Coastal California Gnatcatcher Proposed Regional Monitoring Sampling Design

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A program is being developed to conduct long-term coordinated monitoring of the federally-threatened Coastal California Gnatcatcher (*Polioptila californica californica*) in the United States portion of the species' range. The goals of this program are to: 1) determine the population status of California Gnatcatchers in southern California on conserved and military lands; 2) track trends in California Gnatcatcher habitat occupancy over time in southern California to identify when thresholds have been met that trigger management actions; and 3) identify habitat attributes and threats associated with gnatcatcher occupancy in order to develop specific habitat-based management criteria and recommendations. To date, there have been no systematic surveys for this species across southern California. Surveys have been conducted periodically in portions of the gnatcatcher's range, particularly on conserved and military lands. However, these surveys have been conducted in different years and with a variety of methods providing different population metrics and as a result do not provide a region-wide estimate. In addition, during the last 15 years, there have been extremely large wildfires in southern California across a substantial portion of suitable habitat for gnatcatchers and there is little information on their status in these burned areas.

The first regional Coastal California Gnatcatcher survey is scheduled for 2016. This survey is planned for conserved lands and those military lands in southern California that choose to participate. The objectives of the regional monitoring program are:

1. In 2016, determine the percent area occupied (PAO) by California Gnatcatchers in modeled high and very high suitability habitat on conserved lands and on participating military lands in southern California.
2. Over the next 15 years, determine long-term trends in California Gnatcatcher PAO and in their colonization and extinction rates in modeled high and very high suitability habitat on conserved lands and participating military lands in southern California, and be able to detect at least 30% change in California Gnatcatcher PAO.
3. Beginning in 2016, identify associations between habitat and threat correlates with California Gnatcatcher PAO and with colonization and extinction rates in order to develop biologically meaningful thresholds for management and to specify management criteria and recommendations.

Analysis of Existing Datasets to Develop Regional Monitoring Program Methods

The process of developing a regional Coastal California Gnatcatcher monitoring program has involved evaluating previous survey efforts to select the most efficient and cost effective survey method and to determine the sampling design. Survey reports and data were reviewed from the Western Riverside County Multiple Species Habitat Conservation Program (WRC MSHCP; Biological Monitoring Program 2007, 2008, 2012), the Nature Reserve of Orange County (NROC; Leatherman Bioconsulting, Inc. 2012) and from US Fish and Wildlife Service (USFWS) surveys in San Diego County (Winchell and Doherty 2008, 2014, Miller and Winchell, in review). These data were evaluated by a team of biologists from US Geological Survey (USGS), USFWS, the San Diego Management and Monitoring Program (SDMMP), NROC, and Colorado State University (CSU). Surveys have been performed by WRC MSHCP, NROC and USFWS to estimate PAO by California Gnatcatchers, although the analyses for the NROC surveys are not yet completed. More detailed analyses of detectability were conducted with the USFWS dataset to design the regional sampling plan.

<u>Summary of Previous Subregional Occupancy Survey Results</u>

WRC MSHCP conducted California Gnatcatcher occupancy surveys along 250-500 m transects from October 2006 through June 2007 (WRC MSHCP Biological Monitoring Program 2008). Transects were visited three times in fall 2006 and three times in spring 2007 and PAO was calculated separately for each period. PAO was estimated at 0.29 (95% CI: 0.17-0.44; n = 96 transects) during spring 2007 and 0.42 (95% CI: 0.30-0.56, n = 83 transects) during fall 2006. Probability of detection for spring was 0.35 (95% CI: 0.21-0.53) and for fall was 0.48 (95% CI: 0.35-0.60).

In 2002, the USFWS conducted point count surveys for California Gnatcatchers at 436 points in San Diego and Orange Counties, sampling points 1-4 times. The goal of these surveys was to estimate occupancy and test the performance of a habitat suitability model developed by TAIC (TAIC 2002) and used in designing a preserve system for San Diego County (Winchell and Doherty 2008). The TAIC model defined habitat suitability as Low, Moderate, High and Very High based on cover of sagebrush, slope, precipitation, temperature and other abiotic variables. Occupancy averaged 0.26 (95% CI: 0.16-0.40) and varied by habitat quality. Occupancy in the Very High stratum was 0.48 (SE = 0.12) whereas the Low stratum occupancy was 0. Overall detection probability was estimated to be 0.21 (95% CI: 0.13-0.33).

In 2004, 2007 and 2009, the USFWS continued to conduct point count surveys on conserved and military lands in San Diego County (Winchell and Doherty 2008, 2014). Model-averaged occupancy varied by habitat quality and declined with an increase in elevation. Estimated and derived PAO ranged annually from 0.31 to 0.45 in Very High and from 0.17 to 0.33 in High habitat strata (Table 1). An important result is that the 95% CI for occupancy estimates were much larger in low, moderate and burned habitat strata that received lower levels of survey effort.

<u>Comparison of Detection Probability for Point Counts Versus Wandering Transects</u>

In 2009, the efficiency of area search surveys ("wandering transects") was compared with the point count methodology (Miller and Winchell, in review). The area search surveys had a higher average detection probability (p=0.69, 95% CI: 0.59-0.79) than point counts (p=0.41, 95% CI: 0.31-0.51). The increased probability of detection achieved through area search surveys allows for the number of survey visits required at each sampling point to be reduced from 6 to 3 (MacKenzie et al. 2006, USFWS 2008). This increased detectability will result in substantial cost savings for future survey efforts utilizing the area search survey method.

Table 1. California Gnatcatcher habitat occupancy estimates, 95% CI, and number of sampling points (n) by habitat strata during 2004, 2007, and 2009 point count surveys conducted by USFWS in San Diego County. Occupancy estimates are approximated from Figure 1 in Winchell and Doherty (2014), where occupancy was calculated for 2004 and derived from time-specific extinction and colonization rates in 2007 and 2009.

Habitat Strata	Calculated 2004 Model Averaged Occupancy Estimate (n)	2004 Occupancy 95% Confidence Interval	Derived 2007 Model Averaged Occupancy Estimate (n)	2007 Occupancy 95% Confidence Interval	Derived 2009 Model Averaged Occupancy Estimate (n)	2009 Occupancy 95% Confidence Interval
Very High	0.31 (108)	0.2-0.45	0.37 (211)	0.32-0.47	0.45 (248)	0.38-0.42
High	0.17 (211)	0-0.33	0.25 (129)	0.17-0.33	0.33 (147)	0.27-0.41
Moderate	0 (29)		0.05 (43)	0.01-0.13	0.09 (46)	0.02-0.22
Low	0 (20)		0.19 (26)	0.05-0.50	0.28 (2)	0.10-0.62
Burned High & Very High	0 (60)		0.05 (66)	0.02-0.10	0.09 (83)	0.05-0.13

Regional Monitoring Program Sampling Frame and California Gnatcatcher Habitat Suitability Model

The regional monitoring program study extent includes coastal sage scrub habitat in southern California where California gnatcatchers are known to occur, in the Counties of Ventura, Los Angeles, San Bernardino, Riverside, Orange, and San Diego. To develop a sampling frame for California Gnatcatchers in southern California, a habitat suitability model was developed by the SDMMP. A new model was needed as the TAIC model was developed for coastal regions and does not perform well at more inland locations that differ considerably from coastal areas in climatic and topographic conditions. To identify the sampling frame for southern California, SDMMP constructed a Coastal California Gnatcatcher habitat suitability model using a partitioned Mahalanobis D^2 approach (Knick and Rotenberry 1998, Rotenberry et al. 2002, 2006, Preston et al. 2008).

<u>Modeling Datasets</u>

California Gnatcatcher location records were compiled for 2000 to 2013 from a variety of sources and used to develop and evaluate the performance of alternative habitat models. Data sources included USGS, California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB), USFWS Carlsbad Office, County of San Diego (SanBIOS), Center for Natural Lands Management (CNLM), Marine Corps Air Station Miramar (MCASM), Marine Corps Base Camp Pendleton (MCBCP), Naval Weapons Station Fallbrook (NWSF), NROC, and WRC MSHCP. Gnatcatcher records with a precision lower than 160 m were excluded from modeling datasets. Spatially redundant location records (≤150m apart) were also removed from the modeling datasets. We used 1,063 location records from multiple datasets to calibrate the models and 3,205 records from the USFWS database to independently evaluate and compare the performance of alternative habitat suitability models.

To develop an environmental database for modeling habitat suitability across the study area, we used ArcGIS software (ESRI 2012) to create a grid of points spaced 150 m apart across southern California. Using ArcGIS digital data layers, we calculated various climatic, topographic, land use and vegetation variables at each point in the landscape grid (Table 2). California Gnatcatchers are often associated with California sagebrush *(Artemisia californica)* (e.g., Winchell and Doherty 2008; USGS preliminary analysis of USFWS 2004, 2007, and 2009 data). However, our vegetation layers did not identify coastal sage scrub supporting California sagebrush for the entire

Table 2. Environmental Variables Used in Coastal California Gnatcatcher Habitat Suitability Modeling

Variable(s)	Scale(s)	Description
Elevation	At point	Computed elevation (m) using ArcGIS to extract values from a 10m USGS digital elevation model raster at each point.
Topographical Heterogeneity	30m x 30m area	Computed topographic heterogeneity, a measure of topographic ruggedness (Sappington et al. 2007), using ArcGIS and the elevation raster to calculate a median value for a 30m neighborhood centered on each point.
Slope in Degrees	At point	Computed slope (º) using ArcGIS to extract values from the elevation raster at each point.
Northness	At point	Northness is a measure of northerly aspect. Used the “Aspect” tool in ArcGIS to calculate the cosine of aspect from the elevation raster using the “Raster Calculator” at each point.
Eastness	At point	Eastness is a measure of easterly aspect. Used the “Aspect” tool in ArcGIS to calculate the sine of aspect from the elevation raster using the “Raster Calculator” at each point.
Precipitation: Annual (rainfall year: August 2 to July 31); October to January; February to May	At point	Computed precipitation variables (mm) for monthly, seasonal & annual time periods at each point using ArcGIS and a raster with 1981-2010 precipitation averages downloaded from the PRISM Climate Group (http://www.prism.oregonstate.edu)
Temperature: January Minimum; July Maximum	At point	Computed monthly minimum & maximum temperature (°C) for each point using ArcGIS & rasters with 1981-2010 minimum and maximum monthly temperature averages downloaded from the PRISM Climate Group.
Vegetation/Land Use: % Coastal Sage Scrub % Chaparral % Urban	150m x 150m, 1 km x 1 km	Subregional vegetation maps were merged together from western Riverside County (2005), western San Diego County (2014), southern (2013) and central/coastal (2013) Orange County, NAS Miramar (2012-14), MCB Camp Pendleton (2003) and NWS Fallbrook (2010). The 2010 Fire Resource Assessment Program Vegetation Map for California was used for areas in southern California without subregional mapping. Calculated % of vegetation or land use type within 150m grid cells and 1 km neighborhoods.
Normalized Difference Vegetation Index (NDVI)	At point	Extracted NDVI values from MODIS satellite imagery at each grid point for images taken 5/28 to 6/2/2012. Imagery resolution is 1 pixel = 250 m.
Modeled Habitat Suitability California Sagebrush HSI	At point	196 California sagebrush calibration records and 105 validation records to develop partitioned Mahalanobis D^2 habitat suitability model. Median validation HSI was 0.6. California sagebrush top-performing model HSI incorporated as a predictor variable in selected California Gnatcatcher models.

study area, so we modeled California sagebrush habitat suitability and included sagebrush model predictions in selected gnatcatcher models (Preston et al. 2008). We used 196 calibration and 105 validation records to construct And evaluate alternative California sagebrush habitat models. The selected model had a median validation HSI of 0.6 and predictions of California sagebrush habitat suitability were included in selected gnatcatcher models.

Model Construction and Evaluation

We constructed alternative partitioned Mahalanobis D^2 models for gnatcatchers in southern California (Knick and Rotenberry 1998, Rotenberry et al. 2002, 2006). To avoid spatially biased sampling, we used a subsampling strategy to balance gnatcatcher locations used in calibrating the models (Knick et al 2013). We divided the region up into five sampling units: Los Angeles/Ventura; Riverside/San Bernardino; Orange; San Diego Coastal; and San Diego Inland. We randomly subsampled 50 gnatcatcher locations from each area (i.e. a total of 250 gnatcatcher locations) and calibrated a model. We repeated this subsampling for 1,000 iterations and then averaged the results to develop a final model from which the Mahalanobis D^2 values were calculated across the landscape.

Mahalanobis D^2 represents a standardized distance between the multivariate mean for environmental variables at locations where a species occurs and values calculated for the same set of environmental variables at each grid point in the landscape being modeled (Rotenberry et al. 2002, 2006). The more similar environmental characteristics are at a point in the landscape to the species' multivariate mean, the more suitable the habitat is for the species. Habitat suitability for each grid cell in the study area is indicated by a Habitat Similarity Index (HSI) value that ranges from 0 (least similar to occupied habitat and considered least suitable) to 1 (most similar to occupied habitat and most suitable). Habitat suitability strata for the SDMMP model are defined by HSI values as: Very High = 0.75-1.00; High = 0.50 – 0.74; Moderate = 0.25-0.49; and Low = 0-0.24.

Eighteen models were developed with different combinations of variables and their performance was evaluated to select the top-performing model identifying high and very high habitat suitability. We initially assessed model performance by comparing median and mean HSI values for the calibration and validation datasets for each model. We further evaluated the top model's performance using a Receiver Operating Curve (ROC) to determine the Area Under the Curve (AUC) value (Fielding and Bell 1997). This metric evaluates the model's ability to correctly predict class membership (e.g., suitable vs unsuitable). AUC values range between 0 and 1, with no predictive power for models with an AUC of ≤ 0.5. An AUC value of ≥ 0.70 is considered acceptable in terms of model performance, with higher AUC values representing greater model performance. To conduct the ROC analysis, we randomly selected 3,205 "pseudo absence" locations (Barbet-Massin et al. 2012) from throughout the southern California study area to represent background HSI values and combined these with HSI values for the validation dataset of occupied gnatcatcher habitat.

Habitat Modeling Results

The top-performing habitat model performed well in predicting suitable habitat for California Gnatcatchers with an AUC of 0.96 and median calibration and validation HSI of 0.73 and 0.69, respectively. The SDMMP model aligns well with the TAIC model, in that HSI values were concordant with the habitat quality strata for the 2004, 2007 and 2009 USFWS surveys (Table 3). Over the course of the USFWS surveys there were a substantial number of points classified as Very High and High habitat strata unoccupied by gnatcatchers. Winchell and Doherty (2014) found gnatcatcher occupancy to be highly variable across the landscape over time based upon extinction and colonization dynamics. Thus, High and Very High quality gnatcatcher habitat was not fully occupied over the course of their study. The SDMMP model further discriminates suitable habitat within the various TAIC strata as HSI values are higher at points where California Gnatcatchers were detected compared to points where they were not detected during the USFWS surveys.

Table 3. Comparison of California Gnatcatcher TAIC habitat quality strata classification for a survey point with the SDMMP habitat model's HSI value at that point.

TAIC Habitat Quality Strata	SDMMP California Gnatcatcher Habitat Model for Southern California						
	California Gnatcatcher Detections during USFWS Surveys	Average HSI	Standard Deviation HSI	Median HSI	Minimum HSI	Maximum HSI	n
Very High	Points with Gnatcatcher Detections	0.79	0.23	0.89	0.08	1.00	144
	Points with No Gnatcatcher Detections	0.67	0.30	0.76	0.00	1.00	184
	All Survey Points	0.72	0.28	0.84	0.00	1.00	328
High	Points with Gnatcatcher Detections	0.65	0.28	0.70	0.01	0.99	54
	Points with No Gnatcatcher Detections	0.50	0.36	0.52	0.00	1.00	151
	All Survey Points	0.54	0.34	0.59	0.00	1.00	205
Moderate	Points with Gnatcatcher Detections	0.74	0.30	0.83	0.33	1.00	4
	Points with No Gnatcatcher Detections	0.32	0.35	0.16	0.00	0.99	87
	All Survey Points	0.33	0.36	0.19	0.00	1.00	91
Low	Points with Gnatcatcher Detections	0.23	0.33	0.07	0.00	0.61	3
	Points with No Gnatcatcher Detections	0.17	0.24	0.03	0.00	0.96	39
	All Survey Points	0.18	0.25	0.03	0.00	0.96	42

The variables in the top-performing model included average minimum January and maximum July temperatures, annual precipitation, elevation, northness, eastness, slope, topographic heterogeneity, the percent of urban, coastal sage scrub and chaparral land cover within the 150m x 150m grid cell, and predicted habitat suitability for California sagebrush.

The regional Coastal California Gnatcatcher sampling frame is defined as those locations identified as High or Very High habitat suitability with an HSI ≥ 0.5 (Figure 1).

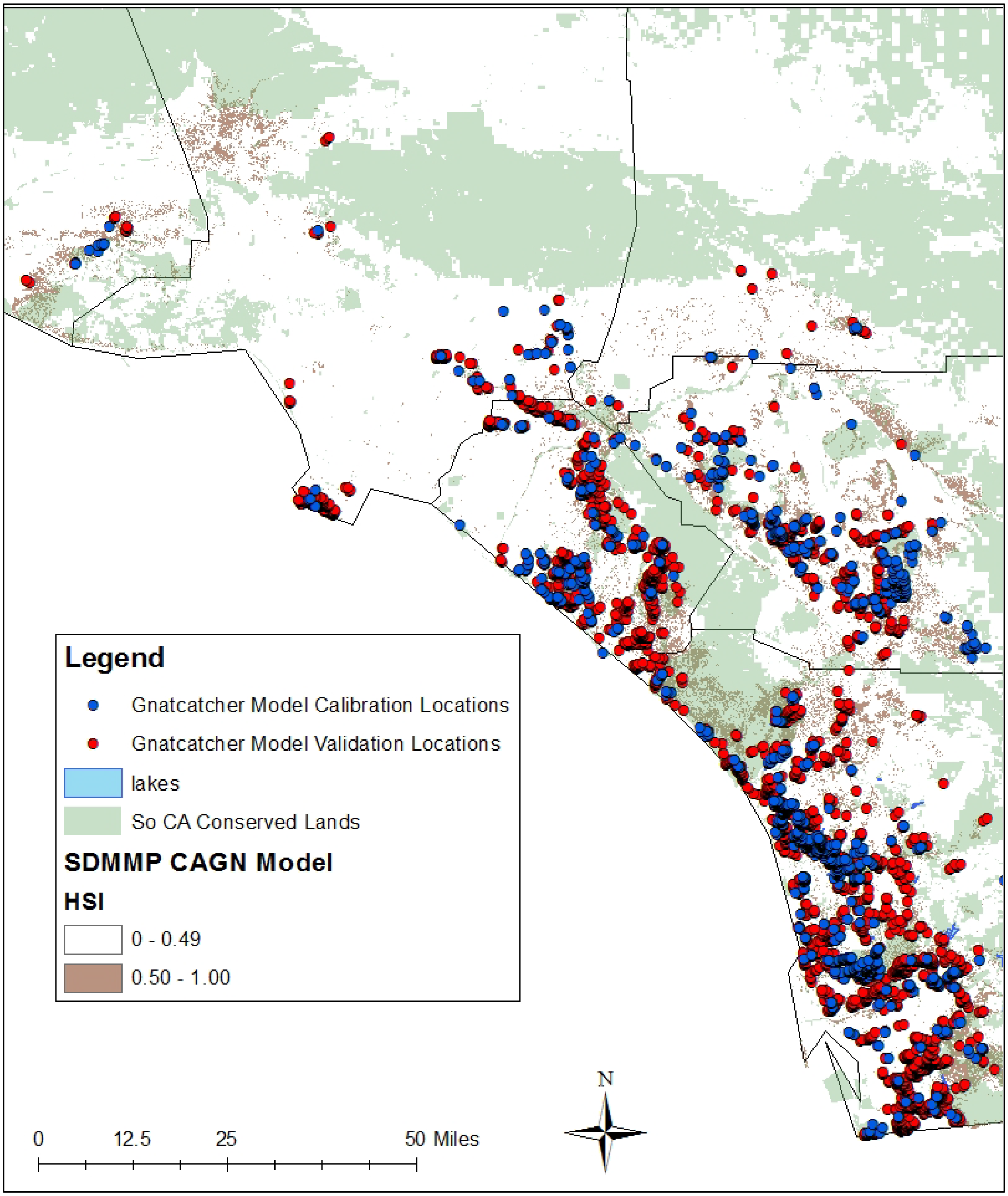

Figure 1. Coastal California Gnatcatcher model calibration and validation locations and habitat suitability predictions for southern California.

Regional and Subregional California Gnatcatcher Sampling Design

<u>Regional Sampling Design</u>

In developing the sampling design for the regional California Gnatcatcher monitoring program, the probability of detection was set at 0.6, a conservative estimate based upon the 2009 area search surveys (Miller and Clark, in review). Detectability is likely to vary annually and there are indications that it is lower during drought years. A study of California Gnatcatchers in southern San Diego County (Preston et al. 1998) recorded 327 hours of vocalizations for 21 pairs over a two year period and found vocalizations varied by month and by stage of the breeding cycle. The loudest and most detectable vocalizations (mewing, scolding, and churring) were highest January through March during pre-breeding territorial advertising, nest building and egg laying periods and again after July, during the fledging period, juvenile dispersal and post-breeding expansion of home ranges. Vocalizations were lowest during incubation and nestling periods (April to July). The USFWS surveys were conducted from April to June and it is anticipated that detectability can be enhanced by surveying earlier in the breeding season when gnatcatcher territorial behavior is more pronounced, as well as by using song playbacks to elicit response. Regional surveys are scheduled to be conducted between March 15 and May 1 to attempt to capture a portion of the pre-breeding and early breeding season when detectability is high.

Only two visits per sampling location are needed for occupancy probabilities of 0.0 - 0.4 and a detectability of 0.6 (Table 6.1 in MacKenzie et al. 2006). However, three visits will be made to each survey point during the first year of regional surveys to ensure sufficient visits in case detectability is lower than anticipated or occupancy is higher than previously documented. More visits are recommended under those conditions. A third survey also helps with unmodeled environmental heterogeneity.

Based upon the USFWS survey results, average habitat occupancy of 0.3 in High and Very High habitat strata was selected for the purposes of estimating the number of sample sites to survey. This is a rather low, conservative estimate of occupancy potentially reflecting conditions during and after drought years (Winchell and Doherty 2015); with a higher estimate of 0.4 more representative of non-drought conditions. Gnatcatcher populations can fluctuate substantially between years, and for long term status and trend monitoring it is important to detect larger declines that could indicate the need to monitor more closely or manage to increase occupancy. In the previous USFWS gnatcatcher surveys, the objective was to detect a 33% change in occupancy in Very High habitat strata and 45% in High (USFWS 2008). For regional sampling, we are combining Very High and High strata and are not sampling Moderate or Low habitat strata. Assuming an occupancy estimate of 0.3, the objective of regional California Gnatcatcher monitoring is to detect a conservative 30% change in occupancy between successive surveys.

We ran simulations in Program Mark to estimate the number of survey visits required to detect specific changes in California Gnatcatcher occupancy. Based upon the above criteria, 330 sampling points are needed on conserved lands in southern California to detect a 30% change in occupancy between surveys (Figure 2 and Table 4). This level of effort allows us to detect meaningful changes in gnatcatcher occupancy.

An initial occupancy threshold that could trigger management to increase California Gnatcatcher populations is a PAO of 0.20 or lower for combined High and Very High suitability habitat. This threshold is based upon occupancy estimates for San Diego and Orange Counties of 0.45 in High and Very High habitat strata in 2002, an extreme drought year after which occupancy likely declined due to low productivity (Winchell and Doherty 2008, 2015). PAOs were also 0.45 for Very High and 0.33 for High suitability habitat in 2009, which is an average 0.39 for combined High and Very High habitat strata. Thus a threshold PAO of 0.2 represents a 50% decline in occupancy for California Gnatcatcher populations based on an estimate of 0.4 occupancy in High and Very High suitability habitat.

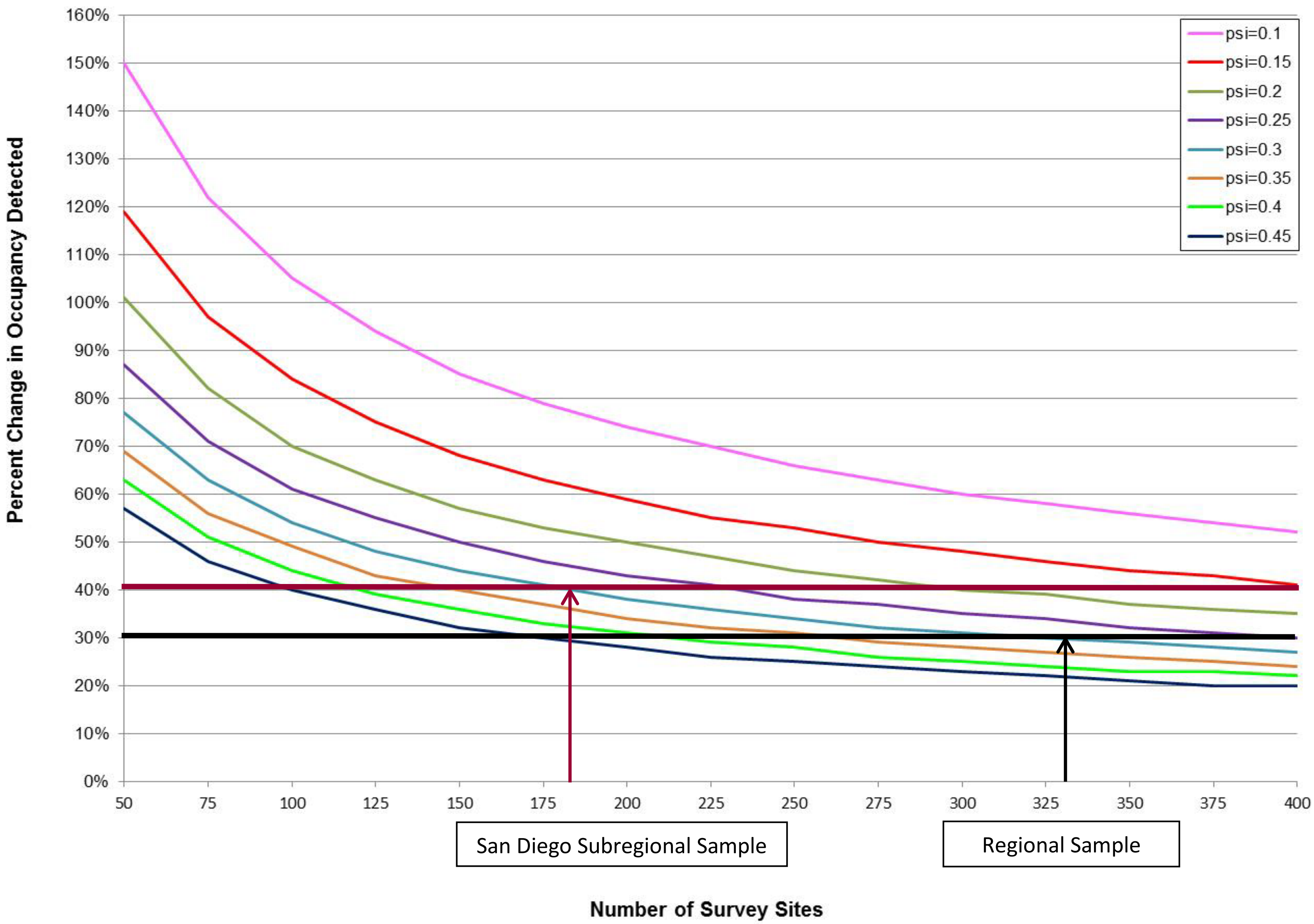

Figure 2. Percent change in occupancy based upon number of survey sites and probability of occurrence (psi).

Table 4. Percent detectable change in occupancy and 90% confidence intervals for occupancy estimates based upon the number of survey sites and for an actual occupancy probability of 0.3, three survey visits, and a probability of detection of 0.6. The gray row represents the sample size needed to estimate ~30% change in occupancy .

Number of Sites	90% Confidence Interval	SE	90% CI Width	% Detectable Change
50	0.184-0.416	0.069	0.23	77%
100	0.219-0.381	0.049	0.16	54%
150	0.234-0.366	0.040	0.13	44%
200	0.243-0.357	0.035	0.11	38%
250	0.249-0.351	0.031	0.10	34%
300	0.253-0.347	0.028	0.09	31%
350	0.257-0.343	0.026	0.09	29%
400	0.260-0.340	0.024	0.08	27%

Subregional California Gnatcatcher Monitoring

In addition to regional monitoring, individual subregional conservation programs may have an independent interest in tracking trends in gnatcatcher occupancy for comparison with regional trends, and to address similar goals and objectives identified for the regional monitoring program. Because the sample size needed to detect a given level of change in occupancy is determined by the combined detectability and occupancy probabilities and not the size of the subregion, it may be appropriate to set different occupancy change detection thresholds at the subregional level based on financial practicability and the proportional contribution of subregional populations to overall regional population stability. For example, because metapopulation dynamics may preserve overall population stability while there is variability in the dynamics of subpopulations, it may be acceptable to detect a larger change in gnatcatcher occupancy at the subregional level before taking management action. Lesser power to detect change at the subregional level may also be acceptable in the context of regional monitoring that is being designed to detect regionally significant changes in occupancy that should prompt a management response.

For those subregional conservation programs that wish to track trends in gnatcatcher occupancy and extinction/colonization dynamics at the subregional scale, the regional monitoring program has been designed to facilitate and assist with the selection of additional subregional sample locations once the conservation programs identify their objectives for detecting change in occupancy. As an example, San Diego County has identified a subregional objective of detecting a 40% change in occupancy between surveys, which boosts the sample effort in this subregion from about 150 to 180 sample plots (Table 4 and Figure 2). Other subregions within which fewer regional sample plots have been identified will likely have a much larger proportional number of subregional plots to sample for moderate power to detect subregional trends.

Spatially Balanced Sampling Point Selection

Sampling points were selected for regional and subregional monitoring in a spatially balanced manner for even distribution across suitable habitat (Stevens and Olsen 2004, Theobald et al. 2007). This is more efficient than random sampling in gathering data on trends in population abundance and is statistically sound. Sample points were selected in ArcGIS using the Spatially Balanced Sampling tool (Theobold et al. 2007, ESRI 2012).

Regional Sampling Locations

SDMMP and USGS selected potential sampling locations for regional Coastal California Gnatcatcher Monitoring in 2016 for conserved lands and military lands that have definitively committed to regional monitoring (Figure 3). The number of High and Very High sites available for monitoring by subregion is shown in Table 5 and the number of potential regional sampling locations based upon spatially balanced sample selection is presented in Table 6. Each sample location is at least 600 m from other sampling locations to ensure spatial independence (Winchell and Doherty 2008). The final spatial configuration and number of sampling locations in each subregion could change depending on the level of subregion participation.

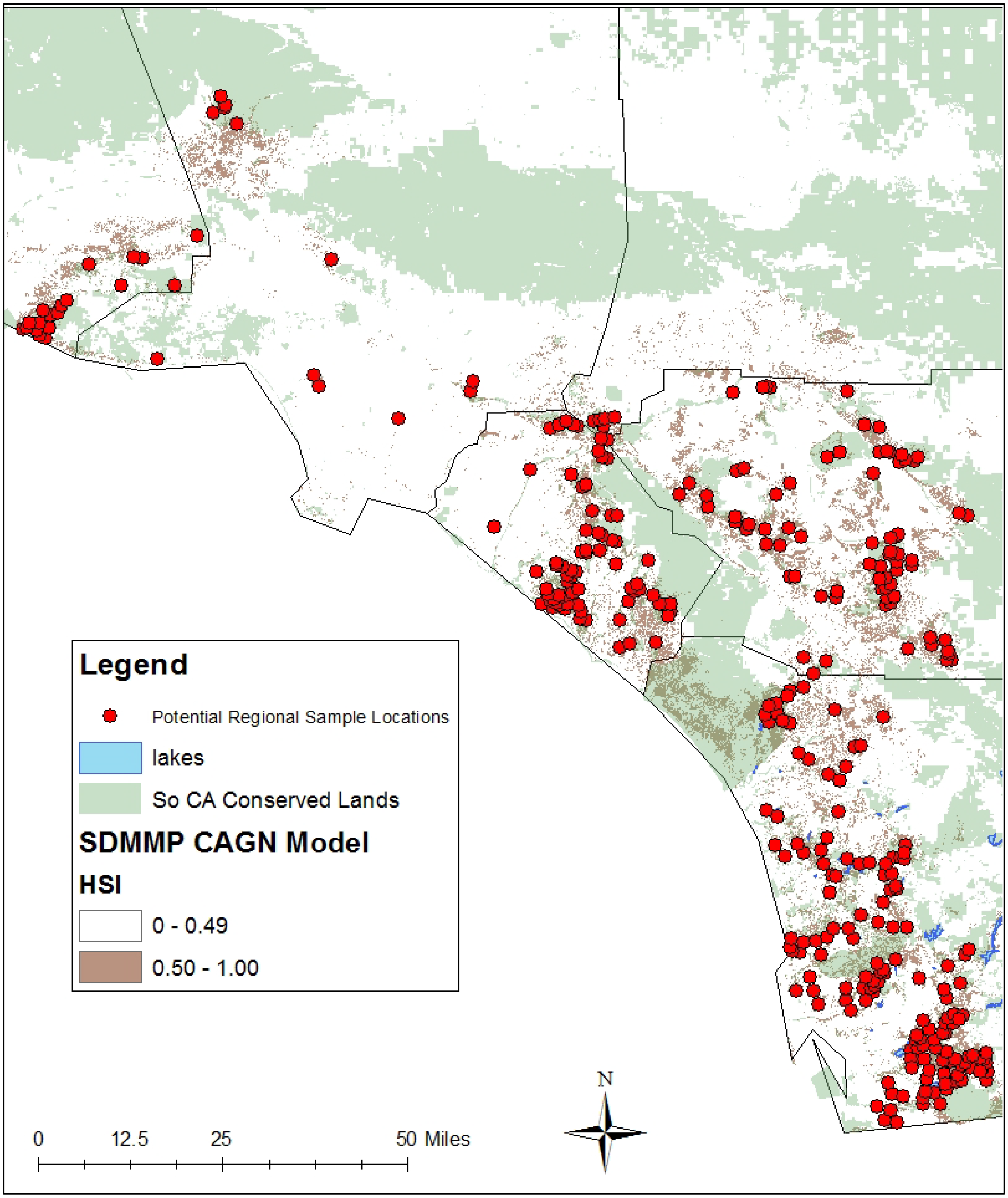

Figure 3. Potential regional California Gnatcatcher sampling points in southern California.

Table 5. Number of potential California Gnatcatcher sampling sites with High and Very High habitat suitability on conserved and military lands by subregion in southern California

Subarea	Total Number of Potential Sampling Points	% of All Potential Sampling Points
San Diego - Non Military	13,317	32.56
NWS Fallbrook	1,273	3.11
MCB Camp Pendleton	7,960	19.46
MCAS Miramar	1,767	4.32
San Diego County Total	*24,317*	*59.46*
NROC	4,278	10.46
Orange Other	2,436	5.96
Orange County Total	*6,714*	*16.42*
Los Angeles	1,141	2.79
Ventura	1,739	4.25
San Bernardino	630	1.54
Riverside	6,357	15.54
Total Survey Points for All Lands	40,898	100.00

Table 6. Estimated number of California Gnatcatcher regional sampling locations in High and Very High habitat suitability by subregion in southern California. Numbers could change based upon final subregional participation.

Subarea	Total Number of Regional Sampling Points	% of All Sampling Points
San Diego	147	44.55
NROC	42	12.73
Orange Other	28	8.48
Orange County Total	*70*	*21.21*
Los Angeles	12	3.64
Ventura	19	5.76
San Bernardino	7	2.12
Riverside	75	22.73
Total Survey Points for All Lands	330	100.00

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