

Guidance on Extending the Current USFWS
California Gnatcatcher Survey Protocol to Cover Survey Periods
That Include Both Breeding and Non-Breeding Periods

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The current USFWS survey protocol for California gnatcatchers (rev. July 28, 1997) calls for either 6 survey visits (1 per week) during the breeding season (March 15 through June 30) or 9 survey visits (1 every two weeks) during the non-breeding season (July 1 through March 14) in a non-NCCP area. The protocol states that it “is based on the best available scientific information regarding the detectability of the coastal California gnatcatcher” and that it “was designed to provide a 95% confidence level of detecting coastal California gnatcatchers at a site when they are present.” Because surveyors often initiate surveys during the latter portion of the breeding season so that a 6-week survey period would extend into the non-breeding season, or likewise initiate surveys in the non-breeding season so that the 18-week survey period extends into the breeding season, we have been requested to determine a consistent method for calculating the number of survey visits necessary when survey periods extend across the breeding and non-breeding seasons.

Our objective is to determine how many surveys would be required, when mixed between breeding season and non-breeding season, to attain the same level of confidence that is obtained using the current single-season protocol. We did not review capture data or evaluate the adequacy of the 6 or 9 survey protocol to determine presence/absence of California gnatcatcher. Rather, for this analysis, we assume the stated level of confidence and the justifications provided in the existing protocol are correct. If capture/recapture data and future analyses determine that more or fewer surveys are required to reach the desired level of confidence, the same process presented herein can be used to recalculate the appropriate number of surveys when the survey period overlaps both the breeding and non-breeding seasons.

The current survey protocol states that it is based on the detection probabilities for California gnatcatcher in the breeding and non-breeding seasons. Detection probability can be calculated as:

$$\text{Eq. 1: } (1-P_b)^x = \alpha \quad \text{or rewritten as } P_b = 1 - \sqrt[x]{\alpha}$$

where P_b is the detection probability during the breeding season, x is the number of survey periods, and α is the probability of failing to detect a California gnatcatcher when it is present.

Because the current survey protocol states that both the breeding season and non-breeding season surveys yield the same probability of detecting a California gnatcatcher when it is present ($\alpha = 95\%$), we can set the equation for the breeding season equal to the equation for the non-breeding season.

$$\text{Eq. 2: } (1-P_b)^6 = \alpha = (1-P_{nb})^9$$

where P_{nb} is the detection probability during the non-breeding season.

To determine what combination of breeding season and non-breeding season surveys will reach the same level of confidence as the current survey protocol, we used the equation:

$$\text{Eq. 3(a): } (1-P_b)^x * (1-P_{nb})^y = \alpha = (1-P_b)^6 = (1-P_{nb})^9$$

where P_b and P_{nb} are the breeding and non-breeding season detection probabilities, x is the number of survey visits during the breeding season, y is the number of survey visits during the non-breeding season, and α is the probability of failing to detect a California gnatcatcher when it is present.

Equation 3(a) can be solved for y :

$$\text{Eq. 3(b): } y = \text{Log}_{(1-P_{nb})} \left(\frac{(1-P_b)^6}{(1-P_b)^x} \right)$$

We then selected a range of P_b values (0.1, 0.2, ... 0.9) and solved for the corresponding P_{nb} using Equation 2. We inserted corresponding P_b and P_{nb} values along with a range of values for x (0-6) into Equation 3. This yielded a range of values for y (the number of surveys needed during the non-breeding season given the number of surveys already conducted during the breeding season)(Table 1).

Table 1. Number of surveys needed during the non-breeding season given the number of breeding surveys indicated. Note that P_{nb} is calculated from P_b under the assumption that 6 surveys during the breeding season yield the same probability of failing to detect a California gnatcatcher when it is present as 9 surveys during the non-breeding season (see Equation 2).

(P_b)	(P_{nb})	Number of Non-Breeding Season Surveys Needed given that X Breeding Season Surveys have been Conducted						
		$X=0$	$X=1$	$X=2$	$X=3$	$X=4$	$X=5$	$X=6$
0.1	0.068	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.2	0.138	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.3	0.212	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.4	0.289	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.5	0.370	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.6	0.457	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.7	0.552	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.8	0.659	9.00	7.50	6.00	4.50	3.00	1.50	0.00
0.9	0.780	9.00	7.50	6.00	4.50	3.00	1.50	0.00

Note that actual mean breeding season detection probability is probably between 0.2 and 0.4 and may or may not yield results that meet the 95% confidence level stated in the current survey protocol. However, the *relative* number of surveys required during the breeding vs. non-breeding season does not depend on detection probability and instead depends only on the presumption that the level of confidence in absence of California gnatcatchers is the same for 6 surveys during the breeding season as it is for 9 surveys during the non-breeding season, even if that confidence is poor. In fact, by solving Equation 2 for P_b and P_{nb} and substituting into Equation 3(b), the equation simplifies to:

$$\text{Eq. 4: } y = 9 - \frac{9x}{6} \quad \text{or} \quad x = 6 - \frac{6y}{9}$$

where x is the number of surveys conducted during the breeding season and y is the number of surveys conducted during the non-breeding season.

By inserting the number of breeding season or non-breeding season surveys already conducted into Equation 4, we can determine how many surveys need to be conducted during the opposite season to reach the same level of confidence as the current single season protocol (Table 2).

Table 2. Combinations of breeding season and non-breeding season surveys that would achieve the same level of confidence as the current California gnatcatcher survey protocol, which requires either 6 breeding season or 9 non-breeding season visits in non-NCCP areas. (note: survey visits are rounded up to the nearest whole number)

If You Have Conducted This Many Breeding Season Visits	You Need To Conduct This Many Non-Breeding Season Visits	If You Have Conducted This Many Non-Breeding Season Visits	You Need To Conduct This Many Breeding Season Visits
0	9	0	6
1	8	1	6
2	6	2	5
3	5	3	4
4	3	4	4
5	2	5	3
6	0	6	2
		7	2
		8	1
		9	0