California Fish and Game 95(2):106-109 2009

THE NUMBER OF CENSUS DAYS NEEDED TO DETECT BLUNT-NOSED LEOPARD LIZARDS, *GAMBELIA SILA*

DAVID J. GERMANO
California State University
Department of Biology
Bakersfield, California 93311-1022
dgermano@csub.edu

In addition to determining the population size and dynamics of a species, censuses are used to determine the quality of a site as habitat and the value of a site from a conservation standpoint (Sutherland 1996). For vertebrates, some studies may only require determining presence-absence of individuals at a site. For conservation planning, it often is useful to compare sites that still harbor the species of interest with those sites that do not (Sutherland 1996). The time necessary to detect a species in its habitat varies by the species under study, the type and quality of the habitat, the environmental conditions during the survey, and the skill of the surveyor. Minimizing the number of surveys necessary to confidently determine whether a particular species is absent can allow time for additional surveys. Although there can never be certainty that a species does not occur on a site, no matter how many surveys are undertaken, determining the optimal number needed for a high probability of detection can be critical.

The blunt-nosed leopard lizard, *Gambelia sila*, is a diurnal, 115 mm snout-vent length, predatory lizard endemic to the San Joaquin Valley and adjacent valleys to the southwest in California (Montanucci 1965, Germano and Williams 2005). It is both state and federally listed as endangered, and as such, there is great concern about what affects its status (USFWS 1998). The first step for improving the likelihood of its recovery from endangered status is determining where the species occurs. Over large areas, visual surveys while slowly driving on paved and dirt roads may be appropriate. However, surveys while slowly walking are needed for smaller sites or areas without road access. Standard methodology for detecting blunt-nosed leopard lizards during walking surveys has been to conduct 10-day censuses either on grids or meandering transects in the spring and early summer when adults are most active (Germano and Williams 1992, 2005). Abundance estimates of leopard lizards can be made by using regression models on data gathered from 10-day censuses (Germano et al. 1997). However, 10 days of censusing may be more time than is necessary if the objective is to determine the presence or absence outside of regulatory requirements. Here, I use data collected at two sites over 16 years to determine how many days are necessary to have a high ($\geq$ 90%) probability of detecting leopard lizard presence.

I used data from study sites on the Elkhorn Plain, San Luis Obispo Co. (Germano and Williams 2005) and the Lokern Natural Area, Kern Co., California (unpublished data). At both sites, 10 or more days of walking censuses of blunt-nosed leopard

lizards occurred per year At the Elkhorn Plain, two 8.1 ha plots with 16 census lines spaced 18.2 m apart were used to census lizards from 1988 to 2003. I used data from 1989 – 1994 when I was in charge of these plots. At the Lokern Natural Area, eight 9.0 ha plots, also with 16 census lines (20-m spacing), were used to count lizards during 10-day censuses from 1997 – 2006. I combined data from these two sites to analyze the length of time required to detect the first blunt-nosed leopard lizard.

Of the 48 pooled censuses in which blunt-nosed leopard lizards were found within a 10-day search, the average time it took to find at least one lizard was 2.27 days (Table 1). It only required an average of 1.18 days to find the first lizard when leopard lizards were abundant on the plot (> 15 sightings in 10 days). However, even when leopard lizards were scarce (≤ 3 lizards per 10 days), the average time to detect the first lizard was 3.60 days and the upper 95% confidence limit was under 5 days (Table 1). Although it took up to 9 days to find the first lizard in one of the censuses, fully 81% of first sightings of blunt-nosed leopard lizards were made in 3 days and 90% of first sightings were made in 5 days (Fig. 1).

Table 1. Mean number of census days, number of surveys (n), standard error (SE), range, and 95% confidence interval (C.I.) of days to make three or fewer, 4 -15, or > 15 sightings of *Gambelia sila* during forty eight 10-day censuses on the Elkhorn Plain, San Luis Obispo County (1990 – 1994) and the Lokern Natural Area, Kern County, California (1998 – 2006).

Number Seen	Mean	n	SE	Range	95% C.I.
≤ 3	3.60	20	0.54	1 – 9	2.47 – 4.73
4 – 15	1.55	11	0.25	1 – 3	0.98 – 2.12
> 15	1.18	17	0.13	1 – 3	0.90 – 1.46
Overall	2.27	48	0.29	1 – 9	1.67 – 2.85

No amount of time spent censusing can ascertain with certainty that at least one individual lizard does not occur at a site, but limiting the number of days spent censusing while still having a high assurance that at least one individual will be detected can greatly increase the number of sites studied. Increasing sample size is an important factor in increasing the power of testing (Gotelli and Ellison 2004). The 10-day census of the endangered blunt-nosed leopard lizard was originally instituted to increase the likelihood that at least one individual would be detected. Recently, the California Department of Fish and Game (2004) increased the required census effort to 17 days (12 in spring/early summer, 5 in late summer/fall) per year because the fully protected status of the species does not allow any mortality of the species associated with proposed project activities. The increased census effort is appropriate when the object is to be as close as possible to 100% sure that the species does not occur on a site. However, when the detection level is not as stringent, the ability to reduce the number of samples from 10 or 17 days would allow greater effort for additional censuses or assessments.

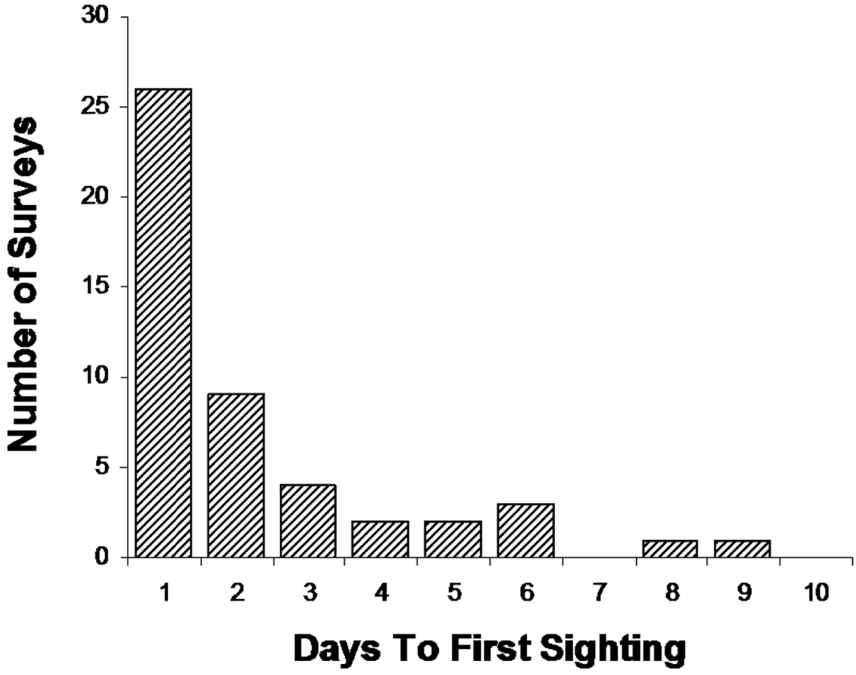

Figure 1. The number of days to the first sighting of *Gambelia sila* during forty eight 10-day censuses at the Elkhorn Plain, San Luis Obispo County from 1990 – 1994 and the Lokern Natural Area, Kern County, California from 1998 – 2006.

I have shown that even when blunt-nosed leopard lizards are scarce, there is a 95% chance of detecting a lizard within 5 days of censusing. Therefore, twice as many sites could be sampled compared to a 10-day censusing scheme, which increases the power of testing. These censuses must still take place during appropriate seasons, times, and temperatures (Germano and Williams 2005). Also, some years may be too dry for much above ground activity of blunt-nosed leopard lizards (Germano et al. 1994) and censuses may not be appropriate for determining occupancy of a site in these years. Although in a few instances a researcher could incorrectly judge the species to be absent from a site when limiting the number of days of censusing to 5, the increase in the number of sites that could be assessed seems justified. There will always remain the chance that the species occurs at a site yet remains undetected no matter how many days of censusing are made, but at these sites the numbers of lizards are likely extremely small and may not represent a population capable of continuing into the future.

ACKNOWLEDGMENTS

I was assisted by numerous people, far too many to name completely. However, I would especially like to thank D. Williams, L. Saslaw, E. Cypher, V. Germano, D.

Germano, R. Germano, M. Germano, M. Georgi, B. Perez, and J. Anderson, who helped conduct censuses at one or both sites.

LITERATURE CITED

California Department of Fish and Game. 2004. Approved survey methodology for the blunt-nosed leopard lizard. DFG BNLL protocol. California Department of Fish and Game. Accessed at http://www.dfg.ca.gov/wildlife/species/docs/ BNLLrevisedprotocol.pdf

Germano, D. J., and D. F. Williams. 1992. Recovery of the blunt-nosed leopard lizard: past efforts, present knowledge, and future opportunities. Transactions of the Western Section of The Wildlife Society 28:38-47.

Germano, D. J., D. F. Williams, and W. Tordoff, III. 1994. Effect of drought on blunt-nosed leopard lizards (*Gambelia sila*). Northwestern Naturalist 75:11-19.

Germano, D. J., and D. F. Williams. 2005. Population ecology of blunt-nosed leopard lizards (*Gambelia sila*) in high elevation habitats. Journal of Herpetology 39:1-18.

Germano, D. J., D. F. Williams, and L. R. Saslaw. 1997(1998). Utility of 10-day censuses to estimate population size of blunt-nosed leopard lizards. California Fish and Game 83:144-152.

Gotelli, N. J., and A. M. Ellison. 2004. A Primer of Ecological Statistics. Sinauer Associates, Inc. Sunderland, Massachusetts. 510 pp.

Montanucci, R. R. 1965. Observations of the San Joaquin leopard lizard, *Crotaphytus wislizenii silus* Stejneger. Herpetologica 21:270-283.

Sutherland, W. J. 1996. Why census? Pages 1-10 in: W. J. Sutherland, editor. Ecological Census Techniques. Cambridge University Press, Cambridge, Massachusetts.

U.S. Fish and Wildlife Service. 1998. Recovery plan for upland species of the San Joaquin Valley, California. Region 1, Portland, Oregon. 319 pp.

Received: 30 May 2008
Accepted: 30 July 2008