WEST Inc.
Environmental & Statistical Consultants

PROPOSAL FOR:
HAWAIIAN HOARY BAT

SEPTEMBER 22, 2016

Submitted to:

Endangered Species Recovery Committee
Hawaiian Hoary Bat Request for Proposals
C/O Kate Cullison
1151 Punchbowl Street, Room 325, Honolulu, HI 96822

September 22, 2016

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Western EcoSystems Technology, Inc. (WEST) is pleased to submit the enclosed proposal in response to the Endangered Species Recovery Committee (ESRC) Hawaiian Hoary Bat (HAHOBA) Research Request for Proposal (RFP) issued June 15, 2016.

WEST is uniquely well suited to assist the ESRC with this project and appreciates the opportunity to submit the following proposal. WEST specializes in combining state-of-the-art scientific and statistical principals to provide its clients with practical, defensible, and professional solutions to natural resource problems. WEST is a leader in the development of modern techniques for the analysis of animal movement, home range estimation, and resource selection by animals. WEST biometricians co-authored a book on resource selection that continues to be the standard citation for a majority of peer-reviewed journal articles related to resource selection modeling and habitat use estimation.

More specific to bats, acoustic sampling, and occupancy modeling, WEST has extensive experience in all areas; working intensively with listed bat species (e.g., Indiana bat, northern long-eared bat) throughout the eastern US. WEST also conducts acoustic monitoring at numerous wind energy and other project-related study sites across the country on an annual basis, with monitoring done at more than 100 sites over the past decade. WEST also has extensive with occupancy modeling sampling design, analysis, and field data collection. WEST developed a bat monitoring sampling design implementing spatially-balanced sampling for monitoring northern long-eared bat calls in parks within the Great Lakes Network of the National Park Service. WEST recently conducted a power analysis for occupancy estimation for Hawaiian hoary bats on the Big Island of Hawaii for a previous collaboration with Sun Edison.

The following proposal describes an adaptive study design developed for a single island; the sampling design and effort are appropriate for implementation on Oahu and/or Maui, pending preference of the ESRC and/or project funders. Costs have been presented for an initial 2- to 4-year field study (for a maximum 5-year total timeline) to be conducted on a single island; however the same proposal could be conducted on two islands (Oahu and Maui) for the costs provided per island, although some cost efficiency could likely be factored in if work was conducted concurrently on two islands.

WEST proposes to conduct an occupancy analysis and resource selection function analysis (separately or within the same model depending on the nature of HAHOBA detection probabilities) to identify land cover or other environmental variables that are associated with regions exhibiting HAHOBA use. The following proposal outlines the initial field study and associated analyses to address Goals 1a and 2a parts (i) and (ii), as defined in the RFP. The data collected during the 4-year study will provide insight into habitat relationships and HAHOBA use, island-specific information on bat occupancy/distribution, and island-specific estimates of detection probabilities. The data gathered during the study will also provide the basis for addressing Goal 3 by assessing trends in HAHOBA occupancy, evaluating the efficacy of the detector data for abundance estimation, and providing the basis for a more rigorous assessment of the sampling design for meeting the stated goals.

This edited proposal is being provided in a red-line format to illustrate the changes incorporated into the proposal based on feedback received from the ESRC. As noted above, this revised proposal is intended to follow an adaptive approach, with modifications of study design incorporated at strategic intervals, as appropriate based on the data collected. Additionally, we would like to clarify that we anticipate the entire process being a collaborative approach, with feedback and input from the ESRC and Hawaiian hoary bat experts incorporated as appropriate throughout the process. Because we expect this to be a collaborative and adaptive effort, we have provided a revised scope and budget that allows for a complete 4-year study to address species distribution and provide high quality data useful in designing a long term occupancy study to estimate population trends. Should initial study results suggest that statistically significant trends in occupancy cannot be reasonably achieved, then the study design will allow for a well-informed distributional study over 2 years that will provide for an assessment of seasonal and annual variation in use, as well as the resource selection modeling, for a cost of approximately half of the total provided herein, with total cost dependent on the final desires of the ESRC in terms of final analyses and deliverables. Given these revisions, we again thank you for the opportunity to provide this proposal and would appreciate the opportunity to collaborate with the ESRC and other pertinent parties.

Please let me know if you have any questions or need any additional information.

Best Regards,

Joel Thompson and Clayton Derby

Joel Thompson
Western EcoSystems Technology, Inc.
Consulting Biologist / Project Manager

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NARRATIVE

a. Summary

In response to the Hawaiian Hoary Bat Research Request for Proposals received from the Endangered Species Recovery Committee (ESRC) on June 15, 2016, Western EcoSystems Technology, Inc. (WEST) has prepared the following revised Proposal to address several priority research needs for Hawaiian hoary bat (HAHOBA) management on the island of Maui and/or Oahu. WEST proposes to conduct a Resource Selection Function analysis to identify land cover or other environmental variables that are associated with regions exhibiting HAHOBA use. The following proposal outlines up to a 4-year study to address Goal 1a, Goal 2a parts (i) and (ii), and Goal 3 as defined in the RFP. The data collected in the 4-year study will provide an initial investigation of habitat relationships and HAHOBA use, island-specific information on bat occupancy, and island-specific estimates of detection probabilities. The data gathered during this 4-year study will provide the basis for estimating long-term trends in HAHOBA occupancy, inference on HAHOBA habitat use, and a more rigorous assessment of sampling designs that may provide acceptable power to detect trends in occupancy. In addition to the data gathered during this specific study, WEST will work with agencies to acquire and incorporate suitable data of a similar nature that may be available from other past or ongoing studies (e.g., Oahu Army Natural Resource Program; SunEdison Wind Farms, USGS). It is assumed that any such data would be provided in a format that requires only minor manipulation to be incorporated into analyses. Raw data that has not been analyzed or otherwise summarized could require a budget modification to analyze prior to its incorporation.

b. Goals

WEST proposes to address several objectives relevant to Goals 1, 2, and 3 as defined in the RFP. We propose an initial study to examine occupancy, distribution, and habitat use that is based on a well-defined target population. The length of the study may vary from 2 to 4 years depending on the goals of the study and an evaluation of the initial results, which will be decided in collaboration with the ESRC and/or others so designated by the ESRC to evaluate the initial study results. Data will be collected from a randomly-selected sample obtained from a sampling frame that adequately enumerates the target population. We propose to develop a sampling design that accommodates multiple goals and provides a robust basis for occupancy estimation and distributional information (Goal 1), resource selection inference (Goal 2), estimates of HAHOBA detection probabilities for levels of related variables, and a pilot data set to evaluate the sampling design for long-term monitoring and research goals related to estimating trend in occupancy (Goal 3 Objective a). Furthermore, the data collected will be used to assess the efficacy of detector data for estimating abundance (Goal 3 Objective b).

c. Objectives

The ESRC has expressed interest in studying both occupancy (i.e., distribution) and resource selection. We propose an initial adaptive study of up to 4 years that will document distribution and estimate seasonal changes in occupancy (Goal 1, Objective (a)) and examine relationships between HAHOBA use and habitat characteristics (Goal 2, Objective (a), parts (i) and (ii)). Together, these research elements will provide the basis for more detailed research when the appropriate data are available (addressed in Goal 3).

Objective (a) of Goal 1 is defined as the documentation of HAHOBA distribution on Maui and/or Oahu. Furthermore, seasonal changes in occupancy are of interest. The information gained through this research will be useful in evaluating risk, informing conservation management actions, and providing baseline information on habitat suitability. After the first 9 months of surveys are complete, single-year occupancy models (MacKenzie et al. 2006) will be used to estimate occupancy rates, detection probabilities, and covariate relationships. These initial estimates will provide a basis for an evaluation of precision and a determination of sample size adequacy. Pending the results of this initial analysis, we will reassess the sampling design, in coordination with the ESRC to determine the year 2 design. As proposed, year 2 sampling would likely consist of continued monitoring of the 100 detectors at their current locations, or continued monitoring of 75 detectors at the same locations with 25 detectors moved to new locations to expand the sample size for the distribution and resource selection studies. Data would again be assessed following year 2 studies to determine if additional years of study were justified to attempt to assess trends in occupancy. Decisions to continue or alter study designs at this point would be done in collaboration with the ESRC and/or their designees). If it was decided at this point that additional data using the proposed sample design was not likely to provide a useful assessment of trends in occupancy, we would suggest halting studies after year 2 and focusing on the distributional study, resource selection, and other analyses. If studies continue beyond the initial 2 years, we propose to complete a multi-year occupancy analysis for imperfect detection probabilities (MacKenzie et al. 2006) following the third summer/fall period of data collection (which should conclude three years of monitoring during the peak bat activity period) to estimate annual and seasonal HAHOBA occupancy and trends in occupancy, to determine what habitat variables are related to occupancy and detection, and to estimate detection probabilities by season to identify the most advantageous sampling windows for future monitoring. We would again evaluate if the power to detect trends in occupancy warrants continued monitoring. Depending on the results to date and in collaboration with the ESRC and/or their designees, we would make a decision as to the need to continue with a fourth year of study, alter the study design, or cease field studies following year 3.

Parts (i) and (ii) of Goal 2 Objective (a) involve identifying suitable HAHOBA habitat. Defining suitable habitat will improve understanding of HAHOBA population limitations and identify areas for habitat management and recovery. A suite of habitat characteristics likely associated with bat occupancy/use will be identified from the literature and professional inquiry, and data reflecting those characteristics will be collected by field crews and from available GIS datasets. These habitat characteristics will include vegetation community data, physical attributes such as slope and aspect, tree architecture, temperature, distance from water and forest, and other possible relevant variables. Resource selection modeling will then identify the variables with the strongest association with HAHOBA occupancy. Habitat suitability can be predicted for unsampled areas if the habitat use variables are available for the entire sampling frame. Then the relationship between use and availability may be assessed.

Goal 3 consists of two main objectives: the development of methods for assessing long-term population trends (Objective a) and the development of methods for estimating abundance (Objective b). Data collected during the initial study will be useful to inform both of these objectives. After at least 3 years of data are available from sampling during the peak bat activity period, an occupancy trend analysis will inform a power analysis to determine the statistical power of tests for trends in occupancy. The power analysis will indicate if sample sizes are appropriate to detect trends of given magnitudes over monitoring periods of interest. WEST previously conducted a power analysis to assess the potential for detecting trends in occupancy; however the data used to inform those analyses were based on relatively small samples from the big island (Hawaii), whereas island-specific data from a larger multi-year sample will provide a more robust dataset for a power analysis specific to Maui and/or Oahu. Furthermore, the data gathered during this initial study will provide baseline information for a longer-term analysis of trends in occupancy if the sampling design does not change substantially (e.g., at least 75 detectors remain in the same locations during all years).

Detector data will be assessed to determine how absolute abundance or indices of abundance might be estimated. A thorough literature review will compare and contrast available models such as N-mixture models (Royle 2004) and spatially-explicit occupancy analyses (He and Gaston 2003) to obtain estimations of HAHOBA abundance. WEST may contribute the “in-kind” use of night vision equipment and/or thermal cameras to investigate the utility of documenting the correlation between the number of calls recorded on acoustic recorders and the number of bats responsible for those calls. If the number of bats and number of calls could be determined, then acoustic data may be more useful in terms of estimating actual abundance instead of just levels of activity, which are treated as indices of abundance.

d. Tasks and Activities

The proposed tasks and activities are outlined in Table 1. Tasks and activities are defined relative to goals and objectives.

Table 1: Proposed tasks and activities

Task number	Task name	Task description	Relationship to project objectives
1	Sampling design	Develop the sampling design with the ESRC working group, establish scope of inference, determine sample size and revisit panel allocation of effort, define sampling complexities such as nonsampling error	Ensure that the sampling design matches the basic research goals as defined in Research Goal and Objective 1a in the RFP.
2	Draw GRTS sample	With the help of the ESRC working group, obtain a sampling frame representing the accessible area of interest on the island of Maui and select a spatially-balanced GRTS sample	A random sample will provide the statistical basis for inference on HAHOBA occupancy and resource selection.
3	Collect data	WEST will provide field crews to collect occupancy and habitat data at up to 100 sample sites for a 4-year period	These data will provide the information necessary to model HAHOBA occupancy and resource selection.

Task number	Task name	Task description	Relationship to project objectives
4	Occupancy and resource selection modeling	WEST statisticians will model occupancy and resource selection with statistical tools in the R software environment.	The results of these analyses will provide estimates of within-year and within-season occupancy, estimates of trends in occupancy, and quantify the relationships between habitat variables and HAHOBA use.
5	Develop habitat use categories, if feasible	Assess whether or not call types (e.g., feeding buzzes) and habitat characteristics can be categorized into use categories (e.g. foraging, roosting).	HAHOBA detector data may be able to be categorized by habitat use type for more fine-scale assessment of use.
6	Report(s)	WEST will provide a report summarizing the sampling design, sampling methods, data analysis, and results. Interim update memos will be provide for review at key intervals (e.g., 9 month analysis and each year)	The report(s) will synthesize the analysis results for the ESRC to inform management actions and further research/study efforts.
7	Develop methods for assessing long-term trends	After the initial 3-year survey period is completed, WEST will use estimates of the occupancy rate and probability of detection to conduct a power analysis for trend testing. We will assess power as a function of the sample size of sites, the length of the monitoring period, and the magnitude of the annual trend. If power is not adequate to detect trends for reasonable monitoring periods and sample sizes, we will explore alternative options for trend detection.	This task will address the ability of the current sampling design and scope of inference for trend detection. If either is found to be insufficient, we will assess ways to improve the design or scope or propose ceasing data collection targeted at assessing trends in occupancy.
8	Develop methods for abundance estimation	After the study is complete, WEST will use the data to assess the feasibility of abundance estimation. A thorough literature review will compare and contrast available models such as N-mixture models (Royle 2004) and spatially-explicit occupancy analyses (He and Gaston 2003) to obtain estimations of HAHOBA abundance.	This task will address the feasibility abundance estimation and the level of data collection necessary to meet this goal.

e. Outputs

The informational outputs of this work include estimates of the probability of detection, HAHOBA occupancy estimates, estimates of island-wide or season-level occupancy trends across years, resource selection functions to describe relationships between habitat characteristics and HAHOBA occupancy. Results and their interpretation will be included in a final report with a description of the sampling design, field methods, analysis techniques, and analysis assumptions. WEST will also provide a database of the data collected for archival and future use by ESRC cooperators. Interim memos will be provided at key decision points throughout the study which will include the results of interim analyses, which may in collaboration with the

ESRC and/or their designees lead to altering study designs and committing to the validity of continued survey efforts.

f. Outcomes

Project outcomes include broad-scale information on HAHOBA distribution and quantified relationships between HAHOBA distribution and suitable broad-scale habitat characteristics from the resource selection functions. The data resulting from this work will provide a baseline data set to support sampling design assessment, the initial sampling effort for long-term occupancy trend monitoring (if future funding is available to continue monitoring efforts), and island-specific data to inform a power analysis for trend detection on Oahu and/or Maui.

g. Materials and Methods

WEST proposes a sampling design that will allow inference on occupancy (Goal 1a), distribution (Goal 1a), and habitat use (Goal 2a parts (i) and (ii)). Designing a survey is often an iterative process, involving discussions among all cooperators to refine project goals, identify survey limitations, and ensure that the sampling design allows appropriate inference to the target population. The sampling design for this project will rely on discussions among cooperators, relative importance of goals, sampling design theory, and power analysis and sample size approximations from existing data (if possible), with study designs reevaluated at critical points along the way. Survey design requires defining the target population, developing the sampling frame to match the target population, identifying nonsampling error sources such as sampling frame error and nonresponse error (e.g., inaccessible sites), allowing inference to subpopulations of interest using stratification or domain estimation, determining the design for placing detectors, and possibly constructing a temporal revisit design to relocate a subset of detectors to increase the spatial extent of the sample and the habitat diversity within the sample. We propose an adaptive survey design that may be updated depending on initial survey results, but ultimately the design must be developed with input from the expertise of the ESRC and their designees/cooperators.

WEST proposes that a spatially-balanced sample of points be selected with generalized random tessellation stratified (GRTS) sampling (Stevens and Olsen 2003, 2004). GRTS sampling is a random sampling approach that allocates sampling effort in a spatially-balanced fashion across the landscape. A GRTS sample is expected to occur proportionally to landscape features, so that different habitat types, elevations, and other ecological characteristics are sampled relative to their occurrence in the sampling frame. Given that some locations will be inaccessible and to increase the flexibility of the sample in the long term, we propose that a large GRTS sample of 1,000 points be initially selected within the area of interest. Detectors will be located at the first 100 accessible sites that are found to meet the definition of the target population. Sampling complexity such as stratification or unequal probability sampling may be incorporated into the sampling design if reliable information on design variables is available. Strata are best constructed from habitat characteristics that do not change over time, such as elevation, so that strata are well-defined over time. WEST will work with the ESRC and agencies to assess and incorporate GIS data, as appropriate, into the sampling design for survey site selection.

A sample size approximation may be conducted prior to the initial sample draw if data are available to determine the appropriate number of detectors. We assume in this proposal that a set of 100 Wildlife Acoustics SM4Bat acoustic detectors (and new microphones will be used for this work. This choice of detector is consistent with recommendations from others working on acoustic studies on the islands (C. Pinzari, personal communication). In addition to the use of the SM4Bat detector and new microphones, WEST will work with biologists with local experience (e.g., C. Pinzari, M. Gorresson) to refine the configuration of the detector and associated components to help ensure high quality data collection. We also assume that data from recorders will be analyzed using a combination of analysis software (i.e., Kaleidoscope Pro, Wildlife Acoustics, Inc.) and bat biologists with experience identifying bat calls, who will review calls identified by the software to ensure accuracy. Given a set of 100 detectors, we propose that the 100 detectors be initially placed according to a random sampling design and implemented year-round for the initial year of the study.

Dual goals of occupancy estimation and habitat selection are achieved with similar approaches and potentially with the same model if data indicate that detection probabilities are related to habitat selection. Evaluating the results of the occupancy analysis and resource selection analysis after the first 9 months will provide guidance for a flexible sampling design approach for the second survey year. An initial patch occupancy analysis will be used to obtain baseline estimates of occupancy rates and detection probabilities, and these parameters will be modeled as a function of habitat characteristics when significant. If detection probabilities are found to depend on HAHOBA habitat resource characteristics, then patch occupancy models must be used to accurately characterize these habitat-use relationships (Nielson et al. 2009). Because trends in occupancy are best modeled from a set of sites visited annually rather than from a panel design (MacKenzie et al. 2006), this result would suggest that the detectors remain in place during the second survey year. If detection probabilities are found to be independent of habitat characteristics, then a subset of detectors (here, we assume 25) may be relocated to the next 25 randomly-selected locations to expand the spatial distribution of the sample and increase replication within habitat types. Resource selection modeling will be used to identify the variables with the strongest association with HAHOBA presence at occupied sites. Then the relationship between use and availability may be assessed. Habitat suitability can be predicted for unsampled areas if the habitat use variables are available for the entire sampling frame.

Trends in occupancy are best estimated when the same sites are visited annually to minimize unexplained spatial variation in the sample (MacKenzie et al. 2006). We have scoped costs assuming that a minimum of 75 detectors will remain in their initial locations for the durationof the study, with the remaining detectors allocated to a set of panels that are monitored for a year and not again during the 4-year period. The detectors placed at these rotating panels will increase the spatial distribution of sites and provide more diverse habitat information for resource selection function modeling. Assuming that 75 of the detectors are allocated to the annual panel (i.e., remain in place for all years) and 25 are moved each year in rotating panels, the final sample after 4 years would consist of a total of 175 sites rather than 100 unique sites. Therefore, for the same investment in detectors and an additional cost of moving a small sample (e.g., 25) the detectors after each year, a larger sample size of unique sites, greater spatial distribution of the sample, and more diverse habitat information for resource selection function modeling are obtained, while maintaining a relatively large sample of static stations (e.g., 75) for assessing trends in occupancy. This panel structure may be useful if preliminary results indicate that some habitats are underrepresented in the sample. Then the annual panel will provide site-level replication for occupancy analysis, but the addition panels of sites will increase the overall spatial replication and the within-habitat replication of sites. Seasonal changes in occupancy will be estimable from the entire sample of sites because they will be located in a single location for an entire year. If it was determined based on the preliminary data that moving a panel of detectors yearly was not warranted, this would result in an overall cost reduction.

The population of interest is ultimately island-wide, but land ownership and accessibility will restrict the placement of detectors. WEST proposes that an appropriate sampling frame be identified to maximize accessibility and to minimize observer danger and complications due to landowner denial of access or topographic obstructions. Focusing on state and federal lands, along with roughly the six other largest landowners on the island, will provide a well-defined population of interest while minimizing efforts to gain access to sufficient sample sites. Even if the sampling frame were restricted to state and federal lands, the sampling frame would likely be sufficient to assess both temporal (i.e., seasonal) and spatial (e.g., elevation, windward vs leeward) changes in occupancy, as state and federal lands are well distributed across the island and cover the full range of available elevations. Although identifying areas inaccessible by observers and removing these areas prior to the sample draw may ensure the safety of observer crews and will make both fieldwork preparation and actual field effort more efficient, we have included costs for up to 80 hours of helicopter time over the 4 year study to place and check detectors in some remote locations. This assumption is based on up to 10 detectors per year being placed in locations that would necessitate helicopter use for installation, maintenance, and retrieval. Alternative means of accessing data (e.g., remote data downloads) would be assessed for these sites to attempt to reduce costs, however it is unclear if such systems would be a cost savings when very large quantities of data are being transmitted.

h. Timetable and Milestones

Year 1:

Months 1-3: Meet with ESRC, DOFAW, USFWS, and other pertinent parties to discuss final study designs.

Months 3-6-: Pursue and secure access agreements with cooperating landowners based on final study designs. Refine sample sites based on access.

*Months 6-12***:** Deploy field equipment and begin data collection. Check field detectors 2 weeks and 4 weeks after deployment, then once every other month. Evaluate the results of the occupancy analysis and resource selection analysis after the first 9 months to inform year 2 study design.

Years 2-4:

Month 1: Provide annual status updates to agencies/interested parties and reevaluate sampling design. If needed, relocate 25 detectors used in the rotating paneland check newly moved detectors 2 weeks after deployment.

Months 2-12: Continue to monitor all detectors every other month. Complete interim analyses and summary memos as needed. Reassess study design and value of continued data collection at end of each year of surveys.

Year 5: Analysis and reporting. Final meeting with ESRC, agencies, interested parties to discuss study results.

i. Permits and Authorizations

WEST will pursue access agreements with State, Federal, and Private landowners to establish working partnerships that will allow for a sufficient distribution of samples. No capture or handling work is necessary that would require any special permits from USFWS or DOFAW, other than access.

j. Monitoring and Evaluation

WEST will utilize long-term experienced field biologists to provide training to and assist local technicians with the deployment of all acoustic recorders. Ongoing monitoring of equipment will be conducted by local field staff, with long-term WEST staff members making annual trips to the study sites to assist with the relocation of detectors. Data will be downloaded during each check (2 weeks following deployment and then Quarterly) and assessed by a biologist/analyst experienced with acoustic bat data.

k. Organization(s) and Key Personnel

Project Team

All Key Staff identified in this submittal have many years of pertinent experience managing research projects with a scope of work similar to that proposed herein. We will use the experience our project managers have gained to efficiently develop study plans, develop strategies for compliance issues, and leverage our relationships with agency staff towards effective permitting and regulatory review timelines. WEST's project team will work to develop a cost effective project work plan by using data and our experience in the region to minimize the need to conduct new surveys to the extent possible. WEST has assisted numerous developers in minimizing survey cost expenditure through an understanding of the permitting requirements and using a data driven approach.

Key project staff will work with WEST's technical matter experts, such as WEST's nationally-recognized avian and bat biologists; biometricians and statisticians; technical writers and editors and the data management department. WEST has over 100 full-time professional scientists and statisticians on staff, bringing expertise in disciplines including biologists, ecologists, regulatory compliance and conservation planning specialists, and GIS professionals. Our commitment to scientific excellence, regulatory compliance expertise, and development of cost-effective, successful projects for our clients is demonstrated throughout our organization, starting with WEST's founders and Principals, and projected throughout all technical and administrative staff. WEST brings this depth and breadth of experience to meet the needs of the technical and management criteria stated in the RFP. Additionally, the key staff will be supported by a complete Information Technology Department, Accounting, Contracting and other key functions that will facilitate a smooth business administration of the project.

WEST's key staff members (identified by name in the Organization Chart, Figure 1) have been selected for their role in this Project by two principal qualifications; (1) technical subject matter expertise, and (2) proven management experience on the key services described in the SOW. WEST's key staff are all seasoned experts who have managed similar efforts on numerous past projects, some of which are described in this submittal. Each key staff member understands the breadth and complexity of the technical scope, scheduling, budget control and management of not-to-exceed price contracting, and the communication requirements necessary to complete the key services.

These individuals will deliver work products of the highest quality, produced efficiently and in adherence with cost and schedule constraints. Each of WEST's key staff has worked directly on similar projects within the region, managed data, mapping, and documentation of results for studies, completed relevant research and/or has worked directly on efforts of a similar or greater scope for other similar projects.

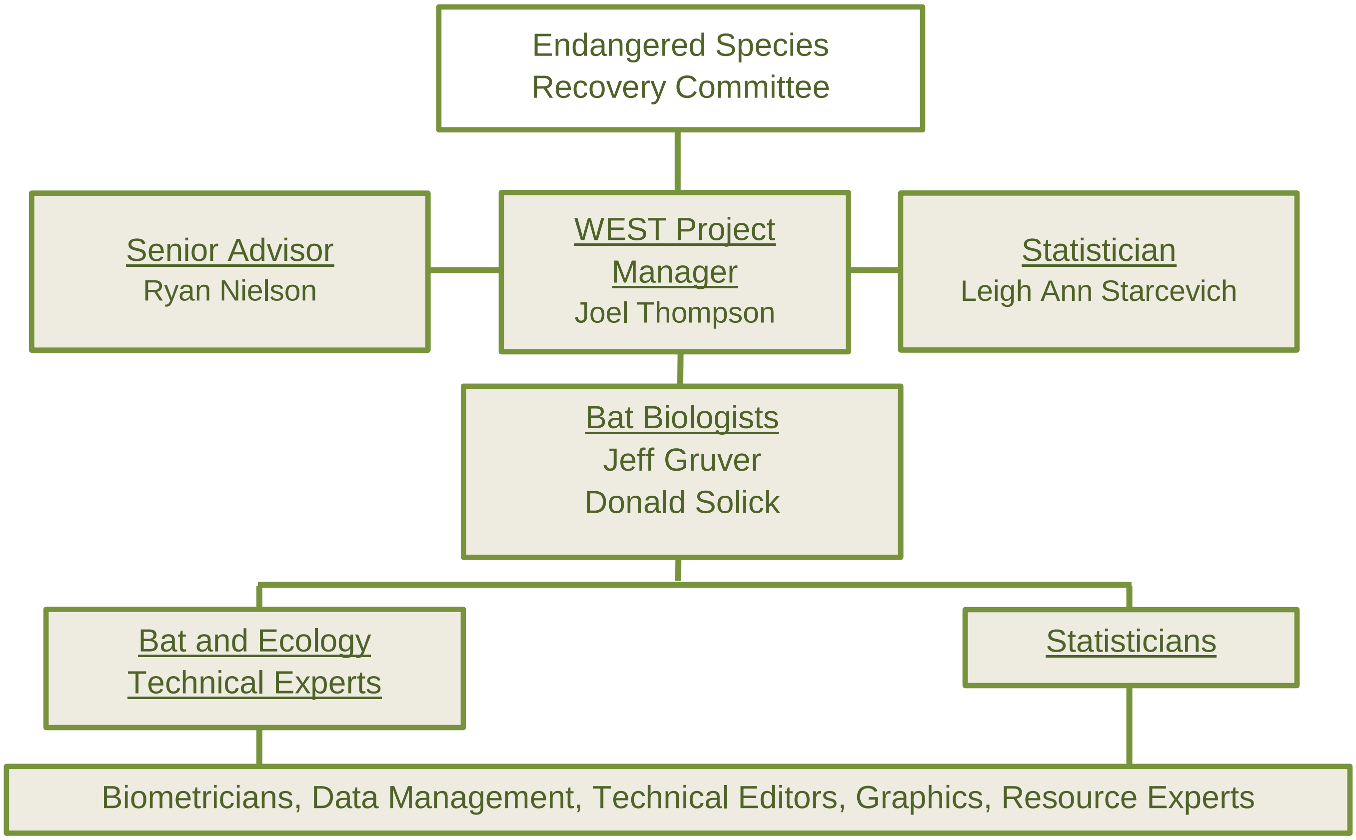

Figure 1. WEST Team Organizational Chart

Quality Assurance and Quality Control

The quality of WEST work products is critical to our success. As such, quality assurance and quality control (QA/QC) measures would be implemented at all stages of the Project. Field technicians and biologists would perform daily QA/QC on field data. Data would be entered by experienced data entry technicians into an Access database, and data would be QA/QC'd by the Project statistician. Data summaries and draft report materials would be QA/QC'd by the Project Manager. Draft reports would be technically edited prior to submission by a Technical Editor. The Senior Manager would review all reports prior to submission. In addition, agency meetings would be attended by the WEST Project Manager and Senior Manager if requested. A QA/QC site visit would be conducted by the Project Manager and/or Field Supervisor to assure field methods are being properly implemented.

Please see Attachment A for resumes of key personnel.

Total Budget: $1,105,081

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