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DETECTION SURVEYS FOR FISHERS AND AMERICAN MARTENS IN CALIFORNIA, 1989-1994: SUMMARY AND INTERPRETATIONS

WILLIAM J. ZIELINSKI
US Department of Agriculture Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, California 95521, USA

RICHARD L. TRUEX[1]
US Department of Agriculture Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, and Department of Wildlife, Humboldt State University, Arcata, California 95521, USA

CHESTER V. OGAN
US Department of Agriculture Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, California 95521, USA

KELLY BUSSE
US Department of Agriculture Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, California 95521, USA

Abstract: Commercial trapping of fishers *(Martes pennanti)* and American martens (M. *americana)* has been prohibited in California since the mid-1900's, yet concern continues to exist about the status of their populations. Recently developed methods for detecting the presence of forest carnivores have made it possible to estimate their distributions and, potentially, to index their populations. We summarize the characteristics and results of track-plate and line-triggered camera surveys that were conducted in California to determine the presence of fishers or martens in areas scheduled for timber harvest or recreational development. Our objectives were to examine the relationship of survey characteristics to survey success and to compile information that can be used to improve detection methods and refine proposals for monitoring population abundance. Secondarily, we mapped the survey locations and results to help describe the current distribution of *Martes* in California. A total of 225 surveys averaged 18.3 stations and 12.6 days per

[1] Present address: Department of Environmental Science, Policy and Management, College of Natural Resources, University of California, Berkeley, California 94720-3114, USA

survey. About 40% of the surveys detected at least one of the species; 3.6% detected both. Fishers were detected after an average latency of 3.4 days; martens, after 3.3 days. Multivariate regression indicated that success at detecting fishers may be affected more by survey duration than by survey extent. Surveys that were successful at detecting either fishers or martens had significantly greater effort (number of stations x duration) than surveys that were unsuccessful. Martens appear well-distributed in the Sierra Nevada/Southern Cascades but were not detected in the Coast Range or Klamath Mountains. Fishers were commonly detected in northwestern California but in the Sierra Nevada were not detected north of Yosemite National Park. The high proportion of successful surveys, the low latencies to first detection, the fact that both methods produced independently verifiable results, and their low cost make track plates and line-triggered cameras effective means for detecting martens and fishers and describing their distributions.

Introduction

Commercial trapping of fishers *(Martes pennanti)* and American martens *(M. americana)* in California was suspended in 1946 and 1954, respectively, due to a perception that the combination of trapping mortality and habitat loss by logging was leading to the decline of both species (Dixon 1925, Grinnell et al. 1937). Concern about the status of fisher and marten in California has increased despite the protection of these species from trapping (Schempf and White 1977, Buskirk and Ruggiero 1994, Powell and Zielinski 1994, Gibilisco 1994). The cessation of trapping was coincident with a period when timber harvest and human population in California dramatically increased (Forest and Rangeland Resources Assessment Program 1988, McKelvey and Johnston 1992).

Suspicions that habitat loss would negatively affect fisher and marten populations and a perceived decline in the number of sightings in California prompted a variety of conservation actions in the 1980s and 1990s. Most fisher and marten habitat in California occurs on land managed by the US Department of Agriculture Forest Service, and under the provisions of the National Forest Management Act (NFMA) the fishers and martens in California have been designated as species “sensitive” to forest management activities. This designation entitles them to “special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing [under the Endangered Species Act (ESA)]” (Forest Service Manual 2670.32). The public have registered their concern directly by submitting 2 petitions (in 5 years) to list the fisher in the western United States under the federal Endangered Species Act (Central Sierra Nevada Audubon Society et al. 1990, Biodiversity Legal Foundation 1994).

With the cessation of trapping in the mid-l 900s a source of verifiable data on the status and distribution of *Martes* in California was lost. Until recently, the haphazard accumulation of sightings of each species and interviews of resource managers has been the sum total of effort to monitor their status since the seasons closed. This information has periodically been summarized for all or parts of the state (Schempf and White 1977; E. Burkett, California Fish and Game, pers. commun. 1992; Gibilisco 1994) but unknown qualifications of the observers, the similarity of appearance of fishers and martens, and the lack of a standardized approach affect the reliability of these reviews.

It has become clear that a random collection of sightings of dubious accuracy is not appropriate to fulfill the mandates of NFMA, to acquire the information necessary to justify listing under ESA, or to base responsible forest management. This data vacuum prompted the development of standardized detection methodology for fishers and martens in proposed management activity areas in California (Zielinski 1991). The present paper summarizes the results of 225 surveys that used the 2 primary methods of detection during the period 1989-1994: enclosed track plates and line-triggered 110 cameras (Barrett 1983, Jones and Raphael 1993, Fowler and Golightly 1994, Zielinski and Kucera 1995a).

Our objectives were to (1) summarize the effort expended during the period 1989-1994, (2) describe the results in terms of survey methodology and survey success, (3) help describe the current distribution of both species in California, and (4) compile information that can be used to improve detection methods and refine proposals for monitoring population abundance (e.g., Zielinski and Stauffer 1996). It is important to know the minimum amount of effort, in days and in number of stations, necessary to ensure a reasonable chance of detecting a target species if it is present. We investigated those variables which affect survey success, and we also focused on how long it takes to detect a target species (latency to first detection). This information can be used to improve the protocols used in more rigorous, planned, and comprehensive attempts to detect target individuals and to monitor populations. Although the data were collected in California the methods used and conclusions drawn should be applicable to other areas where the conservation of *Martes* species is a concern.

Methods

Field

In 1991 a survey protocol was distributed to biologists in each district of each national forest in California and to other biologists interested in determining whether fishers or martens occur in areas proposed for timber harvest or recreational development (Zielinski 1991). This methodology was adapted from a number of ongoing efforts to refine survey techniques for forest carnivores (Barrett 1983, Jones and Raphael 1993, Fowler and Golightly 1994).

Each survey included multiple-detection stations that were distributed at 0.8 km intervals along roads throughout the project area and a 0.8 km buffer around it. Most surveys were conducted in roaded areas, but in roadless areas (>2.4 km from a road) a similar array was used. Each station consisted of a rectangular plywood box that enclosed an aluminum plate sooted with either acetylene or kerosene. A piece of chicken was placed at the rear of the plate and the distal third of the plate was covered with white Con-Tact™ paper. Animals attracted to the bait enter the box, tread on the soot, and leave footprints on the white paper. Most stations were checked every 2 days for a minimum of 12 days. At each visit the plate was checked for tracks, bait was replaced and, if necessary, a new plate was installed. Most biologists planning a survey submitted a short survey plan to our laboratory prior to field work that included a brief description of the survey area and a map identifying the proposed station locations.

The majority of surveys were conducted by Forest Service biologists, and in a manner consistent with the intent of the protocol. Surveys were required to have *at least* 4 detection devices (track plates or line-triggered cameras), spaced about 0.8 km apart and checked for a minimum of 6 days to be included in our summary. Surveys meeting these criteria and that were conducted between July 1989 and December 1994 were eligible for inclusion. Surveys conducted as precursors to research studies were usually more extensive than the typical project-area survey and some surveys, particularly a few conducted by consultants on private land, were less rigorous than desired but the few surveys of this nature were also included.

The survey location and timing were beyond our control because they were dictated by local management activities, availability of funds, and the schedules of local biologists and of volunteers that sometimes helped the biologists. Therefore, the dispersion of surveys across space, among forest types, and across elevations was uncontrolled. A survey was considered distinct when it occurred at a unique time and place. When surveys were run more than once at the same location only the first survey was included in our summary. Adjacent surveys conducted at least 4 weeks apart were considered distinct, but certainly not independent because the same animal (particularly fishers with their larger home ranges) could be detected during each survey. However, surveys that were adjacent *and* sequential were uncommon. If 2 survey areas were within 1.6 km and were run simultaneously, they were pooled and considered a single survey. Most surveys were conducted in either early spring or late fall. Winter surveys were discouraged because snow interfered with the schedule to check the stations and could also affect the mobility of fishers and martens and their ability to find the stations.

Habitat data were not always collected at each station location and the data that are available are visual assessments collected by dozens of different observers. We have not analyzed these data. However, we assume that the biologist planning the survey was familiar with the geographic distribution and general habitat associations of the target species. This assumption was validated for many of the surveys when the survey plans were reviewed. During this review, we realized that biologists more often conducted surveys at elevations and in forest types where fisher, rather than marten, were likely to occur. This result probably occurred because of the widespread understanding that the status of fishers was more uncertain than that of martens.

When our work began, there was no quantitative method to distinguish the tracks of fishers and martens (Taylor and Raphael 1988) so the protocol recommended that when a possible fisher or marten track was discovered that a secondary device, the line-triggered camera (Jones and Raphael 1993), immediately be established at the site to verify the identity of the species. Shortly thereafter a discriminant function was developed that could distinguish the tracks of both species (Zielinski and Truex 1995). In 1993, when the preliminary results of this work were known, the use of line-triggered cameras at the location of a track-plate detection was discontinued.

Although track-plates were the primary detection device in the majority of surveys, some surveys were conducted by biologists who favored the line-triggered camera as the primary detection device, especially before the protocol was released. When line-triggered cameras were the only device used in the survey, they were deployed and checked in the same fashion as the track-plate boxes.

Laboratory

A database was established using Oracle software (version 6.0, Oracle Corporation, Belmont, California) to manage the survey results. Information about the proposed survey date, location, and survey characteristics (e.g. proposed duration, check interval, number of stations, primary detection device) was entered when the survey plan was received, and corrected if necessary, and completed when the survey results were submitted. Surveyors were instructed to remove the Con-Tact paper from plates that had tracks that resembled those of either fisher or marten and to protect them in an acetate document folder. The identity of all tracks and photographs was verified by the authors (WJZ or RLT); if surveyors did not submit either a track or photograph the survey was considered unsuccessful. Questionable tracks were measured and identified according to the methods outlined in Zielinski and Truex (1995).

The location of the center of each survey was visually estimated from a survey map and the UTM (Universal Transverse Mercator) coordinates for all surveys were used to create a map in a Geographic Information System (GIS) (ARC/INFO 6.1.2). The GIS also included a dominant vegetation type layer, commonly referred to as CALVEG (Matyas and Parker 1980) that was derived by visual interpretation of color infra-red satellite imagery. Polygons mapped at 1:250,000 and classified as 1 of 300 vegetation series were aggregated into 42 unit types at a scale of 1:1,000,000. CALVEG identifies only the existing vegetation type and does not include information about the developmental condition of the vegetation in the polygons.

Data were output to SAS (SAS Institute Inc., Cary, North Carolina) for analysis. Using f-tests and regression methods, we explored the factors that affect 2 primary response variables: latency to first detection (in days; LFD) and proportion of surveys that were successful. Independent variables included survey duration, number of stations in the survey, and effort (number of stations X duration of survey).

Results

Survey Characteristics

In total, 225 surveys were used in our analysis, representing 4847 survey days and 3799 stations checked 1377 times. Because data were missing for some variables, not all data were used for each analysis. For example, not all surveys reported the latency to first detection. Surveys were conducted in 17 counties and 11 national forests in California. Track plates were the primary device for 180 surveys that had sufficient data for analysis of survey success; line-triggered cameras were the primary device for 21 surveys. Surveys averaged (± SD) 18.3 ± 13.2 stations and were run an average of 12.6 ± 3.9 days each. In about 80% of the surveys, the stations were checked for visits by a fisher or a marten every 2 days. Effort varied considerably, from 24 to over 4000 station-days (station-day = 1 station checked 1 day = 1 unit of effort) (Fig. 1).

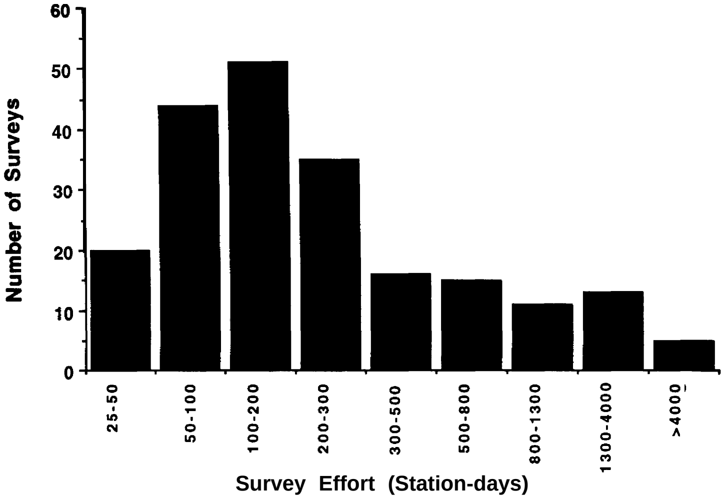

Figure 1. Frequency distribution of survey effort (number of stations X number of survey days) for 22 1 surveys conducted in California from 1989-l 994.

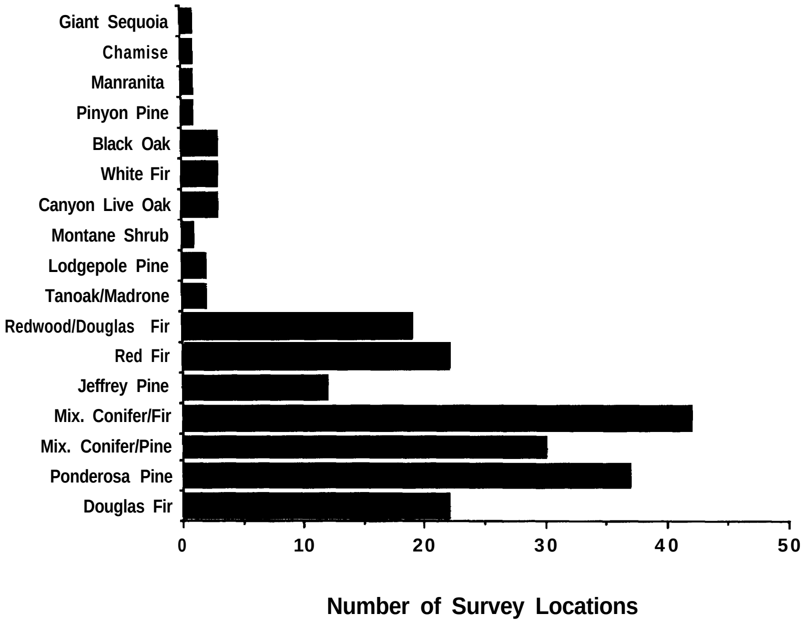

Figure 2. Frequency distribution of CALVEG (Matyas and Parker 1980) vegetation types where surveys occurred.

Most surveys occurred in mixed conifer and ponderosa pine *(Pinus ponderosa)* CALVEG types, with Douglas-fir *(Pseudotsuga menziesii)*, redwood *(Sequoia sempervirens)*/Douglas-fir, and red fir *(Abies magnifica)* types also common (Fig. 2). Three latitudinal zones, about 2° 15' each, were created to describe the elevational distribution of surveys. Surveys in the north occurred at a mean elevation of 1137 ± 583 m, at 1792 ± 463 m in the central region, and at 2017 ± 3 17 m in the south (Fig. 3), which reflects the inverse relationship between latitude and elevation on the distribution of *Martes* habitat.

Survey Results

Eighty-nine (40.3%) of the 221 surveys had at least 1 station that detected either marten or fisher; 52 (23.5%) detected fisher, 37 (16.7%) detected marten, and 8 (3.6%) detected both. A total of 814 detections of either species was recorded, including multiple detections per station as well as detections at multiple stations per survey. Fishers were detected at 39 (21.7%) of the track-plate surveys and 11 (52.4%) of the line-triggered camera surveys; martens were detected at 31 (17.2%) and 5 (23.8%), respectively, of these surveys.

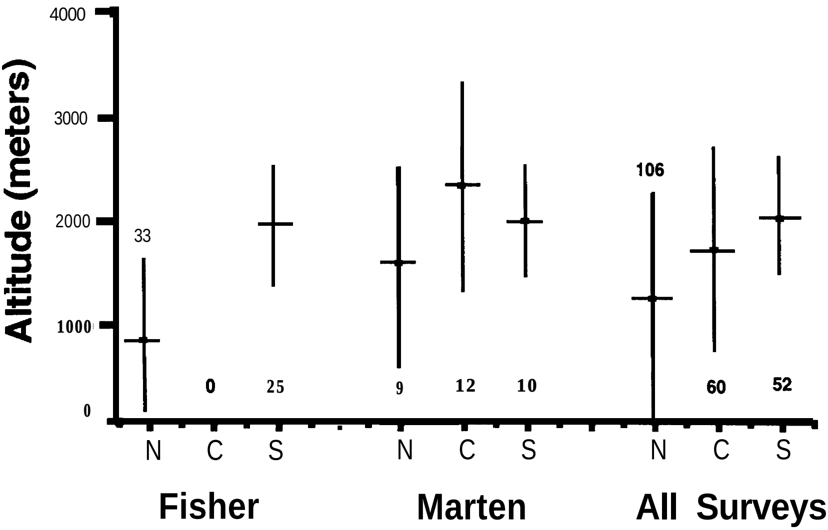

Figure 3. Elevational distribution of 218 surveys, surveys where fishers were detected (n = 58), and surveys where martens were detected (n = 31). N, C, and S represent Northern, Central and Southern latitudinal zones, separated by about 2 degrees and 10 minutes latitude each. Horizontal bars are means and vertical bars are 95% confidence intervals. The numbers above or below each bar are the sample sizes.

Survey Success, Number of Stations, and Effort: Surveys with 4-8 stations had less than half the success rate at detecting either species compared with those surveys with at least 20 stations (Fig. 4), but these differences were not statistically significant. Surveys that succeeded in detecting either species involved expending significantly more effort than surveys that did not (t-test, $P < 0.05$), a phenomenon that occurred even when the number of stations was as few as 6-10 (Fig. 5).

Latency to First and Second Detection: Fishers were first detected after a mean of 3.4 days; martens, after a mean of 3.3 days (Table 1). Each species was detected before about 30% of the total survey duration had elapsed, regardless of the number of stations in the survey (Table 2). Twenty-one surveys detected either fisher or marten more than once, and at a different station than where the first detection occurred. This second detection occurred an average of 6.7 days after the survey began for fishers, and 3.9 days for martens (Table 1). Martens were detected at a second station in a survey significantly sooner than were fishers (t = 2.66, df = 20, P = 0.01).

Table 1. Mean (± SD) latencies to first and second detection (days) for surveys that detected fishers or martens using either track plates or line-triggered cameras. All surveys had at least 4 stations and were checked every 2-3 days.

			Latency (in days)	
	No. Surveys	No. Surveys With Detections	First Detection	Second Detection
Fishers:				
All surveys	169	39	3.41 ± 2.06	6.72 ± 4.23
Track plate only	151	32	3.37 ± 1.93	
Line-triggered camera only	18	7	3.86 ± 2.67	
Martens:				
All Surveys	169	21	3.33 ± 2.58	3.94 ± 2.25
Track plate only	151	18	3.39 ± 2.64	
Line-triggered camera only	18	3	4.33 ± 2.89	

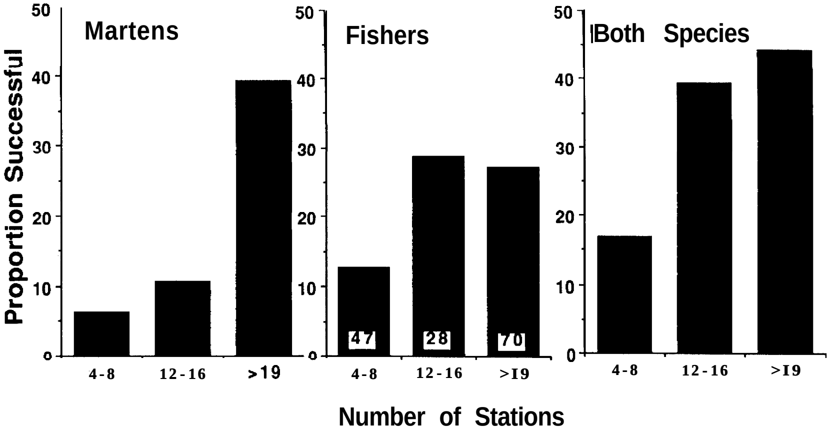

Figure 4. Proportion of surveys (%) that were successful at detecting martens, fishers and either species as a function of the number of stations in the survey. Numbers at the base of bars in the fisher panel are the sample sizes for the station groupings for all panels.

LFD and Type of Detection Device: Surveys that used only track plates detected fishers and martens after a mean of 3.2 and 2.4 days, respectively, whereas surveys that used only line-triggered cameras did so after 3.9 and 4.3 days (Table 1). In those surveys where line-triggered cameras were used to verify the identity of the species detected at a track plate (n = 56), fishers returned to be photographed at the same station on 12 occasions, after a mean of 5.9 days, and martens returned and were photographed on 9 occasions, after a mean of 3.3 days.

Table 2. Ratios (± SD) of latency to first detection/survey duration (both in days) for surveys with different numbers of stations.

Number of Stations	Fisher	Marten
>3	0.27 ± 0.2	0.30 ± 0.2
>9	0.27 ± 0.2	0.28 ± 0.2
>19	0.22 ± 0.1	0.25 ± 0.2
6-10[a]	0.32 ± 0.2	0.34 ± 0.2

[a] This grouping included because it is the number of stations per sampling unit in the monitoring program proposed by Zielinski and Stauffer (1996).

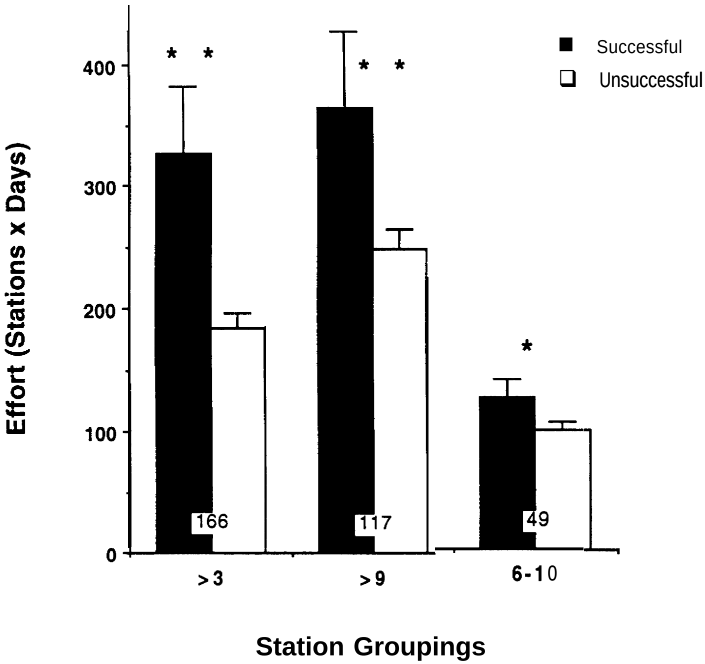

Figure 5. Amount of effort (number of stations x the number of days) expended for surveys that were successful (solid bars) or unsuccessful (open bars) for 3 station-number groupings. The 6-l0 grouping was chosen because it is the number of stations per sampling unit in the monitoring program proposed by Zielinski and Stauffer (1996). Asterisks indicate significant differences in *t*-tests ($P < 0.05$) and numbers at the base of the bars are sample sizes.

LFD, Number of Stations, Survey Duration, and Effort: There was no relationship between the number of stations in the survey and the LFD ($r^2 = 0.083$, $P > 0.05$), though there was a suggestion that as number of stations increased the latency decreased (Fig. 6). There was also no linear relationship between LFD and survey duration ($r^2 = 0.489$, df = 79, $P > 0.05$) nor a relationship between LFD and effort ($r^2 = 0.008$, df = 79, $P > 0.05$). However, when the number of stations in the survey, the duration of the survey, the survey area, and survey effort were included in a multiple regression, the full model was significant, but only for fisher, and the duration of the survey and effort were the 2 variables most responsible for the relationship (Table 3).

Geographic Distributions: Fishers were primarily detected in 2 areas of the state: the northern Coast Ranges/Klamath Mountains and the southern Sierra Nevada (Fig. 7A, B). Fishers were not detected in the southern Cascades or

Table 3. Multiple regression, with stepwise selection, relating the number of stations in the survey, number of days in the survey, effort, and survey area to the LFD for fishers and martens.

Source	df	Mean Square	*F*	Prob > *F*	Variable	Prob > *t*
Fishers:						
Model	4	10.69	3.023	0.03 1	Effort	0.008
Error	33	3.53			Number of Days	0.009
					Survey Area	0.182
					Number of Stations	0.209
Martens:						
Model	4	1.67	0.204	0.9323	Effort	0.692
Error	16	8.16			Number of Days	0.876
					Survey Area	0.817
					Number of Stations	0.638

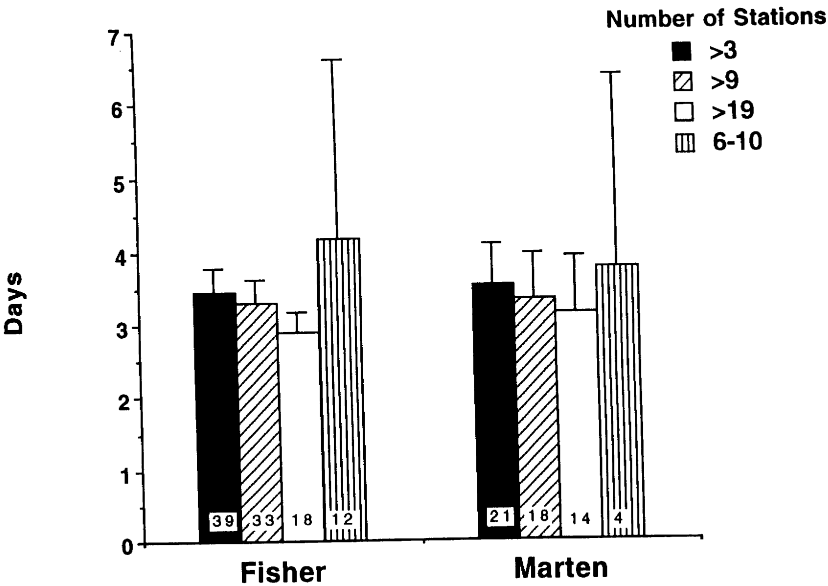

Figure 6. Mean (± SE) latency to first detection (in days) as a function of the number of stations in the survey. The 6-10 grouping was chosen because it is the number of stations per sampling unit in the monitoring program proposed by Zielinski and Stauffer (1996). Sample sizes are presented at the base of each bar.

northern and central Sierra Nevada, an area where they historically occurred (Grinnell et al. 1937). Martens were not detected in the northern Coast Ranges and Klamath Mountains, which includes the entire range of *M. a. humboldtensis* (Fig. 8A). However, martens are well distributed in the southern Cascades and Sierra Nevada (Fig. 8B). Both species were detected together only in the southern Sierra Nevada, where in a few instances an individual of each species visited the same track plate or camera station. Significant areas of the ranges of each species received little survey effort in this retrospective analysis, including several counties in the northern Sierra Nevada, the southern part of the northern Coast Ranges, and the upper elevations of the Klamath Mountains.

Discussion

Track plates and line-triggered cameras are efficient means for detecting the presence of fishers and martens. Twenty-three percent of the surveys detected fishers and 16% detected martens, even when the location of surveys was not

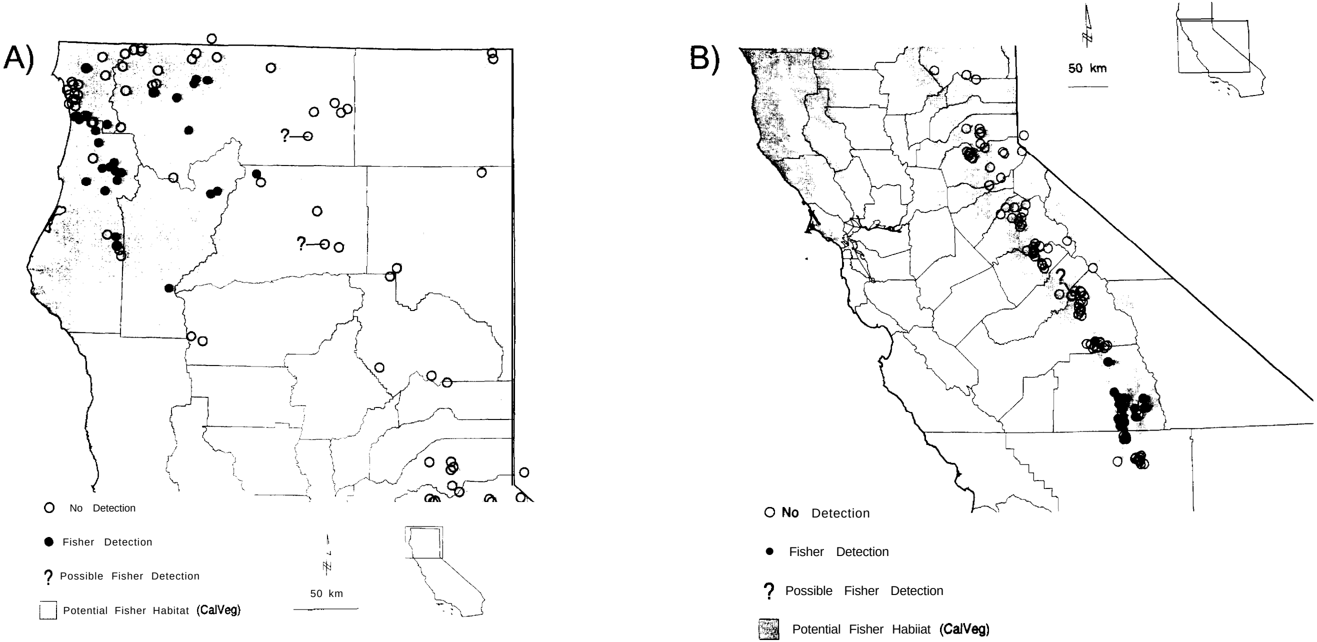

Figure 7. A. Northern California, and B. Central California, distributions of surveys that detected fishers (solid circles) and those that did not (open circles). Question marks denote surveys where a fisher track was reported but was either not submitted for verification or was of marginal quality for verification. Gray background is the distribution of CALVEG (Matyas and Parker 1980) vegetation types considered suitable fisher habitat. This included: Douglas fir-tanoak-madrone, Douglas fir-pine-madrone, Jeffrey pine, tanoak-madrone, madrone-black oak, mixed conifer-fir, mixed conifer-pine, Oregon white oak, ponderosa pine, redwood-Douglas fir, white fir.

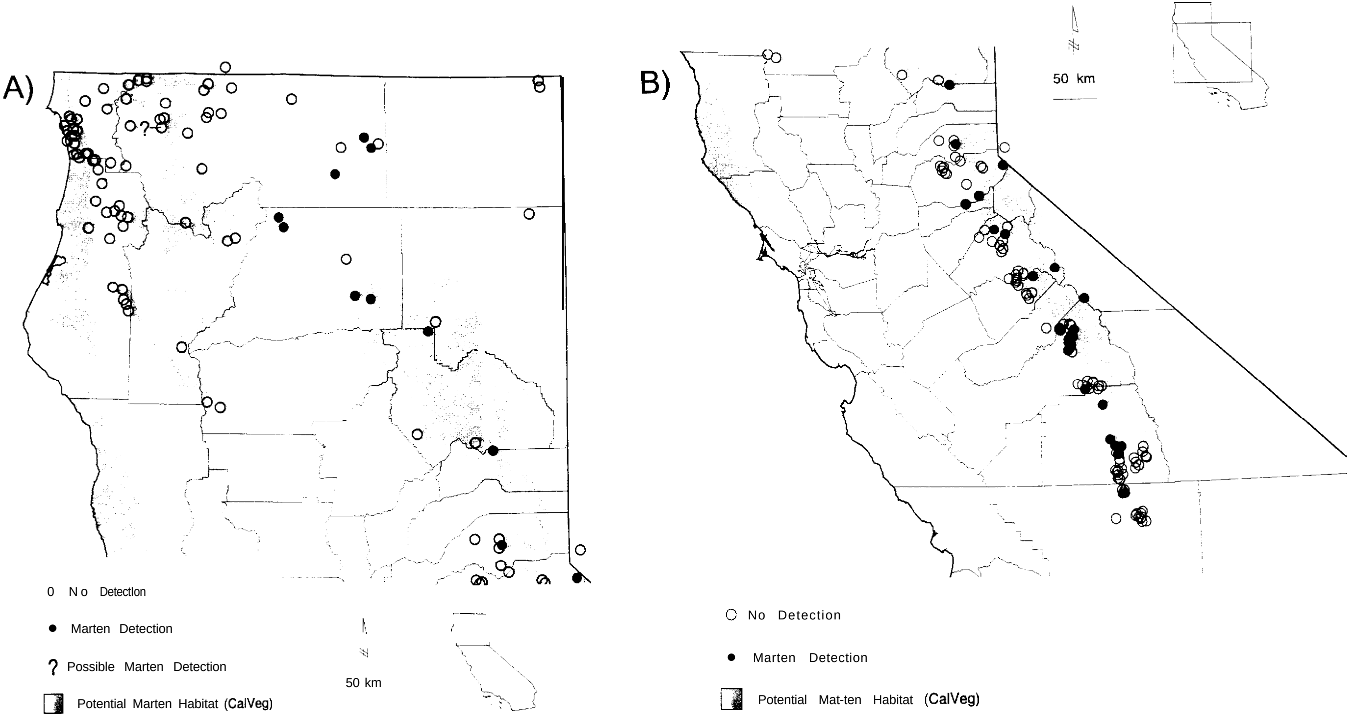

Figure 8. A. Northern California, and B. Central California, distributions of surveys that detected martens (solid circles) and those that did not (open circles). Question marks denote surveys where a marten track was reported but was either not submitted for verification or was of marginal quality for verification. Gray background is the distribution of CALVEG (Matyas and Parker 1980) vegetation types considered suitable marten habitat. This included: red fir, white fir, mountain hemlock, redwood-Douglas fir, lodgepole pine, mixed conifer-fir, Douglas fir-tanoak-madrone, Douglas fir-pine-madrone, Jeffrey pine.

controlled and some surveys were undoubtedly in inappropriate habitat. Another measure of their utility is the short duration, 3-4 days, before **1** or the other species was verified in a survey area. In addition to determining occurrence, these methods were also useful for describing the current distributions at state and regional scales. Collectively, these surveys provided a more reliable understanding of a species' range than does a summary of incidental sightings of unknown accuracy because each record can be independently verified. Although sighting data can be screened for reliability (e.g., Aubry and Houston 1992), and perhaps can be gathered more economically than conducting field detection surveys, we believe that sighting data should be used to augment, not substitute for, surveys using track plates or cameras.

Although the inferences we can draw from the present summaries are limited by the number of uncontrolled variables, a number of interpretations can be made that will benefit future monitoring and detection efforts. That fishers and martens were detected after a mean of only 3 or 4 days reinforces the conclusion that a maximum survey period of about 2 weeks is probably sufficient, provided a reasonable number of stations are used and distributed as recommended. Even the upper confidence limits on LFD, 7.5 days for fishers and 8.4 days for martens, occurred before the end of the recommended duration. A series of surveys (n = 48) of 22 days each were recently completed on commercial forest land in northwestern California (R. Klug, Simpson Timber Co., pers. commun. 1995) and the mean LFD for fishers (martens do not occur in the study area) was about 12 days (n = 31), or 3 times the LFD reported here. However, each survey had only 6 stations, which may have influenced LFD. This result may also have been specific to the relatively small area sampled (and consequently fewer individuals included) compared to the summary of statewide surveys reported here. Regardless of the length of survey or the number of stations in the survey, the first detections in our data set almost always occurred before 30% of the intended survey duration had elapsed and the second detection (at a different station) occurred shortly thereafter.

Some of the most important methodological questions, namely how many stations are required and how long they should be run to achieve a particular probability of detection, are difficult to answer using the type of data summarized here. Sampling rigor was unregulated, and sampling locations and timing were determined by management needs, motivation of local biologists, and the availability of funds and personnel. It was perhaps this lack of strict control on methods and sampling design that made it difficult to elucidate factors that affect survey success, For example, it is logical to assume that as the number of stations in the survey increases, the time until 1 of them is visited by a target species should decrease. Although our analysis did not confirm this prediction, the trend was in the correct direction. The failure to find a statistically significant relationship between these variables may have been due, in part, to a lack of control of habitat and landscape suitability. The CALVEG data suggest that a number of surveys were conducted in general vegetation types that were not considered suitable by our standards, and it is possible that surveys were not conducted in the most suitable seral stages of otherwise suitable vegetation types. Furthermore, we did not assess landscape effects on habitat suitability (e.g., Rosenberg and Raphael 1986).

The data for fisher detections suggest that the number of stations in a survey may be less important than the duration of the survey. Although station number and survey duration certainly combine to affect survey success, determining the minimum number of stations to use given a specific survey duration is difficult. Surveys that had as few as 6- 10 stations were still successful if they expended about *120* units of effort or more (Fig. 5). Using 8 stations this is accomplished with a survey lasting at least 15 days. Although a greater number of stations should probably be used, simply because the detection of rare carnivores dictates that effort be as liberal as can be afforded, it seems that surveys with as few as 6-l0 stations can be as successful as those with more stations provided the stations are in place for at least 2 weeks. However, we caution that our retrospective analyses are not well suited to drawing strong inferences.

The ideal way to evaluate methods would be to control for the presence and abundance of the target species. In no case was the presence of fishers or martens verified before the surveys summarized here were conducted. However, our summary compensates for lack of experimental rigor with sample size. It would be very difficult to conduct a single research study that included 225 surveys (and almost 4000 stations) across the state of California, especially if it was necessary to precede each survey with a mark-recapture or radio-telemetry effort so that the occurrence of the target species at each location was known. A practical compromise might be to at least stratify the sampling area by habitat type and seral stage (using a more comprehensive dataset than CALVEG) prior to conducting the surveys. This approach is proposed by Zielinski and Stauffer (1996) in a population monitoring scheme that determines the sampling effort to detect declines in an index of abundance of fishers or martens in California.

The distribution of successful and unsuccessful surveys is an important assessment of the current status of both species in California. This paper is not intended to be a description of the current distributions because it reviews only 2 methods used to verify presence. However, our data comprise the bulk of the data used recently to create range maps (Kucera et al. 1995; Zielinski et al. 1995). Fishers appear to be very uncommon in the southern Cascades and throughout much of the Sierra Nevada. Although some very recent photographs of a fisher at a camera station (L. Chow, National Biological Service, pers, commun. 1995) and several roadkills suggest the presence of the species just north of the subpopulation depicted in the extreme southern Sierra Nevada in Figure 7B, the detections occurred after considerable previous survey effort. A few recent sightings of fishers have been reported in the northern Sierra Nevada (E. Burkett, California Fish and Game, pers. commun. 1995) but mistaking other species for fishers, especially the more abundant marten, is common (W. Zielinski, pers. obs.; R. Golightly, Humboldt State University, pers. commun. 1994).

The distribution of martens also appears to have changed since it was first described (Grinnell et al. 1937). Surveys indicate that martens are well distributed throughout the Sierra Nevada and Cascades in California, but the absence of marten detections in the range of *M.* ***a. humboldtensis*** is of concern. Although surveys were not common at the higher elevations in the Klamath Mountains, which appear to include some typical marten habitat, the absence of any marten detections in the redwood and Douglas-fir types in this region indicates that if the Humboldt marten still exists it does so at very low densities. Surveys were recently conducted in the redwood type along the coastline in northwestern California (R. Klug, Simpson Timber Co., pers. commun. 1994; R. Golightly, Humboldt State University, pers. commun. 1994). No martens were detected, and with the exception of several fisher detections near the coast the results do not substantially alter the distributions presented here.

Both track-plate and line-triggered camera stations were effective at detecting martens and fishers, but both species were detected in a higher percentage of surveys that used only line-trigger cameras than surveys that used only track plates (fishers: 52.4% versus 21.7%; martens: 23.8% *versus* 17.2%). Much of this difference is probably accounted for by the fact that camera-only surveys occurred most frequently in the extreme southern Sierra Nevada where both species are relatively common and frequently sympatric. Previous work suggests that cameras are somewhat less effective at detecting martens than track plates (Bull et al. 1992, Fowler and Golightly 1994). Had surveys using the 2 devices been conducted with control for geographic location, it is likely that the results would have been similar. However, line-triggered cameras have the disadvantage of being more fragile and prone to malfunction than track-plate stations and being incapable of detecting a second visit to the station between rebaiting (Zielinski and Kucera 1995b).

Surveys that use single-sensor 35-mm cameras (Kucera and Barrett 1993, Kucera et al. 1995) were uncommon during the period summarized here, largely because their significant cost limits the number that can be deployed. The results from 35-mm cameras were excluded from this summary because of the infrequent use of these cameras and absence of a standard protocol during the assessment period. However, more detailed maps of the distributions of martens and fishers have recently been published that were created from the combined results of 35-mm cameras, line-triggered cameras, track plates and other miscellaneous verifiable records (Kucera et al. 1995; Zielinski et al. 1995).

The knowledge that most surveys that include 6-10 stations and are run for at least 12 days will detect either a marten or fisher, if present, in less than 4 days provides a strong foundation for new detection protocols and for sampling designs that monitor changes in abundance and distribution. These results have already been influential in proposals for a new detection protocol that will be applied throughout the western U.S. (Zielinski and Kucera 1995a) and a scheme for monitoring changes in an index of fisher and marten abundance in California (Zielinski and Stauffer 1996). Current survey methods are quite good at documenting that either fishers or martens are present in an area. However, we are much less confident in declaring a species absent when it is not detected. Careful quantification of future detection and monitoring efforts, combined with more experimental work in areas where presence and abundance of target species has been confirmed, will improve our confidence in establishing presence and absence.

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