, now make it possible to map intraspecific variation. For example, future climate layers from the 4th Assessment of the IPCC became accessible to researchers just recently, in February 2011. These layers include a suite of bioclimatic variables and predictive models, and cover four emission scenarios on a decadal timescale, up to the year 2090. These new data have yet to be used in conservation planning, and represent the best estimations of future climate change to date. A fundamental tenant of effective conservation planning is the ability to map biodiversity – here we propose to map both biodiversity pattern and process in order to provide managers with the best possible tools for making informed decisions.

Approach and Scope of Work

We propose to use existing genetic[9] and morphological data from about 20 sites of the following bird and reptile species to identify areas important for conservation in the Santa Monica NRA: wrentit (*Chamaea fasciata*), western fence lizard (*Sceloporus occidentalis*), side-blotched lizard (*Uta stansburiana*), and western skink (*Plestiodon skiltonianus*). These species have contrasting vagilities and food niches, and occupy different strata of the vegetation. The species are common with widespread distributions in California, although the wrentits are mostly limited to coastal chaparral habitat. All four species occur throughout much of Santa Monica Mts. NRA. We will use satellite remotely sensed and climate data, in conjunction with recently developed spatially explicit ecological modeling techniques[10] to project alpha- and beta diversity across the landscape.

In local to regional scale studies (with environmental layers at spatial resolutions of ~ 20m - 1km), the remote sensing of environmental parameters can be used to indirectly discern patterns of diversity[11]. Such space-borne measurements can provide information on primary productivity, climate, and habitat structure, factors that are thought to be important in determining the distribution and local amounts of biodiversity[12-14]. Recent advances in GIS technologies and spatial statistics have increased the predictive power of spatial analyses by refining approaches that first identify and quantify associations between environmental variables and biodiversity[10,15,16], and then use this information to project the response variable patterns both spatially and temporally (see Figure). These statistical associations can be used to project patterns of diversity across a landscape, resulting in continuous predictions of alpha- or beta diversity, even in unsampled areas.

Our approach comprises three main steps. First, we use species distribution modeling (SDM) to model where each target species is likely present. SDM provides information about environmental factors determining the species' range, and has been applied extensively in ecology, evolution, and conservation biology[17-23]. Second, we model intraspecific variation. A variety of regression techniques can be used to model intraspecific alpha- and beta diversity. Although rarely used in ecology, tree regression and random forest techniques[24] are highly suitable to model alpha diversity[10,25]. In addition, dissimilarity approaches, such as generalized dissimilarity modeling[26], can complement and confirm these analyses, and are readily applied to questions concerning beta diversity. Both methods have advantages over traditional regression techniques; there are few assumptions regarding the shape of the relationships between environment and diversity, model performance can be assessed by permutations, and the importance of individual environmental variables in predicting diversity can be assessed. We have successfully employed these methods in recent studies of biodiversity in South America[2,17], Africa[27], and the United States[25].

Finally, reserves will be designed using the modeling results from the second step, resulting in a map that identifies key areas for conservation, taking into account the potential for adaptive responses to climate change. Designing areas to protect features of biodiversity typically involves a constrained optimization algorithm in which the objective is to establish protected areas that meet the representation targets for the features while taking up as little land as possible[28]. Socio-economic data can be included as part of the constraint on land use. Because it is unfeasible to survey or sample all species in the entire area under consideration for conservation, planners need to rely on surrogate species[29]. Effective surrogates are those for which priority areas also represent the diversity in other species not sampled. Protecting areas that harbor much intraspecific variation per unit area is an efficient strategy to conserve biodiversity with limited resources. Thus, in the case presented here, for a species to be an effective surrogate, areas of high diversity should overlap between species. To assess the utility of intraspecific variation as surrogates, we will identify areas harboring the highest amounts of genetic and phenotypic variation for each species, and examine the overlap between species. We will compare these results to those from previous work to assess the general utility of our framework.

Once the contemporary relationships between intraspecific variation and environmental variables are determined, potential scenarios of human-induced change can be modeled. Downscaled climate change scenarios (~ 1 km resolution) from the IPCC 4th Assessment (IPCC 2007, www.worldclim.org) will greatly facilitate studies of the impacts of climate change on biodiversity. Using the same modeling approaches outlined above, we will project intraspecific variation into the future by assuming that its current relationship with environmental conditions will remain the same in the coming decennia. We will then identify areas where intraspecific genetic and morphological variation is likely to be subject to the greatest impacts of climate change.

Results will be disseminated in the form of publications in scientific journals, scientific conferences, targeted workshops that will include practitioners and decision makers, and via user-friendly web manuals for use by NPS, LCCs, and other agencies.

Products/Data Sharing

Specific products resulting from this project are: i) maps identifying areas harboring high amounts of intraspecific variation (morphological and genetics) across multiple species in Santa Monica Mountains NRA; ii) maps of the projected impacts of climate change on intraspecific variation; and iii) a toolbox of methods, including software and environmental data layers, that can be used by land managers throughout the California LCC and elsewhere. Maps will be used by NPS in order to enable managers to make more informed conservation decisions. Methods, information on our approach and software, and data will be made available online to conservation planners and managers that are interested in implementing our approach. In particular, although some environmental data layers are readily available from existing sources, others require considerable computational resources in order to prepare the layers for use in the spatial modeling approaches described above. We will make available those environmental data layers for use by conservation planners throughout the US. In addition to environmental data on current conditions, we will also compute and make available ensembles of future predicted climate conditions based on the 4th Intergovernmental Panel on Climate Change scenarios. Modeling software (species distribution modeling; generalized dissimilarity modeling, random forest algorithms, and other techniques to model intraspecific variation; and reserve design) is available through other sources, yet we will compile a comprehensive list of software, with URLs, a discussion of the advantages and disadvantages, as well as web-based manuals specifically designed for carrying out the conservation prioritizations.

We will compile data on intraspecific variation in months 1-3, and prepare environmental data in months 3-4. We will model intraspecific variation and identify important areas in months 4-10 (deliverables 1, 2, 4). Reports and papers will be written in months 10-12, during which we will also assess the general utility of our approach (deliverable 3) and make available a methodological toolbox to LCCs (deliverable 5).

Timeline	**2011**			**2012**								
Activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Compiling data	■	■	■									
Environmental layer preparation			■	■								
Modeling				■	■	■	■	■	■	■		
Writing reports and papers											■	■

Measuring Results

The deliverables of this project will be measured by: a) the maps of areas in the Santa Monica Mountains NRA harboring high levels of genetic and morphological intraspecific variation, as well as maps of the projected impacts of climate change on intraspecific variation in the four target species; b) the availability of a standardized framework, tools, and data for use by conservation planners; and c) papers and reports describing the results of the proposed project as well as the general utility of our approach combining these and previously published results from our work in Ecuador. Given the recognized importance of protecting intraspecific variation, we anticipate that conservation managers will be interested in implementing our approach elsewhere. Thus, the proposed project has the potential to serve as a model for conservation planning, not only in California, but also elsewhere.

References

[**1**]Myers et al. 2000 Nature 403:853-858
[**2**]Thomassen et al. 2010 Evol Appl 3:1-16
[**3**]Thomassen et al. 2011 Evol Appl 4:397-413
[**4**]Smith et al. 1993 Biodivers Lett 1:164-167
[**5**]Crandall et al. 2000 Trends Ecol Evol 15:290-295
[**6**]Moritz 2002 Syst Biol 51:238-254
[**7**]Forest et al. 2007 Nature 445:757-760
[**8**]Smith & Grether 2008 In: Carroll & Fox (Eds) Oxford University Press, Oxford
[**9**]Delaney et al. 2010 PloS ONE:e12767
[**10**]Thomassen et al. 2010 Mol Ecol 19:3532-3548
[**11**]Turner et al. 2003 Trends Ecol Evol 18:306-314
[**12**]Gaston et al. 2000 J Appl Ecol 37:39-59
[**13**]Nagendra et al. 2001 Internatl J Remote Sens 22:2377-2400
[**14**]Justice et al. 1998 IEEE Trans Geosci Remote Sens 36:1228-1249
[**15**]Foll & Gaggiotti 2006 Genetics 174:875-891
[**16**]Joost et al. 2007 Mol Ecol 16:3955-3969
[**17**]Buermann et al. 2008 J Biogeog 35:1160-1176
[**18**]Carstens & Richards 2007 Evolution 61:1439-1454
[**19**]Graham et al. 2004 Evolution 58:1781-1793
[**20**]Guisan & Zimmermann 2000 Ecol Model 135:147-186
[**21**]Kozak et al. 2008 Trends Ecol Evol 23:141-148
[**22**]Swenson 2008 J Evol Biol 21:421-434
[**23**]Saatchi et al. 2008 Remote Sensing Env 112:2000-2017
[**24**]Breiman 2001 Machine Learning 45:5-32
[**25**]Harrigan et al. 2010 PloS ONE:e15437
[**26**]Ferrier et al. 2007 Diversity Distrib 13:252-264
[**27**]Freedman et al. 2010 Mol Ecol 19:3773-3788
[**28**]Sarkar et al. 2006 Ann Rev Environ Resources 31:123-159
[**20**]Caro TM 2010, Island Press.

California Landscape Conservation Cooperative 2011 Proposal Budgets

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)**	**Total**
Salaries	$ 66,938.00	$ -	$ 18,383.00	$ 85,321.00
Supplies	$ 2,000.00	$ -	$ 10,000.00	$ 12,000.00
Overhead	$ 12,241.00	$ -	$ -	$ 12,241.00
Equipment	$ -	$ -	$ 5,000.00	$ 5,000.00
Other (specify)	$ 1,011.00	$ -	$ 73.00	$ 1,084.00
Total	$ 82,190.00	$ -	$ 33,456.00	$ 115,646.00

Other:

Travel to meetings for data compilation/collaborations: $400; communication charges UCLA 15 FTE months/year @ $40.75/month: $611

** In-kind contributions by partners consist of computational resources and genetic and morphological data that has already been collected as well as UCLA support (see below)

$10,000 = morphological and genetic data already collected by NPS

$5,000 = computers, hard drive and purchased environmental data layers

$18,383 = salary and benefits of UCLA faculty/staff

5% salary for PI to oversee the project

5% salary for a research director to oversee data management
5% salary for an administrative assistant
$73 = communication charges related to above salary

United States Department of the Interior

NATIONAL PARK SERVICE
Santa Monica Mountains National Recreation Area
401 West Hillcrest Drive
Thousand Oaks, California 91360-4207

California Landscape Conservation Cooperative
3020 State University Dr. East #2007
Sacramento, CA 95819

April 4, 2011

Dear Reviewing Committee,

I am writing to express my support for the project "**Maximizing evolutionary potential under climate change in southern California protected areas**" proposed for funding under the California Landscape Conservation Cooperative. We have a long history of collaboration with scientists from UCLA, and this project would incorporate data generated jointly at UCLA and NPS. We are eager to continue our cooperation, as laid out in the proposal. We will provide the necessary genotype data from our study area and contribute our expertise and information about the other aspects of the project such as landscape and habitat use and urbanization impacts on focal species.

Santa Monica Mountains National Recreation Area is a National Park immediately adjacent to Los Angeles, the second largest urban area in the U.S. Given that our mandate in the National Park Service is to protect the natural resources of the parks for future generations, our work here in the Santa Monica Mountains is focused on the current and future threats to those resources. This means trying to understand and mitigate, when possible, the effects of altered landscapes on animal communities. In particular, the conservation of ecological communities in the face of climate change will require the conservation of areas with the highest level of adaptive potential. Using data from UCLA and NPS biologists, this project will map areas of adaptive potential so that they may be identified as high priority areas for conservation. This method will identify future biodiversity hotspots and will aid in conservation planning for future climate scenarios. Given that we are one of the few parks still acquiring land, this information will be of direct relevance to us and our land management partners at California State Parks and the Mountains Recreation and Conservation Authority as we make land purchase decisions. In addition, the methods employed will be widely available to land managers all over the world. The proposed project is of great interest and relevance to our research and conservation objectives.

Sincerely,

Christy Brigham Ph.D.
Chief of Planning, Science and Resource Management
(805) 370-2339
Christy_Brigham@nps.gov

PRBO Conservation Science
4990 Shoreline Highway
Stinson Beach, CA 94970
415-868-1221
www.prbo.org

prbo

April 8, 2011

Debra Schlafmann, Coordinator
California Landscape Conservation Cooperative
Modoc Hall, Suite 2007
3020 State University Dr. East
Sacramento, CA 95819

Dear Deb,

I am writing in support of the project "Maximizing evolutionary potential under climate change in southern California protected areas" by Tom Smith and the Center for Tropical Studies at University of California, Los Angeles (UCLA), being submitted for funding by the California Landscape Conservation Cooperative in 2011. As you know, PRBO is dedicated to conserving birds and ecosystems through research and outreach. This project presents a potentially very valuable new approach to accomplishing our common goals of reducing negative climate change impacts on biodiversity.

Through a partnership between UCLA and the National Park Service, this project will integrate existing data on genetic and morphological variation of bird and reptile species in the Santa Monica Mountains National Recreational Area with climate and other data to identify areas with high intraspecific variation. Products include producing maps identifying areas harboring high amounts of intraspecific variation across multiple species, an assessment of the general utility of this approach, and a toolbox of methods, including free software integrated with GIS, that can be used by land managers throughout the California LCC.

With accelerating climate change, novel approaches are needed to manage and conserve biodiversity. Efforts focusing on a single species are unlikely to be sufficient to maintain biodiversity in the long run. The proposed project pilots an urgently needed new approach by incorporating adaptive variation of multiple species as a means to prepare for future climate change impacts. It has potentially great value to the research and conservation efforts of PRBO and our partners in the LCC.

Sincerely,

Ellie M. Cohen
President and CEO

Cc: Grant Ballard, PhD, Director, Climate Change and Informatics Group

April 11, 2011

The Nature Conservancy
201 Mission Street, 4th floor
San Francisco, CA 94105

California Landscape Conservation Cooperative
3020 State University Dr. East #2007 Sacramento, CA 95819

To whom it may concern,

I am writing in support of a proposal from Dr. Tom Smith of the Center for Tropical Research at UCLA for funding from LCC to maximize evolutionary potential under climate change in southern California protected areas by mapping intraspecific genetic and morphological variation in multiple species. Dr. Smith and his lab have pioneered and published a novel approach using genetic and morphological data to map key evolutionary processes in Ecuador and are proposing adapting this approach to Southern California to increase resilience and adaptation to climate change.

As a scientist with The Nature Conservancy, I can attest that this work will have direct application to our conservation planning in Southern California and beyond as we seek to maximize the performance of protected area designs to meet multiple goals for conservation of species, natural communities and ecological and evolutionary processes. The tools that will be developed and shared as part of this work plan will, for the first time, allow for ecological patterns like threatened species distributions, and evolutionary processes like genetic and phenotypic diversity to be integrated in spatial conservation plans which are resilient to species range shifts and other effects of climate change. This approach will have important application for prioritizing conservation actions, such as land protection, for CA state and federal resource agencies, regional land trusts, and other conservation NGOs.

I strongly urge the committee to fund this proposal and support this important contribution to robust conservation planning and efficient conservation of biodiversity.

Sincerely,

Mark D. Reynolds, Ph.D.
Associate Director of Science
The Nature Conservancy

BRIEF CURRICULUM VITAE
THOMAS B. SMITH

Department of Ecology and Evolutionary Biology & Center for Tropical Research, Institute of the Environment, University of California, Los Angeles, La Kretz Hall, Suite 300, Los Angeles, CA 90095-1496, Phone: 310-206-4712, tbsmith@ucla.edu, http://www.ioe.ucla.edu/, http://www.eeb.ucla.edu/

Current Positions

- Director, Center for Tropical Research, UCLA Institute of the Environment. 2002-present.
- Professor, Department of Ecology and Evolutionary Biology and Institute of the Environment, UCLA. 2002-present.
- Adjunct Professor of Biology, Department of Biology, San Francisco State University. 2004-present.
- Senior Fellow, Zoological Society of London. 1997-present.
- Member, Scientific Advisory Board, Point Reyes Bird Observatory, Stinson Beach, CA. 2002-present.
- Member, Council of Environmental Deans and Directors, 2007-present.

Professional Experience

2007-2009 Acting Director, Institute of the Environment, UCLA.
2001-2005 Member, Board of Directors, Foundation for Environment and Development in Cameroon (FEDEC).
1999-2001 Professor of Biology, Department of Biology, San Francisco State University.
1998-2001 Executive Director, Center for Tropical Research, San Francisco State University.
1996-2001 Faculty member, Center for Population Biology, University of California, Davis.
1995-1999 Associate Professor, Department of Biology, San Francisco State University.
1992-1995 Assistant Professor, Department of Biology, San Francisco State University.
1997 Visiting Professor of Zoology, University of Queensland, Brisbane, Australia.
1993 Senior Visiting Fellow, Conservation Genetics, Institute of Zoology, Zoological Society of London.
1992-1993 President, Northern California Chapter of the Society for Conservation Biology.
1988-1992 Postdoctoral Fellow, Integrative Biology and Museum of Vertebrate Zoology, UC Berkeley.
1978-1981 Research Assistant, Department of Wildlife Ecology, University of Wisconsin-Madison.

Academic Degrees

Ph.D. Zoology, University of California at Berkeley, 1988
M.S. Wildlife Ecology, University of Wisconsin-Madison, 1981
B.S. Natural Sciences, University of Wisconsin-Madison, 1978

Selected Honors and Awards

2004 Elected Fellow, American Ornithologists' Union.
2002 Point Reyes Bird Observatory Board of Directors Special Service Award.
1997 Founding Member of Gamma Psi, Phi Beta Delta.
1994 Elected Fellow, California Academy of Sciences, San Francisco.
1989 Senior Fulbright Research Scholar.

Publications

154 papers and book chapters published or in press on evolutionary ecology, mechanisms of speciation, conservation of vertebrates, maintenance of rainforest biodiversity, microevolutionary divergence and population genetic structure of migrant birds, and ecology of disease.

Major Grants

Received more than $16 million in research funding from agencies and foundations, including NSF, NASA, NGS, EPA, USAID, NIH, and the Turner Foundation.