

Effects of Trail Width on the Densities of Four Species of Breeding Birds in Chaparral¹

Aaron L. Holmes² and Geoffrey R. Geupel²

Abstract

We investigated densities of four common species, Wrentit (*Chamaea fasciata*), Spotted Towhee (*Pipilo erythrophthalmus*), Bewick's Wren (*Thryomanes bewickii*), and Orange-crowned Warbler (*Vermivora celata*) in relation to trail width in chaparral habitats of Mt. Tamalpais, Marin County, California. Point count sampling stations were assigned to one of three trail width groups—thin (≤ 2 m), medium (2.1–4 m), and wide (> 4 m). We found a marginally significant ($P < 0.1$) negative effect of trail width on the density of Spotted Towhee when thin trails were compared to medium/wide trails. For the other three species our results suggest a trail width effect when thin trails were compared to medium/wide trails ($P < 0.2$), although additional study is needed to confirm or negate these tentative conclusions. Only one species, Orange-crowned Warbler, showed a positive relationship between density and trail width

Key words: Bewick's Wren, chaparral, Orange-crowned Warbler, road, Spotted Towhee, trail, Wrentit.

Introduction

Several studies on the effect of roads show that they may negatively affect the ecosystems and wildlife around them (reviewed in Forman and Alexander 1998). The Marin Municipal Water District conducts limited mechanical clearing of vegetation along fire roads and recreational trails as part of a fuels management program. Potential impacts to songbirds include the direct effect of reduced habitat availability, as well as indirect effects resulting from the creation of long, thin habitat edges within otherwise continuous habitat. To assess if this trail widening impacts songbird abundance we estimated the densities of four species breeding in chaparral habitats with varying trail widths.

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²PRBO Conservation Science, 4990 Shoreline Hwy. Stinson Beach, CA. Corresponding author e-mail: aholmes@prbo.org.

Methods

Study Area

The study was conducted on lands managed by the Marin Municipal Water District located on Mount Tamalpais, Marin County, California during the 1999 nesting season.

Mount Tamalpais is located in coastal Marin County, just north of the San Francisco Bay. The study area was comprised of a mosaic of two chaparral habitat associations and ranged in elevation from 350 to 650 m. The chamise association, typically found on xeric south- or west-facing slopes and ridges is typified by dense stands of chamise (*Adenostoma fasciculatum*) interspersed with manzanita (*Arctostaphylos manzanita*) and buckbrush (*Ceanothus cuneatus*), all species that reach heights of 1 to 2 m at maturity. A second association, mixed chaparral, occurs on more mesic sites, often grading into mixed evergreen forest, and is dominated by a mix of manzanita, chamise, buck brush and interior live oak (*Quercus wislizenii*). Coffeeberry (*Rhamnus californica*), blue blossom (*Ceanothus thyrsiflorus*), and chaparral pea (*Pickeringia montana*) also occur in lesser amounts. This community is common along the ridge and on the north-facing slope of Mt. Tamalpais. Sampling points were distributed in both habitat associations. All single-track trails and fire roads within appropriate habitat were selected for study and point counts were established approximately 250 m apart beginning 100 m from the trail or fire road origin. For this analysis we excluded points that fell within the mixed evergreen forest that bordered the chaparral associations. Hiking and mountain biking are the principal uses of all the trails included in this study, although motorized vehicles occasionally used several of the fire roads for maintenance activities.

Bird Surveys

We conducted point count surveys (Ralph et al. 1993) and employed distance sampling at a total of 86 count stations during May and June 1999. All birds detected within 100 m were recorded and distance from the observer was estimated within 10-m bands during a 5-minute period. The type of detection (song, visual, or call) was also noted. Surveys began within a half hour after local sunrise and continued for no more than 4 hours in order to restrict sampling to peak singing hours. Counts were not conducted during excessively

rainy, foggy, or windy conditions where bird activity levels or detection probability may have been reduced. One individual who had multiple years of prior experience conducted all of the surveys. Intensive training in distance estimation occurred prior to the collection of any data.

Trail width was measured perpendicular to the trail, to the nearest 0.5 m, at the center of each point count. Edges were defined by the boundary with shrubby vegetation whether or not trails had been mechanically cleared. These were nearly always discrete and easily determined.

Statistical Analysis

We used the program DISTANCE (Laake et al. 1993) to develop density models for four of the most abundant species occurring in chaparral, Wrentit (*Chamaea fasciata*), Spotted Towhee (*Pipilo erythrophthalmus*), Bewick’s Wren (*Thryomanes bewickii*), and Orange-crowned Warbler (*Vermivora celata*). We assigned points into three trail width groups—thin (≤ 2 m), medium (2.1 - 4 m), and wide (>4 m). For most analyses, we combined medium and wide trails in order to compare single track (i.e., thin) to wider trails. Data were summed across two surveys for each count station. We used only song data to model the detection probability as we believed it would be less likely than visual or call detections to be affected by trail width. Because female Wrentits sing (although less often than males), whereas female Spotted Towhees, Bewick’s Wrens, and Orange-crowned Warblers do not, the density estimate for Wrentits should be higher relative to true density. Models were selected among alternates based on minimum Akaike information criterion (AIC). Detection models used a half-normal key function with Cosine series expansion (Laake et al. 1993). We then developed density models for each trail width category, and trail effects were tested for significance using a two-tailed t-test.

Results

Mean trail widths at point counts was 3.2 m (N = 86). Mean width was 1.1 m for the thin trail category (N =

31), 3.5 m in the medium width category (N = 37), and 6 m in the wide category (N = 18). Densities of Wrentit, Spotted Towhee, and Bewick’s Wren were lower at points in the medium/wide trail category compared to the thin trail category (table 1). The index to Wrentit density was 28 percent lower on medium/wide trails (P = 0.13). Spotted Towhee density was 38 percent lower (P = 0.09), and Bewick’s Wren density 32 percent lower on medium/wide trails (P = 0.16). The index to Orange-crowned Warbler density was 80 percent higher on medium/ wide trails, although once again the difference was not significant statistically (P = 0.17). For the two species with sufficient data, we split medium from wide trails to see if the magnitude of this effect increases with increasing trail width. There was no difference in densities of either Wrentit ($t_{(53)} = 0.04$, P = 0.96) or Spotted Towhee ($t_{(53)} = 0.02$, P = 0.99) between medium and wide trails (fig. 1).

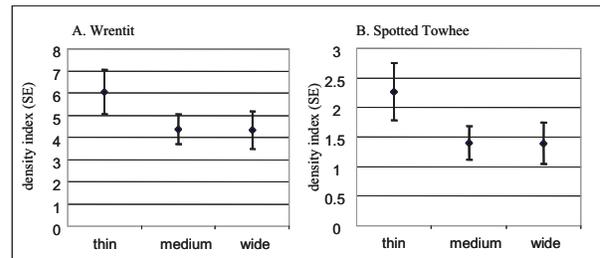


Figure 1— Densities (se) of Wrentit (A) and Spotted Towhee (B) at locations with thin (1 - 2 m), medium (2 - 4 m), and wide (>4 m) trails through chaparral habitats of Mt. Tamalpais, California.

Discussion

This study provides tentative evidence that fragmentation of chaparral habitat by wider trails and fire roads results in a negative effect on the density of some shrub-nesting bird species. The results of our analyses were not statistically significant by conventional measures, but should be considered suggestive and used to guide further studies that will seek a firm conclusion (Robinson and Wainer 2002).

Table 1— Mean bird density indices with standard errors in relation to thin (≤ 2 m), medium (2.1–4 m), and wide (>4 m) trails in chaparral habitat, Marin County, California.

Species	Density index \pm se		$t_{(84)}$	P
	Thin	Medium/wide		
Wrentit	6.08 \pm 0.99	4.36 \pm 0.63	1.54	0.13
Spotted Towhee	2.27 \pm 0.49	1.40 \pm 0.25	1.77	0.09
Bewick’s Wren	3.04 \pm 0.59	2.07 \pm 0.38	1.43	0.16
Orange-crowned Warbler	0.36 \pm 0.12	0.65 \pm 0.14	1.38	0.17

We believe that the observed difference in songbird densities is unlikely to stem directly from loss of available habitat. At the scale of the 100-m radius bird survey plots, less than 3 percent of the habitat is removed for the trails. The reductions in songbird densities were of a much greater magnitude (28-38 percent). Our observations suggest similar rates of recreational use on all the trails within the study area. In fact, many trails connect to form discrete loops such that a hiker or mountain biker will often hike a route that combines thin and wider trails within a continuous stand of vegetation. Therefore we do not believe that variable rates or other aspects of recreational use are likely causes of differential use by songbirds.

Other researchers have documented numerous ecological effects of trails (reviewed in Forman and Alexander 1998). Miller et al. (1998) documented negative effects of trails on songbirds in both forest and grassland ecosystems in Colorado. The trails used in their study were 1.25 m, similar in width to our thin trail category. Three of four species in grassland, and five of 11 species in forest were significantly less abundant around trails. Reduced abundance of some forest-nesting songbirds along roads and power lines has been documented in New Jersey (Rich et al. 1994). Haskell (2000) found reduced abundance and species richness of macroinvertebrate soil fauna up to 100 m from forest roads in the Southern Appalachian Mountains. He hypothesized that this may reduce abundance of songbirds near roads, and may serve as an alternative explanation for studies in Europe that have attributed reduced roadside bird abundance to noise levels (Reijnen 1995).

Differential use of surrounding habitat based on trail width could be a functional response related to a species habitat associations and changes in vegetation resulting from the trails themselves. Alternatively differences could be due to a behavioral response to discrete vegetation edges and resulting habitat structure. Only Orange-crowned Warbler demonstrated a positive response in density to trail width, which may relate to an affinity for openings within the shrub canopy not shared by the other species. Independent data in similar habitat is needed to further evaluate this possibility.

Because densities of both Wrentit and Spotted Towhee do not differ between medium and wide trail classes (greater than 2 m), our data suggests mechanical clearing of vegetation on fire roads may not affect the densities of these species if limited to existing trails already wider than 2-3 m. However, clearing vegetation

to widen a thin (0.5-2 m) trail may have a negative impact on these species and other wildlife. Although this study offers only limited support for our conclusions, we recommend that only single-track trails <2m wide be established if new recreational trails are developed.

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