2015 California LCC Ecosystem Process Projects – Cover Page

Project Title:
Effects of changing hydroperiod on reproductive occupancy of threated Central California tiger salamander in vernal pool and seasonal wetlands in the CA Central Valley under different climate scenarios

Project Lead and Co-Lead Contact Information:
L. Arriana Brand, Ph.D., Associate Scientist, Conservation Science Partners; arriana@csp-inc.org; 510-229-2012.
Rick D. Scherer, Ph.D., Lead Scientist, Conservation Science Partners; rick@csp-inc.org; 970-484-2898.
Dave Theobald, Ph.D., Senior Scientist, Conservation Science Partners; davet@csp-inc.org; 970-484-2898.
Eric Hansen, M.S., Consulting Biologist and Species Expert on CTS; echansen@sbcglobal.net; 916-921-7848.
Kim Forrest, Wildl. Refuge Manager, FWS San Luis NWR Refuge Complex; kim_forrest@fws.gov; 209-826-3505.
Bob Parris, Deputy Refuge Manager, FWS San Luis NWR Refuge Complex; bob_parris@fws.gov; 209-826-3505.
Matt Gause, Land Manager, Westervelt Ecological Services; mgause@westervelt.com; 916-646-3644.

Project Duration:
30 months

Total Requested Funding:
$192,697

Partners: Our project will provide science-based support for numerous partners and stakeholders involved in the management and enhancement of vernal pool and seasonal wetlands, including recovery of special-status species such as the federally threatened California tiger salamander (*Ambystoma californiense*) in California's Central Valley. Our project represents a strong cross-sectoral partnership among NGO, governmental, and private sector organizations and associated staff involving existing and new collaborations. Primary science support will be provided by the nonprofit Conservation Science Partners, Inc. (A. Brand, 510-229-2012, R. Scherer, D. Theobald, B. Dickson). The FWS San Luis Management Complex (K. Forest, 209-826-3505, B. Parris) and FWS Merced National Wildlife Refuges will provide access to up to 200 breeding ponds for the study, and Westervelt Dutchman Creek Conservation Bank (M. Gause, 916-646-3644) will provide 5 years existing and 1 year additional data on California tiger salamander and pool attributes. The FWS Sacramento Field Office (Thomas Leeman, San Joaquin Valley Division Chief, 916-414-6544) will help guide us to ensure that we address management needs from the regional perspective. The results of our study will be used by numerous stakeholders to increase understanding of impacts of changing hydroperiod and other attributes of pools on CTS in vernal pool ecosystems, and prioritization of management options under a range of possible climate change projections. Other stakeholders include CA Department of Fish and Wildlife (William Cook; 209-826-0463) and the US Bureau of Reclamation (Liz Ayres Vasquez, 916-978-5460), among others that may be contacted during the course of the project to maximize the availability of our work.

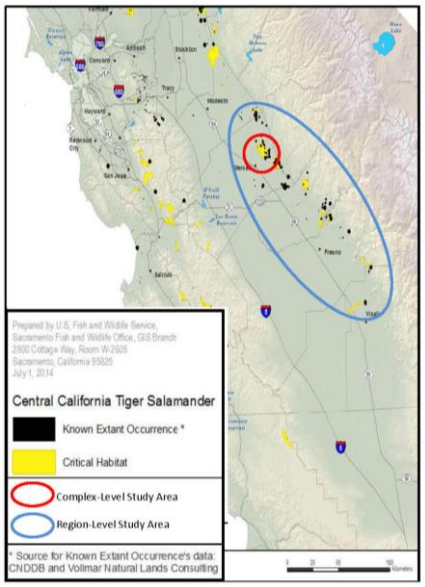

Fig 1. Study Area in CA Central Valley

Geographic Scope: Vernal pool and seasonal wetlands with associated upland habitats of the Central Valley Ecoregion. Due to the identified information gap we will focus on the San Joaquin Valley within CA Central Valley (Figure 1).

Partner Contributions/Leveraging: Our project will benefit from over $65,850 in-kind services and contributions, including CTS data collected from 2010-2014 and continuing in 2015 at Westervelt's Dutchman Creek Conservation Bank (Objective 1, 2, and 3). Eric Hansen will provide a portion of necessary gear including YSI water meter, turbidometer, GPS unit, seins, and other equipment (Objectives 2 and 3). Conservation Science Partners will contribute $10,500 in equipment, including computers, servers and devices for data storage, analyses, and outputs (Objectives 1, 2 and 3). We will also utilize free sources of remote-sensing and GIS data (Objectives 1, 2, and 3).

2015 California LCC Ecosystem Process Projects – Main Proposal

1. Project Summary/Management Relevance: California's Central Valley supports over 20 endemic, special-status species associated with vernal pools and seasonal wetlands, yet loss of 90% of the original extent of these habitats has resulted in highly-fragmented, remnant pools of varying habitat quality. Managers need science support to inform conservation priorities and possible enhancement of remaining pools, particularly since projected increases in temperature and decreases in precipitation may dry ponds to an extent that reduces or precludes their habitat value. Ongoing changes in climate will, in turn, cause changes in hydrologic regime, with a decreased hydroperiod expected to detrimentally affect reproductive occupancy of special status species such as the California tiger salamander. The relationship between changing climate and hydrologic regime of vernal pools has not been studied, but may be crucial for continued persistence of vernal pool species. We propose to examine the pool characteristics (pond duration and timing, water quality, turbidity) and upland characteristics (habitat type, soil type, dry matter) related with occupancy of pools by CTS larvae and metamorphs at a local scale comprised of both private (Conservation Bank) and public (FWS Refuge) lands. We will use occupancy models and model selection techniques to evaluate pool and upland characteristics that increase metamorphic occupancy in relation to hydroperiod (Maret et al. 2006, Johnson et al. 2013). We will use existing datasets to identify key needs, augmented with new data to expand the range in observed variation in predictor variables to develop robust predictive models. We then propose to develop and validate predictive models for current conditions and multiple climate scenarios that project salamander occupancy as a function of hydroperiod, itself related with evaporation and runoff as a function of catchment area, pool size, and upland land cover. Our predictive framework uses more intensive field-based and remote sensing inputs on refuge lands, and explores models that leverage remote sensing and weather data on private lands over a regional scale for which field-based data may not be available. We focus on the San Joaquin Valley portion of California's Central Valley since this area is lacking information, and for example, is almost entirely devoid of prior scientific studies on Central California Distinct Population Segment of the California tiger salamander (henceforth, California tiger salamander, CTS), yet is under substantial threat since the majority of remaining vernal pool habitats occur on private lands. By integrating existing field-based, remote-sensing, and GIS datasets, our project will identify important habitat and landscape features needed by managers to prioritize management and conservation actions for amphibians, including a special-status species, facing changes in climate in this critically endangered ecosystem.

2. Capacity: Our project builds upon existing datasets, expertise and capabilities of scientists from Conservation Science Parnters (NGO), a private sector environmental consulting, a private sector Conservation Bank (Westervelt Ecological Services), and federal land managers (San Luis Refuge Complex). Land management in these habitats is focused on recovery of federally threatened California tiger salamander and other special-status species of vernal pool ecosystems in California's Central Valley. The project team has >110 years' collective experience studying or managing wetlands for endangered vertebrate species, with expertise on ecology and conservation of the California Tiger Salamander, ecological modeling, and remote sensing. The lead investigator (Arriana Brand) has over 20 years' experience conducting wetland conservation research, developing predictive models for vertebrate species, and assessing effects of changing hydrologic regime. The project will be co-lead by Rick Scherer, who has a strong ecological modeling background including analysis of occupancy data and extensive experience modeling demography and spatial distribution for reptiles and amphibians, and Dave Theobald, an authority on modeling ecological process over large spatial extents. The project will also be co-lead by Eric Hansen who has participated in California research for over 39 years, and maintains all permits required through Section 10(a)(1)(A) of the federal Endangered Species Act, 16 U.S.C. 1531 et seq. and Fish and Game Code Section 1002 and Title 14 Sections 650 and 670.7 to complete this work. Mr. Hansen is also the lead for several San Joaquin Valley studies of the threatened giant garter snake (*Thamnophis gigas*) supported by Central Valley Project Improvement Act Habitat Restoration Program and Conservation Program grants. The management team includes Matt Gause, Senior Biologist and Land Manager at Westervelt Ecological Services, and Kim Forrest and Robert Parris, Wildlife Refuge Manager and Deputy Wildlife Refuge

Manager, respectively, at the FWS San Luis NWR Refuge Complex. These managers know the challenges associated with managing vernal pool and wetland systems, and have already and will continue play a central role in identifying the information needs to be addressed by this project. The project team has all federal and state endangered species permits, management experience, survey skills, ecological and hydrological knowledge of species and habitats, and expertise in landscape ecology and hydrology, climate change, GIS modeling, remote sensing, statistical modeling, and relevant software to implement this research.

3. Project Approach: California's Central Valley has been substantially altered by agricultural development, urban expansion, and alteration of hydrologic regimes. Nearly all native grassland and oak savanna have been eliminated from the Valley floor, and an estimated 90% of the historical extent of vernal pools in California have been lost (Dahl and Allord 1996, Holland 1998, USFWS 2014). Alteration of the hydrology of vernal pools has been a major cause of their destruction since European settlement, including plowing and draining for agriculture or urban uses, which has also continued recently (2005-2012; Witham et al. 2013). Given this dramatic loss, recovery of the species that depend upon these habitats, including 20 endemic, federally listed plants and invertebrates, such as fairy shrimp (*Branchinecta* spp.) and vernal pool tadpole shrimp (*Lepidurus packardi*), remains a central focus of the USFWS Vernal Pool Recovery Plan (USFWS 2005). Threats impacting CTS has also lead to a subsequent 5-year review upholding that status and continued effort towards developing a recovery plan for that species (USFWS 2014). California tiger salamander serves as a model species for which hydroperiod requirements also likely represent needs for listed vernal pool branchiopods and other imperiled amphibians such as western spadefoot (*Spea hammondii*; Burgess 1950, Anderson 1968, Feaver 1971, USFWS 1994). To benefit CTS and other vernal pool species, several important areas have been set aside, including the San Luis Refuge Complex, critical habitat, and a series of privately managed Conservation Banks. However, the ultimate success of these efforts depends upon maintaining adequate hydrologic regime within remnant pools for continued persistence and colonization to newly created pool sites. While CTS occurs in areas of adequate hydroperiod, areas with a reduction in hydroperiod cause larvae to die. Additionally, projected changes in climate, including projected increases in temperature and decreases in precipitation, are expected to alter the hydrologic regime (duration, timing of inundation) of seasonal pools with potentially detrimental effects (Cayan et al. 2008, Changing Climate 2012, USFWS 2014). To aid species' recovery, our approach focuses on identifying pool and upland characteristics for management and conservation actions, given future climate scenarios, that promote adequate hydrologic regime to maintain successful reproduction of a threatened vernal pool vertebrate.

A focus on hydroperiod required by CTS integrates key ecological functions between vernal pools and upland habitats (Figure 2). Water in the pools depends on adjacent upland features that contribute water to the pools, including upland habitat type and soils within runoff catchment areas needed to maintain adequate water quality, depth, duration, and timing of inundation. California tiger salamander larvae will dessicate if a site dries before larvae complete metamorphosis, such that pool persistence is the most important factor related with survival of metamorphs (Schaffer et al. 1993, Loredo 1996, Johnson et al. 2013). However, while climate change was not considered an imminent threat at the time of listing, it is now a topic of considerable management concern (Bob Parris, Kim Forrest, Matt Gause, Thomas Leeman, personal communications; USFWS 2014). Climate projections for the Central Valley indicate increased temperature and decreased precipitation, with California temperatures likely to increase 2.7 to 8.1 degrees Fahrenheit under lower to higher emissions scenarios (Cayan et al. 2008). Despite these predictions, there is substantial uncertainty regarding the long-term persistence of CTS and other vernal pool endemics.

Fig 2. CTS occupied pool and upland

To address these uncertainties, we will evaluate probabilities of CTS reproductive occupancy (of larval and metamorph stages) as a function of pool features, upland characteristics, and changing hydroperiod at three spatial scales extending from local to regional. Specifically, our core project objectives will: 1) identify pool characteristics that increase occupancy of CTS larvae and metamorphs as a function of hydrologic regime at the local scale, 2) develop and validate predictive models and maps for CTS larval and metamorphic occupancy in current conditions and climate scenarios at the refuge complex scale using field-based and remote sensing attributes, and 3) develop and validate predictive models and maps for CTS larval and metamorphic occupancy in current conditions and climate scenarios at a more extensive, regional scale using remote sensing attributes only. The combination of field-based and remote-sensing methods to develop predictive maps will allow us to evaluate this approach for aiding management decisions using the most efficient data collection methods. We will then apply these methods to identify high priority areas for recovery of CTS under scenarios of climate change that address changing hydrologic regime as a key input for recovery planning.

CA LCC Ecosystem Process Priorities addressed: Our collaborative project integrates efforts of land managers and researchers to address key management needs in vernal pool and ephemeral wetland habitats that support recovery of endemic, special status vernal pool species, including CTS, in the face of increased temperatures and decreased precipitation expected with climate change. This project meets all 2015 CA LCC Ecosystem Process Project Priorities and Strategy Goals. First, we will address effects of altered hydrologic regime (pond duration and timing) on special-status species within vernal pools, including projection of hydrologic regime within predictive models that project hydroperiod resulting from changes in evaporation and runoff characteristics related with a changing climate. Second, our project will promote cross-sectoral understanding of alteration of hydroperiod through climate scenarios that allows managers to explicitly consider management options within a range of projections of climate change to link actions to key climate impacts and vulnerabilities. Third, our project leverages several existing datasets to identify information gaps and priority issues, including existing CTS occupancy and pool attribute data, existing remote sensing coverages, and existing GIS coverages developed for the FWS. Fourth, our approach will inform management decisions, including options for pool enhancements that increase hydroperiod, such as building berms at local scales within Conservation Bank and Refuge Lands, as well as prioritization of particular areas of private or public lands at a regional scale that contain pools robust to the range in variability in future climate projections for recovery planning. Finally, this project serves as a foundation for continued efforts beyond this project, with synthesized datasets, methods and models that are transferable to other areas and species with refinement. This project will directly support natural resource decision-making and conservation delivery by providing tools and information that is urgently needed by managers.

4. Project Scope of Work: Climate-driven changes in precipitation and temperature that alter hydrologic regime severely threaten recovery of endangered pond-breeding amphibian species in vernal pool and wetland ecosystems. In spite of this threat, little information on actions for increasing the persistence of amphibian populations is available to managers, particularly in the San Joaquin Valley. We propose to meet this critical need by focusing our project on the key information requirements of managers to identify, prioritize or enhance areas for conservation. First, we will identify attributes of vernal pools and upland areas adjacent to the pools that are associated with successful metamorphosis by CTS, the life history stage that indicates successful breeding. We will fulfill this objective using previously collected data from the Dutchman Creek Conservation Bank. Second, we will develop and validate predictive models and maps for current conditions and for scenarios that encompass different climate projections.

Fig 3. Adult California tiger salamander

We will address these needs by managers at three spatial scales: local scale (Objective 1), refuge complex scale (Objective 2), and regional scale (Objective 3). The local and refuge complex scales include Conservation Bank

and Public Lands primarily managed for protection of vernal pool ecosystems that contain CTS, and the regional lands include FWS designated CTS Critical Areas that are primarily on private lands and used for commercial purposes. Our approach includes model validation, and addresses the trade-off between increased model specificity at smaller special scales, and increased extent across larger spatial scales.

Objective 1. Identify pool characteristics that increase occupancy of CTS larvae and metamorphs as a function of hydrologic regime and upland characteristics at the local scale. We will begin our project using existing datasets at the Westervelt Dutchman Creek Conservation Bank. These datasets have been collected for management monitoring of CTS. We will use retrospective analyses to evaluate characteristics of vernal pools and hydrologically modified water features that that increase species' persistence in support of management and recovery planning, and to identify further information needs.

(1a). Integrate existing datasets collected on Conservation Bank Lands to support standardized monitoring efforts. We will integrate historic monitoring datasets for CTS and associated vernal pool species using existing datasets, including a 5-year presence-absence dataset, and a 2-year abundance dataset, as well as data pertaining to pool and upland characteristics collected at the Westervelt Dutchman Creek Conservation Bank. These datasets have been collected for management monitoring of CTS, and include important predictor variables pertaining to hydrologic regime (e.g., volume and hydroperiod), water quality, and upland characteristics from as many as 30 vernal pools and other emphemeral wetland features. We will use retrospective analyses to evaluate pool and upland characteristics that increase species' occupancy in support of management and recovery planning. These data have been collected following standard methods for compliance monitoring and represent a high level of data quality. Additionally, we will merge vegetation data collected at field locations, weather data, and landscape data that builds upon Landsat and other remotely-sensed imagery. We will undergo a data management effort to integrate species' datasets and standardize protocols and data structure to enhance long-term collaboration.

(1b). Evaluate pool and upland characteristics that enhance species' persistence in the face of drought and climate change. Based on the synthesized dataset, we will use occupancy models with AIC model selection to evaluate pond and upland characteristics associated with occupancy by CTS metamorphs while accounting for imperfect and heterogeneous detection probabilities (MacKenzie et al. 2006). Our study design will utilize ponds that range in recruitment of larvae and successful metamorphosis which spanned a period of extreme drought. These sites span vernal pools and hydrologically altered water features, for which we will assess occupancy and/or persistence over time. This type of retrospective analysis, using existing data augmented with additional key variables from remote sensing, provides a cost-effective means to inform management actions that improve the species' persistence in the face of climate change. It also enables us to identify additional data collection needs for work at the refuge complex scale.

Fig 4. Hydroperiod affects ability of CTS to metamorphose

Objective 2. Develop and validate predictive models and maps for CTS larval and metamorphic occupancy in current conditions and scenarios at the refuge complex scale. This portion of our project focuses on wetland features within the refuge complex scale, encompassing the Dutchman Creek Conservation Bank combined with the adjacent San Luis National Wildlife Refuge Complex. This Refuge Complex is one of the few publicly owned protected areas in the San Joaquin Valley focusing on vernal pools ecosystems and is critically important for the California tiger salamander. At this scale, our project will apply predictive models and maps to current conditions and climate change scenarios, with data collection efforts to develop and validate these models.

(2a). Collect data at complex scale standardized to local scale and augmented with additional variables as needed. From the standardized set of variables analyzed at the local scale, we will augment the dataset by collecting additional data at the complex scale. The goals of this data collection effort are to 1) standardize data collection protocols, 2) validate predictive models at the complex scale, and 3) develop model inputs across a larger and wider range of conditions that can then be applied at the refuge and regional scales.

Of over 200 available pools, those chosen for larval sampling will follow a stratified, random selection of sites representing varying landscape characteristics. Each pool will be sampled using 8 x 4 feet or 12 x 4 feet seines and/or dipnets with 1/4 inch mesh. Each seine will be fitted with floats at the top and weights at the bottom which assists in keeping the net open (net bottom contacting the sediments and the net top at the water surface). Pools will be sufficiently seined to detect larval presence while minimizing disturbance to the pool and the risk of injuring larvae while sampling. The length and maximum depth of each seine pull will be recorded to determine the volume of water seined, and the percentage of the pool sampled. The maximum depth and water temperature of each pool will also recorded, water metrics including pH, specific conductivity (EC), and water temperature will be measured at each pool site using a portable YSI 556 Multi-Probe unit, and turbidity will be measured with a Lamotte 2020e turbidometer. Data recorded for each sampling location will include UTM coordinates and environmental characteristics, including vegetation and substrate types, slope, aspect, residual dry matter, and fossorial mammal activity/burrow density.

Any CTS larvae captured will be quickly placed into holding buckets filled with water from the sampled pool. Other amphibian larvae (e.g., *Pseudacris regilla*) and invertebrates (e.g., tadpole shrimp) species if present will be noted and quickly returned to the pool from which they came. Presence of other vernal pool species such as other amphibians or large branchiopods (fairy shrimp, tadpole shrimp, and clam shrimp) will also be noted, and could be added in future, transferable modeling efforts. The total length (TL, measured from the tip of the snout to the end of the tail) and snout to vent length (SVL) of each captured larvae will be measured (in mm). Developmental stage will be noted to track the rate of metamorphosis. We will sample each pool a minimum of 4 times per field season.

(2b). Evaluate pool and upland characteristics that enhance species' persistence in the face of drought and climate change. In order to expand the spatial scale and to improve robust analyses and predictive models, we will utilize the augmented, synthesized dataset comprised of the larger range of variation contained within the refuge scale dataset. We will use causal analysis (Figure 5; Textor et al. 2011)) as well as occupancy models with AIC model selection techniques to evaluate pond and upland characteristics associated with occupancy by CTS metamorphs (MacKenzie et al. 2006). These sites span a wider range in vernal pools and seasonal water features, with associated variables pertaining to upland disturbance, water quality, pool physical attributes, pool biological attributes, and potential for predation for which we will use causal analysis to aid study design (Figure 5). This occupancy analysis across the refuge scale will enable us to identify covariates that are strong predictors of metamorphic occupancy to use in predictive models.

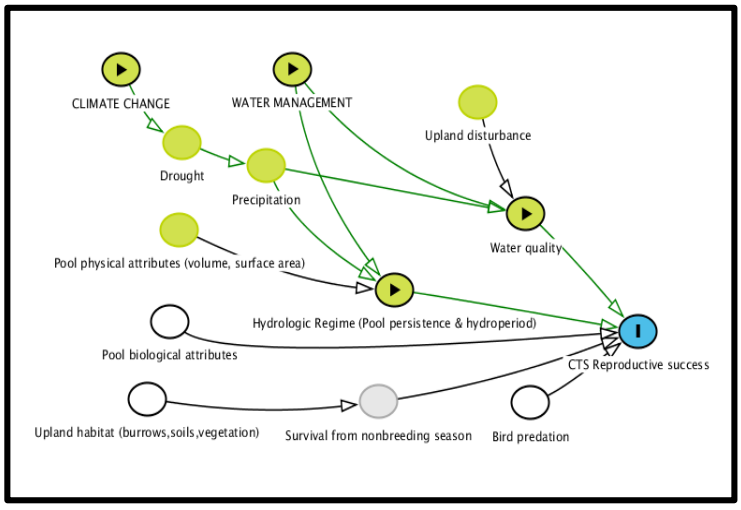

Fig 5. Causal diagram with hypothesized variables that influence CTS

(2c). Develop scenarios of climate change with associated data inputs from field data and remotely-sensed imagery. As a foundation for our broader effort, we will begin with development of scenarios across private and

public lands at the complex scale in the San Joaquin Valley. The process of developing scenarios ensures direct communication between scientists and managers to ensure that results support management needs. Existing projections in precipitation and temperature, and modeled relationships with hydroperiod, will serve as the primary content of our scenarios, for which we will consider at least for along a range of options projected to 2050 (e.g., Our Changing Climate 2012). However, we will explore the possibility of including management options as well. For example, initial conversations with managers have suggested that pools can be enhanced by building berms surrounding pools as a low-impact, cost effective way to hydrologically enhance pools identified to be at risk of insufficient hydroperiod. This management option could be prioritized for specific ponds within range of climate scenarios that address projected changes in temperature and precipitation.

Development and implementation of scenarios will involve two additional key steps: 1) developing data inputs from field and remotely-sensed data, and 2) developing links between data inputs and climate scenarios within projected ranges of temperature and precipitation for the region (e.g., Cayan et al. 2008). First, we will utilize fitted occupancy models from Objective 2B to identify variables and data inputs required to predict occupancy under current conditions, for example in new areas, for which we expect pond duration to be a key variable for prediction. Second, we will develop relationships to predict hydroperiod or other hydrologic variables as a function of climate projections, to enable linking these projections with predictive models. To accomplish this, we will use vernal pool coverages that have been developed from across the Central Valley (Witham et al. 2014), combined with remote sensing data comprised of bi-weekly or monthly Landsat imagery characterized by NDVI and/or NDWI to characterize pond hydroperiod. We will then apply a causal modeling approach to develop a statistical relationship to predict hydroperiod as a function of weather factors (temperature, precipitation), pool attributes (e.g. surface area and pool volume, associated with evaporation), and upland attributes (catchment area, soil type, dry matter, vegetation type, etc., associated with runoff). We will then apply this statistical sub-model within predictive models to predict CTS metamorphic occupancy as a function of hydroperiod within climate scenarios.

(2d). Develop and validate predictive models and maps at the complex scale. Using the coefficients from fitted models, with relevant inputs from field-based data and climate projections of the hydroperiod, we will project expected larval and metamorphic occupancy as a function of hydrologic regime (e.g. hydroperiod), water quality, and upland features for current and scenario conditions. In order to validate the models, we will use the newly collected set of data in combination with predictions to assess the percent correct classification and will conduct logistic regression analysis to identify model features that improve the percent of correct classification. We will utilize this validation approach both as quality control for predictions at the complex scale, as well as to refine models for a more limited set of predictor variables collected via remote sensing at greater extent across the regional scale.

<u>Objective 3</u>. Develop and validate predictive models and maps for CTS larval and metamorphic occupancy in current conditions and scenarios at the regional scale. This portion of our project focuses on wetland features at a larger spatial scale, spanning the region of the northern and central San Joaquin Valley within California's Central Valley. The majority of known and potential breeding ponds and surrounding uplands for CTS occur on private lands used for grazing and agriculture (USFWS 2014). Using models developed within Conservation Bank and Public Lands focused on protection of vernal pool ecosystems for CTS, we will utilize the model development and specification to refine and prioritize predictive models to apply regionally. Because it will only be possible to access a subset of locations on private lands, our modeling approach will explore the ability to predict to new sites using remote sensing data rather than data collected in field locations. This dependence upon data derived from remote-sensing decreases our model specification, but enhances the extent

Fig 6. Example of pool seining techniques

available to predict CTS occupancy of metamorphs for current conditions and scenarios. This approach will help to guide conservation priorities for the Fish and Wildlife Service that cover the majority of Critical Areas designated for the CTS on private lands within the San Joaquin Valley.

(3a). Develop scenarios of climate change and management options at the regional scale. At this larger scale, we will base scenarios upon regional projections of temperature and precipitation and their effects upon hydroperiod, as well as upland characteristics from remotely sensed data. Our goal is to provide the FWS Refuge and Ecological Services Programs information regarding prioritization of water features expected to maintain adequate hydrologic regime given different scenarios of climate change to aid in prioritization of vernal pool habitats for protection. This type of sensitivity analysis will help prioritize management efforts, particularly in the development of a recovery plan for the Central California tiger salamander and vernal pool systems generally.

(3b). Collect data at Regional Scale. From the standardized set of variables analyzed at the complex scale, we will collect an additional data across the region where we can gain access to wetland features. The primary goal of this data collection effort is to validate predictive models at the regional scale using standardized sets of variables collected at smaller spatial scales. While the precise areas of sampling are yet to be determined, we are looking into the possibility of including sites near UC Merced, the Stone Corral Ecological Reserve in Tulare County, among other sites.

(3c). Develop and validate predictive models and maps at the regional scale. Using models developed at the complex scale that spans the range in wetland conditions of vernal pools and other seasonal wetland features on public lands and conservation banks, combined with statistical relationships among hydroperiod and remotely-sensed data, we will project expected larval and metamorphic occupancy as a function of hydrologic regime (e.g. hydroperiod), water quality (turbidity), and upland features for current and scenario conditions across the region. Our goal here is to increase the extent of these predictive models across private lands, so that we will focus on a subset of variables that can be obtained with remotely-sensed data, rather than site-specific variables. As discussed above, repeated Landsat imagery that characterizes NDVI or NDWI bi-weekly or monthly will be used to estimate pond-specific hydroperiods. Additionally, approaches will be used to estimate water turbidity, and upland characteristics that likely enhance runoff within a catchment area. To validate the models we will again will use logistic regression analysis to identify model features that improve the percent of correct classification for the more limited set of predictor variables collected via remote sensing at the regional scale. Our goal is to explore the ability to project CTS population status using remotely-sensed data across the range of public and private lands that are critically important for CTS and associated seasonal wetland ecosystems in California's Central Valley.

5. Deliverables/Timeline/Data Sharing: Our project will generate deliverables for each objective. Deliverables for Objective 1 at the local scale include (1A) integrated historic datasets for CTS in conservation bank monitoring sites, and (1B) model of pool characteristics that enhance species' persistence and occupancy. Products for Objective 2 at the complex scale include (2A) augmented, standardized datasets across the complex scale with additional covariates as needed, (2B) identified pool characteristics that enhance species' persistence and occupancy across a wider range of variation, (2C) scenarios of climate change with associated data inputs, and (2D) validated, predictive models and maps of CTS occupancy for the most important public lands protecting vernal pools and CTS within the San Joaquin Valley for at least four climate-change scenarios of projected temperature and precipitation. Finally, products for Objective 3 at the regional scale include (3A) scenarios of climate change with a more limited set of remotely-sensed data input available for private lands, (3B) new datasets of CTS validation surveys, and (3C) validated, predictive models and maps to provide priorities for conservation actions across the region. ArcGIS maps, statistical models, products, summary reports and SOPs will be made available in partnership with FWS, Westervelt, and LCC, as well as other stakeholders as

appropriate. Quarterly updates will be provided by email for project partners including FWS, land managers, and the California LCC.

Project 30-month timeline

	FY15	**FY16**			**FY17**					**FY18**
	F	W	SP	SU	F	W	SP	SU	F	W
Objective 1: Products 1A, 1B at Local Scale										
Synthesize existing data	X									
Analysis Local scale CTS occupancy	X	X								
Objective 2: Products 2A, 2B, 2C,2D at Refuge Complex Scale										
Collect data: CTS, pool & upland attributes		X	X	X						
Analysis Refuge CTS occupancy			X	X	X					
Develop Refuge scenarios, inputs & links				X	X	X				
Develop & validate predictive models & maps					X	X				
Objective 3: Products 3A, 3B, 3C at Regional Scale										
Develop Regional scenarios, inputs & links					X	X				
Collect data: Regional scale CTS surveys						X	X	X		
Develop & validate predictive models & maps							X	X	X	
Reporting										
Updates to Managers and CA LCC		X				X				X
Final								X	X	X

6. Measuring results: Success will be measured by providing land managers with 1) integrated datasets for CTS occurring in conservation bank and public land monitoring sites; 2) robust statistical estimates of pool and upland characteristics that enhance species' persistence and occupancy at local and refuge scales; 3) scenarios of future climate change and suitable management options or recommendations; 4) validated, predictive models and maps of CTS occupancy for the most important public lands protecting vernal pools and CTS within the San Luis Refuge Complex under current conditions and future climate scenarios; and 5) validated, predictive models and maps of CTS occupancy for public and private lands that include critical areas for CTS regionally across the San Joaquin Valley.

7. Transferability: The methods and products generated from our project will be highly transferable to other species and areas within the CA LCC, and transferable to other LCCs. First, our approach is readily transferable with relatively minimal refinements to other areas for the California tiger salamander, which includes additional regions within the Distinct Population Segment (DPS) of the Central California CTS such as the Sacramento Valley, and two other DPSs in Santa Rosa and Santa Barbara for which the DPS are federally listed as endangered. Additionally, our approach can be to additional species, including several species that we may sample concurrently in these habitats. Finally, the approach and methods as a whole is readily transferable to other LCCs, as our projects uses methods that are highly versatile for other species and locations, including the use of remotely sensed data that greatly enhances the transferability of our work.

References:

Anderson, P.R. 1968. The reproductive and developmental history of the California tiger salamander. Master's Thesis, Department of Biology, Fresno State College, Fresno, CA.

Burgess, R.C., Jr. 1950. Development of spade-foot toad larvae under laboratory conditions. Copeia 1950:49-51.

Cayan, D. R., E. P. Maurer, M. D. Dettinger, M. Syree, and K. Hayhoe. 2008. Climate change scenarios for the California region. Climate Change 87 (Supplement 1): S21-S42.

Dahl, T.E. and G.J. Allord. 1996. History of wetlands in the conterminous United States. In. J. D. Fretwell, J.S. Williams, and P. J. Redman (compilers) National Water Summary on Wetland Resources. U.S. Geological Survey Water- Supply Paper 2425. pp. 19-26.

Feaver, P.E. 1971. Breeding pool selection and larval mortality of three California amphibians: Ambystoma tigrinum californiense Gray, Hyla regilla Baird and Girard and Scaphiopus hammondi hammondi Girard. Master's Thesis, Department of Biology, Fresno State College, Fresno, California. 58 pp.

Ferguson, J. 1951. The Rate of Natural Evaporation from Shallow Ponds. Australian Journal of Scientific Research, Series A: Physical Sciences, vol. 5, p.315.

Holland, R.F. 1998. Great Valley vernal pool distribution, photorevised 1996. Pages 71-75 *in* C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren, Jr. and R. Ornduff (Editors). Ecology, Conservation and Management of Vernal Pool Ecosystems – Proceedings from a 1996 Conference. California Native Plant Society, Sacramento, CA.

Johnson, J. R., M. E. Ryan, S. J. Micheletti, and H. B. Shaffer. 2013. Short pond hydroperiod decreases fitness of nonnative hybrid salamanders in California. Animal Conservation 16: 556-565.

Loredo, I., and D. Van Vuren. 1996. Reproductive ecology of a population of the California tiger salamander. Copeia 4: 895-901.

Loredo, I., D. Van Vuren, and M. L. Morrison. 1996. Habitat use and migration behavior of the California tiger salamander. Journal of Herpetology 30:282-285.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. L. Bailey, and J. E. Hines. Occupancy estimation and modeling: Inferring patters and dynamics of species occurrence. Academic Press, MA, USA.

Maret, T. J., J. D. Snyder, and J. P. Collins. 2006. Altered drying regime controls distribution of endangered salamanders and introduced predators. Biological Conservation 127: 129-138.

Our Changing Climate 2012. Vulnerability and adaptation to the increasing risks from climate change in California. A summary report on the third assessment from the California climate change center. 15pp.

Ryan, M. E., J. R. Johnson, B. M. Fitzpatrick, L. J. Lowenstine, A. M. Picco, and H. B. Shaffer. 2012. Lethal effects of water quality on threatened California salamanders but not on co-occurring hybrid salamanders. Conservation Biology 27: 95-102.

Shaffer, H.B., R.N. Fisher, and S.E. Stanley. 1993. Status report: the California tiger salamander (*Ambystoma californiense*). Final report for the California Department of Fish and Game. 36 pp.

Textor, J., and J. Hardt, and S. Knuppel. 2011. Dagitty: A graphical tool for analyzing causal diagrams. Epidemiology, 22: 745.

Trenham, P. C., and H. B. Shaffer. 2005. Amphibian upland habitat use and its consequences for population viability. Ecological Applications 15: 1158-1168.

Witham, C.W., R.F. Holland and J.E. Vollmar. 2014. Changes in the Distribution of Great Valley Vernal Pool Habitats from 2005 to 2012. Sacramento, CA. Report prepared for the U.S. Fish and Wildlife Service and Bureau of Reclamation CVPIA Habitat Restoration Program under Grant Agreement No. F11AP00169 with the USFWS.

U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and threatened wildlife and plants; determination of endangered status for the Conservancy fairy shrimp, longhorn fairy shrimp, and the vernal pool tadpole shrimp; and threatened status for the vernal pool fairy shrimp. Federal Register 59(180):48136-48153.

U.S. Fish and Wildlife Service. 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Portland, Oregon. 606 pages.

U.S. Fish and Wildlife Service. 2014. California Tiger Salamander, Central California Distinct Population Segment (Ambystoma californiense), 5-year Review. Fish and Wildlife Service, Sacramento Fish and Wildlife Office. October 21, 2014. Available: http://ecos.fws.gov/docs/five_year_review/doc4466.pdf. 63pp.

L. ARRIANA BRAND, PH.D., Associate Scientist, Conservation Science Partners, Inc., 11050 Pioneer Trail, Suite 202, Truckee, CA 96161, USA, Tel: 1-510-229-2012, Email: arriana@csp-inc.org.

(A) PROFESSIONAL PREPARATION

Colorado State University, Fort Collins, CO, USA	Ecology	Ph.D.	1998-2004
Humboldt State University, Arcata, CA, USA	Wildlife Biology	M.Sc.	1995-1998
University of California, Santa Barbara, CA, USA	Environmental Studies	B.Sc.	1987-1993

(B) APPOINTMENTS:

2014-present	Associate Scientist, Conservation Science Partners, Inc., Berkeley and Truckee, CA
2009-2014	Wildlife Biologist, USGS Western Ecological Research Center, Vallejo and Davis, CA
2004-2009	Research Wildlife Biologist, Sustainability of Semiarid Hydrology and Riparian Areas Research Center, University of Arizona, Tucson, AZ

(C) RELEVANT EXPERIENCE: I have over 20 years' experience using a wide variety of mathematical, GIS, and statistical tools to study vertebrates in relation to specific resource management and conservation questions. My research has focused on the effects of changing hydrologic regime, habitat loss and fragmentation on density, productivity, species richness, predation risk, and population status of vertebrates in wetland and upland environments. Predictive models provide a means to place estimates of wildlife responses to hydrologic, restoration, or climate changes directly into a framework that is meaningful for policy decisions. I have worked with interdisciplinary teams to project the effects of hydrologic changes on vegetation and birds in multiple systems, and to project changes for scenarios based on different policy options implemented within a Decision Support System. Providing science support to management has been a major part of my work at numerous study areas including the San Pedro River, AZ, Rio Grande, NM, San Francisco Bay, CA, Ivanpah Valley, CA, and Central and San Joaquin Valley, CA. Since 2014 I have worked with Conservation Science Partners to continue my research on developing sound scientific outputs to inform management for several endangered species including Desert Tortoise, Giant Garter Snake, and California Tiger Salamander (CTS). Our project will continue this work to aid local management and recovery planning by integrating data on endemic, threatened CTS within the remaining public and private lands available for species recovery to evaluate characteristics of vernal pool and seasonal wetlands that improve persistence and occupancy in relation to changing hydrologic regime that are expected to put these species at greater risk due to climate change effects.

(D) PUBLICATIONS: (Out of 30 peer-reviewed publications and technical reports)

Brand, L. A., J. Y. Takekawa, J. Shinn, T. Graham, et al. 2014. Effects of wetland management on carrying capacity of diving ducks and shorebirds in a coastal estuary. Waterbirds 37: 52-67.

Brand, L. A., M. Dixon, T. Fetz, S. Stewart, J. Stromberg, et al. 2012. Projecting avian responses to restoration scenarios on a large dryland river (middle Rio Grande, New Mexico, U.S.A.). The Southwestern Naturalist 5: 150-162.

Brand, L. A., L. M. Smith, J. Y. Takekawa, N. D. Athearn, et al. 2012. Trajectory of early tidal marsh restoration: elevation, sedimentation and colonization of breached salt ponds in the northern San Francisco Bay. Ecological Engineering 42:19-29.

Brand, L. A. and B.R. Noon. 2011. Source-sink status of shrub-nesting birds in a desert riparian corridor. Wilson Journal of Ornithology123:48-58.

Brand, L.A., J. Stromberg, M. Dixon, D. Goodrich, et al. 2011. Projecting avian response to linked changes in groundwater and riparian floodplain vegetation along a dryland river: a scenario analysis. Ecohydrology 4:130-142.

Brand, L.A., J. C. Stromberg, and B. R. Noon. 2010. Avian density and nest survival on the San Pedro River: Importance of vegetation type and hydrologic regime. Journal of Wildlife Management 74: 739-754.

Brand, L.A., G.C. White, and B.R. Noon. 2008. Factors influencing species richness and community composition of breeding birds in a desert riparian corridor. The Condor 110:1-12.

Brand, L.A., B.R. Noon, and T.D. Sisk. 2006. Predicting abundance of desert riparian birds: validation and calibration of the effective area model. Ecological Applications 16:1090–1102.

Dr. Rick D. Scherer

Curriculum Vitae

Address

Conservation Science Partners
5 Old Town Square
Suite 205
Ft. Collins, CO 80524
Ph.: 970 484 2898
E-mail: rick@csp-inc.org

Academic Record

Ph.D., Fish, Wildlife and Conservation Biology, 2010
Colorado State University, Ft. Collins, CO

M.S., Ecology, 2004
Colorado State University, Ft. Collins, CO

B.S., Marketing, 1988
Indiana University, Kelley School of Business, Bloomington, Indiana

Selected Peer-reviewed Publications

Pilliod, D.S., and R.D. Scherer. *In press*. Managing habitat to slow or reverse population declines of the Columbia spotted frog in the northern Great Basin. Journal of Wildlife Management.

Scherer, R.D., A.C. Doll, L.D. Rea, A.M. Christ, C.A. Stricker, B. Vitteveen, T.C. Kline, C.M. Kurle, and M.B. Wunder. *In press*. Stable isotope values in pup vibrissae reveal geographic variation in diets of gestating Steller sea lions (*Eumetopias jubatus*). Marine Ecology Progress Series.

Scherer, R.D., E. Muths, and B.R. Noon. 2012. The importance of local and landscape-scale processes to the occupancy of wetlands by pond-breeding amphibians. Population Ecology 54:487-498.

Muths, E., R.D. Scherer, and D.S. Pilliod. 2011. Compensatory effects of recruitment and survival when amphibian populations are perturbed by disease. Journal of Applied Ecology 48:873-879.

Scherer, R.D, and J.A. Tracey. 2011. A power analysis for the use of counts of egg masses to monitor wood frog (*Lithobates sylvaticus*) populations. Herpetological Conservation and Biology 6:81-90.

Pilliod, D.S., E. Muths, R.D. Scherer, P. Bartelt, P.S. Corn, B.R. Hossack, B.A. Lambert, R. McCaffery, and C. Gaughan. 2010. Effects of amphibian chytrid fungus on individual survival probability in wild boreal toads. Conservation Biology 24:1259-1267.

Scherer, R.D., E. Muths, and B.A. Lambert. 2008. The effects of weather on survival in populations of boreal toads in Colorado. Journal of Herpetology 42:508-517.

Muths, E., R.D. Scherer, P.S. Corn, and B.A. Lambert. 2006. Estimation of temporary emigration in male toads. Ecology 87:1048-1056.

Reports

Scherer, R.D., J.Shepherd, R. Ditgen, B.R. Noon, and I. Leinwand. 2010. Occupancy of beaver (*Castor canadensis*) in Rocky Mountain National Park. Report to Rocky Mountain National Park.

Theobald, D. M., J. S. Baron, P. Newman, B. Noon, J. B. Norman, III, I. Leinwand, S. E. Linn, R. Scherer, K. E. Williams, and M. Hartman. 2010. A natural resource condition assessment for Rocky Mountain National Park. Natural Resource Report NPS/NRPC/WRD/NRR—2010/228. National Park Service, Fort Collins, Colorado.

David M. Theobald
Conservation Science Partners, Inc.; 5 Old Town Square, Suite 205, Fort Collins, CO 80524

(A) Professional Preparation

Ph.D., University of Colorado, Boulder, Department of Geography, 1995
M.A., University of California, Santa Barbara, Department of Geography, 1990
B.A., University of Colorado, Boulder, Department of Geography, 1986

(B) Appointments

2013 – Senior Scientist, Conservation Science Partners, Inc. [501(c)(3)]
2012 - *Affiliate Professor,* Department of Fish, Wildlife, and Conservation Biology, Warner College of Natural Resources, Colorado State University.
2010 - 2012 *Research Scientist,* Department of Fish, Wildlife, and Conservation Biology, Warner College of Natural Resources, Colorado State University.
2005 - 2010 *Associate Professor*, Department of Human Dimensions of Natural Resources, Warner College of Natural Resources, Colorado State University.
2001 - 2005 *Assistant Professor*, Department of Human Dimensions of Natural Resources, Warner College of Natural Resources, Colorado State University.
1995 - 2001 *Smith Conservation Fellow*, Natural Resource Ecology Lab, Warner College of Natural Resources, Colorado State University.

(C) Relevant Experience

Dr. Theobald is a Senior Scientist at Conservation Science Partners, and an adjunct professor in the Department of Fish, Wildlife, and Conservation Biology at Colorado State University. Dave has over 20 years experience in applying concepts from geography and landscape ecology and methods from spatial analysis to understand patterns of landscape change and their effects on wildlife habitat and biodiversity. He has engaged in a variety of collaborations, including developing resource monitoring designs, analyzing trade-offs in the effects of proposed planning policies on the sustainability for a variety of western counties, directing an inventory of open space and protected lands, developing detailed, nationwide forecasts of development patterns that are consistent with climate change scenarios, and identifying movement through natural landscapes at regional to continental scales.

(D) Relevant Publications

Theobald, DM. 2014. Development and applications of a comprehensive land use classification and map for the US. *PLOS ONE*.

Theobald, DM. 2013. A general model to quantify ecological integrity for landscape assessments and US application. *Landscape Ecology* DOI 10.1007/s10980-013-9941-6.

Theobald, DM, SE Reed, K Fields, and M Soule. 2012. Connecting natural landscapes using a landscape permeability model to prioritize conservation activities in the US. *Conservation Letters* 5(2): 123-133.

Baldwin, RF, SE Reed, BH McRae, **DM Theobald**, RW Sutherland. 2012. Connectivity restoration in large landscapes: Modeling landscape condition and ecological flows. *Ecological Restoration* 30(4): 274-279.

McRae, BH, SA Hall, P Beier, and **DM Theobald**. 2012. Where to restore ecological connectivity? Detecting barriers and quantifying restoration benefits. *PLoS ONE* 7(12): e52604.

Theobald, DM, KR Crooks, and JB Norman, III. 2011. Assessing effects of land use on landscape connectivity: loss and fragmentation of western US forests. *Ecological Applications* 21(7): 2445-2458.

Bierwagen, BG, **DM Theobald**, CR Pyke, A Choate, P Groth, JV Thomas, and P Morefield. 2010. National housing and impervious surface scenarios for integrated climate impact assessments. *Proceedings of the National Academy of Sciences* 107(49):20887-20892.

MATTHEW J.J. GAUSE, , Senior Ecologist and Land Manager, Westervelt Ecological Services, LLC., 600 North Market Boulevard, Suite 3, Sacramento, CA 95834 USA, Tel: 1-916-646-3644, Email: mgause@westervelt.com.

(A) PROFESSIONAL PREPARATION

University of California, Davis, CA, USA Botany B.Sc. 1989-1992

(B) APPOINTMENTS:

2007-present Senior Ecologist/Land Manager, Westervelt Ecological Services, Sacramento, CA
2003-2007 Vice President-Ecological Resources, Wildlands Inc., Rocklin, CA
1998-2003 Principal Biologist, May & Associates, Inc., Walnut Grove, CA

© RELEVANT EXPERIENCE: Mr. Gause is a senior ecologist and oversees Westervelt's land management and biological monitoring operations on over 7,000 acres of mitigation lands encompassing more than 16 conservation projects. Mr. Gause is responsible for the day to day management of Westervelt's properties encompasing vegetation management, livestock grazing, water management, , performance standard monitoring and long- term stewardship endowment budgeting. In addition, Mr. Gause provides review during the land acquisition due-diligence process, including threatened and endangered species identification, easement restriction analysis, and future land management cost estimation.

Mr. Gause has a broad range of experience with the restoration and on-ground management of wetland ecosystems, endangered species habitats and native grasslands. Through his work in the Central Valley and San Joaquin Valley over the last two decades Mr. Gause has acquired extensive experience in developing and implementing habitat monitoring and management plans providing the capacity to develop plans that have functionality and cost-effectiveness. Mr. Gause has developed and implemented management plans for a wide variety of terrestrial and aquatic ecosystems that support federally listed species such as the vernal pool fairy and tadpole shrimps, and California tiger salamander.

Eric C. Hansen, Consulting Environmental Biologist

4200 N Freeway Blvd, Suite 4 • Sacramento, CA 95835 • (916) 921-8281

Years of Experience

This Firm/Other Firms or Agencies:
16/2

Education

2008 MS, Biological Sciences, California State University, Chico, CA

2001 BS, Evolution and Ecology, University of California, Davis, CA

Professional Affiliations

American Society of Ichthyologists and Herpetologists

Society for the Study of Amphibians and Reptiles

The Wildlife Society

Herpetologists League

General Experience & Qualifications

Eric is an environmental consultant with 16 years of experience including research, NEPA/CEQA studies, environmental compliance and monitoring, and conceptual designs. He is also an experienced contract manager and interfaces with contracting officers, clients, and subcontractors. He has managed contracts and grants valued from $2K to $500K integrating multiple subcontractors and disciplines to execute projects efficiently.

Representative Project Experience

Volta Wasteway Level 2 Diversification/Incremental Level 4 Development Pilot Project, Merced County, CA. On behalf of USBR and in conjunction with the San Luis and Delta Mendota Water Authority and Grasslands Water District, Eric assembled an interdisciplinary team of institutional veterinarians, toxicologists, and biostatisticians to monitor the effects of potential water quality degradation on the Volta Wildlife Area giant garter snake population. Eric is responsible for contract and project management and for executing the monitoring program developed in conformance of the project's Biological Opinion, and oversees all other components of environmental compliance relating to giant garter snake for the project. (2010-ongoing)

Hansen, E.C, R. Wack, R. Poppenga, K. Strohm, C. Johnson, D. Bunn, and R. Scherer. 2011. Comparative pathology, health, and contaminant exposure within San Joaquin Valley and Sacramento Valley giant garter snake (*Thamnophis gigas*) populations. Report prepared for the Bureau of Reclamation (BOR) pursuant to BOR Agreement No. 08FG200042. March 31, 2011. – This study evaluated health, pathology (hematology, plasma biochemistry, parisitology, and bacterial flora) and contaminant exposure (selenium, total mercury, methyl mercury, boron, PCBs, and organophosphate (OP) and organochlorine (OC) pesticides directly in snakes, through diet, and in the environment) in giant garter snakes and a non-threatened congener within both declining and stable populations, providing the baseline data needed for more focused research directing species recovery. (2008-2013)

Hansen, E.C., H. McQuillen, S. Sweet, S. Gala, and J. Marty. 2010. Response of the Giant Garter Snake (*Thamnophis gigas*) to Water Primrose (*Ludwigia hexapetala*) Removal at the Cosumnes River Preserve. Report prepared for the Central Valley Habitat Improvement Act Conservation Program. December 29, 2010. – Producing positive results, this study tested whether restoration of open-water foraging habitat would result in the return of giant garter snakes to previously occupied areas of Snake Marsh. Combined with detailed hydrologic and vegetation reports, this study provided valuable recommendations for long-term management at the Preserve. (2009-2010)

Professional Training

California Tiger Salamander Workshop--Special Emphasis on Sampling/Surveying Upland Habitats, Carmel Valley, CA, June, 2010 - Sponsored by the Elkhorn Slough Coastal Training Program and administered by Dr. Pete Trenham

California Tiger Salamander Workshop, Watsonville, CA, March, 2010 - Sponsored by the Elkhorn Slough Coastal Training Program and administered by Dr. Pete Trenham

Rare Pond Species Survey Techniques Workshop, Rohnert Park, CA, March, 2008 - Sponsored by the Leguna de Santa Rosa Foundation and The Wildlife Project and administered by Dr. Jeff Alvarez and Dr. David Cook

California Tiger Salamander Workshop--Special Emphasis on Sampling/Surveying Upland Habitats, Carmel Valley, CA, June, 2010 - Sponsored by the Elkhorn Slough Coastal Training Program and administered by Dr. Pete Trenham

Kim Forrest

Experience: Wildlife Refuge Manager, U. S. Fish & Wildlife Service, San Luis NWR Complex, CA; October 1999 - Present

- Oversee national wildlife refuge complex of three refuges and the largest conservation easement area in the western U. S.: supporting ½-million waterfowl, 25 threatened or endangered species, and waterbird concentrations of national significance; with a staff up to 50, and visitor use of 120,000/year.
- Natural resource planning, restoration, and management of diverse habitats, primarily remnant California wetlands, riparian woodland, native shrub uplands, and grasslands.
- Engage in conservation issues with regional, statewide, national consequence: urban encroachment, transportation projects, oil and gas exploration, water quality/quantity, personnel standards, floodplain restoration, flood management.
- Successfully garnered funding for the largest ARRA-funded (American Recovery and Reinvestment Act) project in FWS: $10 million 16,500-sq. - ft. Headquarters & Visitor Center; completed in 2-1/2 years. It is the only LEED Platinum building in the FWS, and "net-zero" energy (59 kW photovoltaics); FWS "Environmental Leadership Award", U.S. Dept. of the Interior "Environmental Achievement Award", U.S. Dept. of Energy "Federal Energy and Water Management Award".
- Develop and maintain partnerships with other agencies, NGOs, conservation groups, and funding organizations in order to effectively protect, restore, and manage the severely diminished natural resources of the Central Valley of California.
- Implemented 2nd-largest (2,700-acre) riparian woodland restoration project in CA, targeting endangered species.
- Implement one of very few FWS endangered species captive propagation and reintroduction efforts; resulting in the primary recovery efforts for the riparian brush rabbit. These efforts (habitat restoration and endangered species recovery) total an investment of $30 million, and required working closely with university and non-governmental organization partners -- resulting in the riparian restoration NGO expanding its program from regional to statewide.
- Analyze and evaluate refuge activities to ensure that all operations are in accordance with annual and long-term plans, priorities, and objectives. Remain alert to – and resolve -- potential problems within the full scope of refuge operations, maintenance, biological, habitat/water management, fire management, land acquisition, regulations/policies, public use, and law enforcement programs; as well as adverse outside influences.
- Oversee planning, design, development of new wildlife-oriented public use programs. Garnered $500,000 for facilities.
- Involved with water issues of the CA Central Valley; including complex water quantity, quality, transport, scheduling.
- Routinely double station budget of $2.5 million by competing for, obtaining, successfully implementing, and accounting for grant funds that are utilized for restoring rare habitats and species, constructing public use facilities, and conducting research. These grants have totaled approximately $30 million.
- Involvement in designing and implementing a continuum of land management authorities in a diversity of venues; from a refuge/NWRS overlay on military lands (Navy and Air Force in Guam), to FWS easement on The Nature Conservancy land, to FWS easements on private lands (duck hunting clubs and agricultural lands); help design and facilitate management practices among federal, state, and private landowners; wrote FWS Strategic Plan for San Joaquin Valley Initiative Area.

Special Skills and Assignments:

- Thirty-eight years' experience with the National Wildlife Refuge System.
- Major wildlife, habitat, restoration, administrative, and maintenance projects.
- Major land acquisition planning and acquisition, both fee title and easement.
- Law enforcement officer (12 years).
- National and Regional committees and assignments: Oil and Gas Management on NWRS, Refuge Manager Career Pathways, Indefinite Delivery Indefinite Quantity contract for wetland restoration, CVPIA implementation, mosquito management, establishment of Guam NWR, Refuge Law Enforcement Task Force.
- DOI International Technical Assistance Program capacity-building projects:
    - Tanzania: Recommendations to Improve Activities, Services, and Infrastructure – 5 Wildlife Mgt. Areas
    - Morocco: Sustainable Tourism/Protected Area Management Plans -- Capacity Building
    - Bangladesh: Integrating Sustainable Public Use into Protected Area Management

Education: Utah State University, Logan, UT, June 1976; Bachelor of Science/Wildlife Biology

Robert W. Parris

Deputy Wildlife Refuge Manager, U.S. Fish and Wildlife Service, San Luis National Wildlife Refuge Complex, PO Box 2176, Los Banos, CA 93635 - 209 826-3508 – bob_parris@fws.gov

Experience:

- Close to thirty years experience as a wildlife refuge manager and wildlife biologist for federal agencies.
- Deputy Wildlife Refuge Manager, U.S. Fish and Wildlife Service, San Luis NWR Complex, CA, August 2001 – Present
- Deputy Wildlife Refuge Manager, U.S. Fish and Wildlife Service, Long Island NWR Complex, NY, December 1997- July 2001
- Wildlife Biologist, U.S. Fish and Wildlife Service, Long Island NWR Complex, NY, January 1991 - December 1997
- Wildlife Biologist, Department of the Army, Picatinny Arsenal, NJ, November 1986 - December 1990
- Prepared and implemented land management plans including comprehensive conservation plans for two refuge complexes (nine National Wildlife Refuges and four National Wildlife Refuges respectively) and one military installation
- Responsible for natural resource and public use management at two National Wildlife Refuge Complexes and one military installation including monitoring of natural resources, population management actions, wildlife re-introductions, active habitat management, habitat restoration, visitor services, emergency services and administration (including obtaining outside funding)
- Involved with NEPA preparation, Section 7 consultations, aquatic and wetland permitting, as well as other legal requirements for natural resource activities
- Planned and conducted numerous monitoring and inventorying activities of wildlife populations and habitats on federal lands
- Involved with listed species management for a variety of threatened and endangered species
- Involved with contaminant investigations/monitoring on federal lands
- Involved at many different levels with natural resource research projects on NWRs lands
- Served as subject editor on the FWS on-line journal
- Serve as chair of the National FWS Line Officer Team
- Experienced in wildlife/natural resource management in forest, wetland, grassland and aquatic habitats
- Experienced in moist soil management of wetlands and open marsh water management techniques in salt marshes
- Conducted graduate research studies on American woodcock, nongame wildlife, and great blue herons
- Experienced in visitor services management and public outreach for National Wildlife Refuges

Education:

- State University of New York, College of Environmental Science and Forestry - Syracuse, NY, 9/79 - 8/86, 72 semester hours, PhD Environmental Science and Forest Biology
- Ohio State University - Columbus, Ohio, 9/76 - 8/79, 96 quarter hours, MS Zoology
- Hofstra University - Hempstead, NY, 9/72-6/76, 125 semester hours, BA Biology