SAMPLE URF Application #2:
THE EFFECTS OF LATITUDINAL AND VERTICAL CHANGE ON BEETLE DIVERSITY

PROJECT PROPOSAL:

Beetles belong to the order Coleoptera, the largest in all the animal kingdom. They are distinguished by the hardened wing casing that encloses their front wings. Beetles are found in virtually every habitat and can exploit many food sources. Though often considered pests, beetles can provide ecosystem services such as pollination, nutrient recycling, and pest control. Dung beetles, for example, improve soil structure and nutrient recycling, and prevent habitat formation for pests in the process of burying and consuming dung (Brown et al, 2010).

Biodiversity has become a hot topic for biologists. Biodiversity is the variety of life found in an ecosystem or in the world. As the movement towards conservation gains more traction, so does the idea of preserving biodiversity, particularly in sensitive areas. Maintaining biodiversity is thought to be important because it would ensure that ecosystem's productivity remained stable. Understanding and conserving an ecosystem requires knowledge of each factor of its environment. These factors are what allow for variable environments around the globe and differing species diversity to accommodate. Some species are ecological generalists, meaning they can survive in several environments, but most are not.

Beyond just examining ecosystems, there are habitats and microhabitats to consider. Individual trees, especially in tropical areas where they can grow to an amazing height, can provide several different microhabitats. Those living in the canopy strata would be exposed to day light and potentially susceptible to fewer and different predators, while those living in the understory may have better access to food. The variation in resources available along different zones of the tree can reveal what conditions certain species are best adapted for and an understanding of this can assist in conservation and management of tropical species.

The questions I hope to address with my research are: 1) do changes in latitude affect beetle diversity?, and, 2) do vertical changes in a forest affect beetle diversity? Ecuador is a biodiversity hotspot and so new species of beetles are constantly being discovered and described. However, the deforestation of the Amazon rainforest provides a constant and impending threat to all species that reside in the rainforest. With how expansive Coleoptera is, beetle species may be going extinct before they are discovered. It is important to understand if there are microhabitats along the forest vertical gradient supporting higher beetle diversity so those areas can be studied and their habitat protected.

To see if vertical and latitudinal differences cause a difference in beetles, I will be placing black light traps along vertical transects in a subtropical and a tropical environment. Five trapping events will take place at Freeman Ranch and five trapping events will take place at Tiputini. For each trapping event, three traps will be placed on a transect up a randomly selected tree. One trap

will be placed at the ground level, the next at mid canopy, and a final trap at the top of the canopy. The traps will be placed in the evening and checked at sunrise. Detailed methodology is described in stage two and three of my timeline.

Much of Texas falls in the Subtropical Steppe. Freeman Ranch is in the Edward's Plateau Ecoregion of Texas and is primarily dominated by the Plateau Live Oak (*Querqus fusiformes*) and Ashe Juniper (*Juniperus ashei*).

The area in Ecuador surrounding Tiputini is considered the Tropical Wet region. Tiputini is specifically in the western Amazon Basin rainforest.

I predict that the diversity of beetles will be much greater at Tiputini compared to Freeman Ranch. Freeman Ranch is in a subtropical zone at approximately 29 latitude, while Tiputini is in a tropical rainforest at approximately -0.6 latitude. The latitudinal gradient suggests that biodiversity increases as you move towards the equator (Nicholson et al, 2016). As canopy height is much greater at Tiputini, where trees can get over 100 feet in height, than Freeman Ranch, dominated by trees that can reach 40 feet, I expected to see a greater difference in diversity of beetles along the transect heights in trees at Tiputini. Additionally, I expect to see more beetles, in general, at the ground level at both locations than at the higher vertical points (mid- and upper canopy). However, I am uncertain as to if the number of representatives from beetle families will vary. A similar study on butterflies found that more butterflies were understory specialists, about 68%, while only 14% were canopy specialists (Molleman et al, 2006).

Conducting this study will give me more experience in conducting research, especially since I plan on going to graduate school.

Literature Cited

Brown, J., Scholtz, C. H., Janeau, J. L., Grellier, S., Podwojewski, P. (2010). "Dung beetles (Coleoptera: Scarabaeidae) can improve soil hydrological properties". Applied Soil Ecology. 46: 9. doi:10.1016/j.apsoil.2010.05.010.

Molleman, F., Kop, A., & Brakefield, P. M. Zwaan. B. J (2006) Vertical and temporal patterns of biodiversity of fruit-feeding butterflies in a tropical forest in Uganda. Biodiversity & Conservation, 15, 107-121.

Nicholson, D. B., Holroyd, P. A., Valdes, P., & Barrett, P. M. (2016). Latitudinal diversity gradients in Mesozoic non-marine turtles. Royal Society Open Science, 3(11), 160581.

PROJECT TIMELINE:

Stage 1: Purchase & Test Equipment

With these grant funds I will purchase equipment outlined in the Budget section from BioQuip. Once the equipment arrives, I will do a trial run out on Freeman Ranch to learn how the equipment works and fine tune the sampling regime, more than one sampling trial may be required. The trial run(s) will be conducted shortly after the equipment arrives.

Stage 2: Research on Freeman Ranch & Research in Ecuador

The experimental design will include randomly selecting 5 sampling sites at Freeman Ranch and 5 sites at the Tiputini Biological Station. Once the sites are randomly selected, a tree at each site will be selected randomly. At each tree, a transect will be run along the trunk with three traps along it at varying heights. A trap support line will be set in trees using a sling shot to fire a fishing weight with the line attached. These insect traps will consist of a light, funnel, bucket, battery, and chord. These traps are standard for insect studies. One will be placed at the ground level while the other two will be suspended in the trees; one at mid-canopy level and the other at the top of the canopy. These traps will be placed at sunset and then checked at sunrise. The number of beetles collected and number of beetle species (sorted to morphospecies) collected will be recorded. These tests on Freeman Ranch will be conducted over a five-day period in late May. The tests at Tiputini will be conducted over a five-day period in late June to early July.

Stage 3: Examine Data

Two hypotheses will be tested; does latitude affect species diversity of beetles and does vertical height in trees affect species diversity of beetles? These will be analyzed using a chi-squared test. With the collected data, I will be able to take the Lou Jost diversity index to get the effective species diversity. I will compare the diversity across all the altitudes with a chi-squared to see if there is a significant difference in diversity. The diversity of Freeman Ranch beetles versus Tiputini Biological Research Center beetles will also be compared using a chi-squared test. Data analyses will be completed by early August.

Stage 4: Put together paper

Once the data are analyzed, I will begin putting together a short paper reporting my findings, along with a poster and presentation to accompany the paper. The paper and presentation will be completed and reviewed by early October.

Stage 5: Present Findings

I will present my research at the Undergraduate Research Conference in the fall of 2017 and the Biology Department Colloquium in spring of 2018, and I also intend to have my findings published in the Journal of Undergraduate Research.

BUDGET NARRRATIVE:

Below is an itemized list of everything I will need for my research. All equipment will be purchased through BioQuip products. I will be covering the additional $14.69 for shipping.

Product	**Price Per Unit**	**Amount**	**Cost**
Universal Light Trap, Lid, Funnel, Drain, Chord	$71.45	X3	$214.35
12 Watt U-Shape Black Light Tube, Ballast, Vanes, 12 VDC	$88.10	X3	$264.30
DC Battery Pack, with charger, 12 V/14 AHr	$138.45	X3	$415.35
Shipping & Handling			$120.69
		Total:	$1014.69