Upland Stamp Account Grant Application, FY 2015/16

1. Grant Name/Project Title: Tests of efficient methods for assessing Mountain Quail abundance and habitat.

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3. Issue/Problem Statement: Drought and increased wildfire severity have altered the structure, composition, and distribution of chaparral habitats in the Sierra Nevada Mountains, relative to pre-fire suppression conditions (van Wagtendonk and Fites-Kaufman 2007). These trends will likely continue in the future due to climate change (McKenzie at al. 2003, Westerling et al. 2006), yet their impact on Mountain Quail (*Oreortyx pictus*) is essentially unknown. Investigations of Mountain Quail ecology are hindered by the poorly-developed state of assessment methods (Gutiérrez and Delehanty 1999). Mountain quail abundance, for example, has occasionally been assessed by line transect distance sampling and auditory point count sampling (Brennan and Block 1986, Roberts et al. 2011), but line transects are impractical in dense chaparral (Burnham et al. 1980), and auditory censuses rely on assumptions about vocalization behavior that are unproven and questionable (Gutiérrez and Delehanty 1999). Assessment of Mountain Quail habitat is similarly hindered by the lack of practical and efficient methods for measuring dense, frequently impenetrable, chaparral vegetation.

4. Project Description:

The Game Bird Research Group (GBRG) proposes to: 1) quantify the temporal patterns of Mountain Quail vocalizations that underpin abundance estimates derived from call counts, and 2) test a method for efficiently assessing chaparral vegetation with a recreational-grade unmanned aerial vehicle (UAV). All field work will be conducted in Stanislaus National Forest.

Temporal patterns of Mountain Quail vocalization will be investigated by conducting repeated call counts at 50 listening stations along Forest Service roads in areas known to be occupied by breeding Mountain Quail. In order to ensure the independence of call samples, listening stations will be positioned at least 1.5 km apart (maximum reported audibility of the Mountain Quail crow call is 1.2 km (0.75 mi, McLean 1930). Calling behavior will be sampled on a weekly basis during the first three hours after sunrise over the entire singing season (~1 April-1 June, Grinnell et al. 1918). Gutiérrez and Delehanty (1999) report a second, lesser peak of vocalization "near dusk," but surveys of diurnal birds are seldom conducted at dusk, so we will not expend effort to sample during that period. Estimated locations of individual calling males will be plotted on georeferenced aerial photographs. Data on temporal patterns of vocalization will be analyzed by season and hour of day (morning only), with special attention to variation in call frequency at both time scales. Data on the spatial distributions of singing males will be used to characterize the audibility of crow calls over a range of distances, and to explore the use of auditory point counts for estimating density, including the use of distance to calibrate a detection decay curve for probabilistic population estimation (Buckland et al. 2001).

The composition and structure of chaparral vegetation will be assessed using aerial photographs acquired with a lightweight unmanned aerial vehicle. Chaparral vegetation is notoriously difficult to measure using either land-based methods (e.g., sample plots, line-intercept) or remotely-sensed imagery (e.g., acquired by satellite or low-flying aircraft). Where chaparral is fully developed, or where thorny species like whitethorn (*Ceanothus cordulatus*) are abundant, land-based methods can be nearly impossible to implement. Images acquired from satellites or low-flying aircraft, while very useful for investigating woodlands and forest (see Bland 2013 for an application with Sooty Grouse, *Dendragapus fuliginosus*), lack sufficient resolution to identify individual shrubs. With the recent development and mass production of durable, lightweight, unmanned aerial vehicles (a.k.a., drones, unmanned aircraft systems, quadcopters), it is feasible, and very affordable, to acquire high-resolution still images or video from altitudes ranging from 1-1000 m (Anderson and Gaston 2013, Whitehead 2014). For example, the DJI Phantom 2 Quadcopter (DJI Innovations, Shenzen, China, www.dji.com/products) fitted with an 11 megapixel GoPro Hero3 digital camera cost less than $1000. Technological innovations, including GPS-enabled auto-pilot for orientation control, stable hovering, and auto return-to-home functions, make new quadcopters relatively easy to operate (ease of operation is demonstrated in many YouTube videos, e.g., www.youtube.com/watch?v=UxtOMsIsezo).

A drone will be used to capture still images of vegetation plots from directly above, at altitudes ranging from 10-100 m. A 20-m length of high-visibility ribbon will serve as a reference scale. The images will be printed on site, and the investigator will traverse the plot on foot, recording the species code of each shrub directly onto its likeness on the image (Fig 1). In our office, the marked-up images will be scanned, and spherical correction filters available in Adobe Photoshop (Adobe Systems, Inc., San Jose, CA) will be used to correct spherical aberration caused by the camera lens. We will then use ArcGIS software (Esri Inc., Redlands, CA) to conduct standard compositional analyses of the images (e.g., percent shrub and tree cover, percent frequency and cover per species, etc.).

5. Expected Benefits:

In addition to providing a final report to CDFW, at least one draft manuscript of scientific findings will be provided, ready for submission to a regional peer-reviewed scientific journal.

The work on vocalization patterns, upon publication, will likely become a standard reference for Mountain Quail vocalization behavior, and a cornerstone for subsequent Mountain Quail census work. The knowledge acquired regarding temporal variation in vocalization patterns is essential for developing scientifically-defensible point census protocols, and will provide a provisional detectability coefficient for future probabilistic population estimation. The methodological approach we use might also serve as a model for developing auditory census protocols for California's two other quail species, California Quail (*Callipepla californica*) and Gambel's Quail (*Callipepla gambelii*).

The work using UAVs to assess chaparral vegetation, upon publication, could have widespread application in vegetation research, given the simplicity, practicality, and cost-effectiveness of the method. Ideally, GBRG will make use of the method in future investigations of Mountain Quail habitat.

If this project is funded, GBRG would apply for UGBA funds in successive years to conduct follow-through research on how wildfire severity affects Mountain Quail populations. Funding would be sought from additional sources at that time, using successful completion of the present project to bolster our request.

6. Itemized Budget:

Item	Description	Cost
Personnel		
PI's salary	5 mo @ $6,000/mo	$30,000
Operating expenses *		
Est. campground fees		$300
Est. mileage	3,600 mi @ $0.575/mi	$2,070
Grant Administration		
Overhead, GBRG	12 %	$3,884
Total Cost:		**$36,254**

* All equipment will be provided by the PI (vehicle, UAV, GPS unit, laser rangefinder, computer, portable printer, computer software).

7. Schedule:

	Calendar Year 2016											
	CDFW 16/16						CDFW 16/17					
	J	F	M	A	M	J	J	A	S	O	N	D
Call counts, UAV flights, and preparation of data				■	■							
Data analysis					■	■						
Report and manuscript preparation							■	■				

8. Organizational status and capacity:

GBRG is a tax-exempt corporation dedicated to studying and monitoring California's upland game birds. Unlike more familiar nonprofit organizations, GBRG is a non-membership corporation established for scientific purposes, and aspires to remain small, focused, and efficient. GBRG's corporate documents, including its Articles of Incorporation and IRS tax-exempt certification, can be viewed at www.gamebirdresearch.org. The corporation's founder and principal investigator, James Bland, has conducted several game bird research projects for

CDFW over the past 20 years. He recently developed an auditory-based census protocol for Sierra Sooty Grouse (*D. f. sierrae*, Bland 2013) that dealt with many of the same issues and obstacles as the work we are proposing for Mountain Quail.

GBRG has submitted a second application for UGBA funds to study Sooty Grouse. We do have the capacity to conduct the two studies simultaneously. During the month of May, when the optimal census period for both species overlaps, GBRG could employ and train another collaborator to conduct censuses. If both studies are funded, the schedules indicated for each project would need to be extended by approximately two months but costs would not change.

9. References:

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Figure 1. Proposed labeling system for assessing vegetation composition from a low-elevation photograph. Note this is a low resolution image taken from a full-sized helicopter. Images from a UAV will be higher resolution, cover a larger area, and taken from directly overhead.