Life on a Highway: Sources of Mortality in an Endangered British Columbian Badger Population

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Abstract: Populations of the British Columbia subspecies of North American badger[1] (*Taxidea taxus jeffersonii*) are endangered, but relatively little is known about the factors that have contributed to this status. In an effort to assess the sources of mortality within this population, we radiotagged and monitored 13 free-ranging badgers in the Thompson region between 1999 and 2002. During 4791 radio·days of monitoring, we documented the deaths of 6 radio-tagged animals. We also recorded the mortality of 1 of the radio-tagged badgers after monitoring had ended. Six of the 7 badgers were killed on roads or railways, in addition to at least 11 other untagged badgers that suffered the same fate. Most of these mortalities occurred during July when traffic volumes peaked and the movements of badgers were greatest. The survivorship of badgers in the Thompson region may be related to the frequency with which animals crossed roads and to the density of paved roads within their respective home ranges. Research is currently underway to assess the efficacy of alternative crossing structures and modified concrete roadside barriers to reduce badger road mortality.

Key Words: North American badger, badger, *Taxidea taxus*, *Taxidea taxus jeffersonii*, movements, transportation corridor, mortality risk, British Columbia

Introduction

Throughout much of their range, populations of North American badgers (*Taxidea taxus*) are considered to be relatively stable or increasing (Messick 1987); however, in the Thompson and Okanagan regions of British Columbia (B.C.), populations of badgers appear to be in decline, which may be a result of low survival within the population (Rahme et al. 1995). The objective of our research was to identify causes of mortality within a representative population of badgers in the Thompson region. Identifying and reducing mortality sources will ultimately help the recovery of this critically endangered population of badgers.

[1]NatureServe Explorer (version 4.0, July 2004) lists *Taxidea taxus* and *T. t. jeffersonii* as the American badger. The BC Species and Ecosystems Explorer (September 2004) lists the common name for *T. taxus* as 'badger'.

Study Area

The study area was located in the vicinity of Kamloops, British Columbia (50º40' N, 120º20' W), and covered approximately 4390 km^2 (Fig. 1). This area includes the Bunchgrass (BG), Ponderosa Pine (PP), Interior Douglas-fir (IDF), Montane Spruce (MS), and Engelmann Spruce–Subalpine Fir (ESSF) biogeoclimatic zones (Meidinger and Pojar 1991). The climate of the BG, PP, and IDF zones is characterized by warm to hot, dry summers and cool to cold winters with relatively little snowfall. Summer droughts are typical and prolonged. Much of the moisture available for plant growth in these zones is derived from winter snowfall.

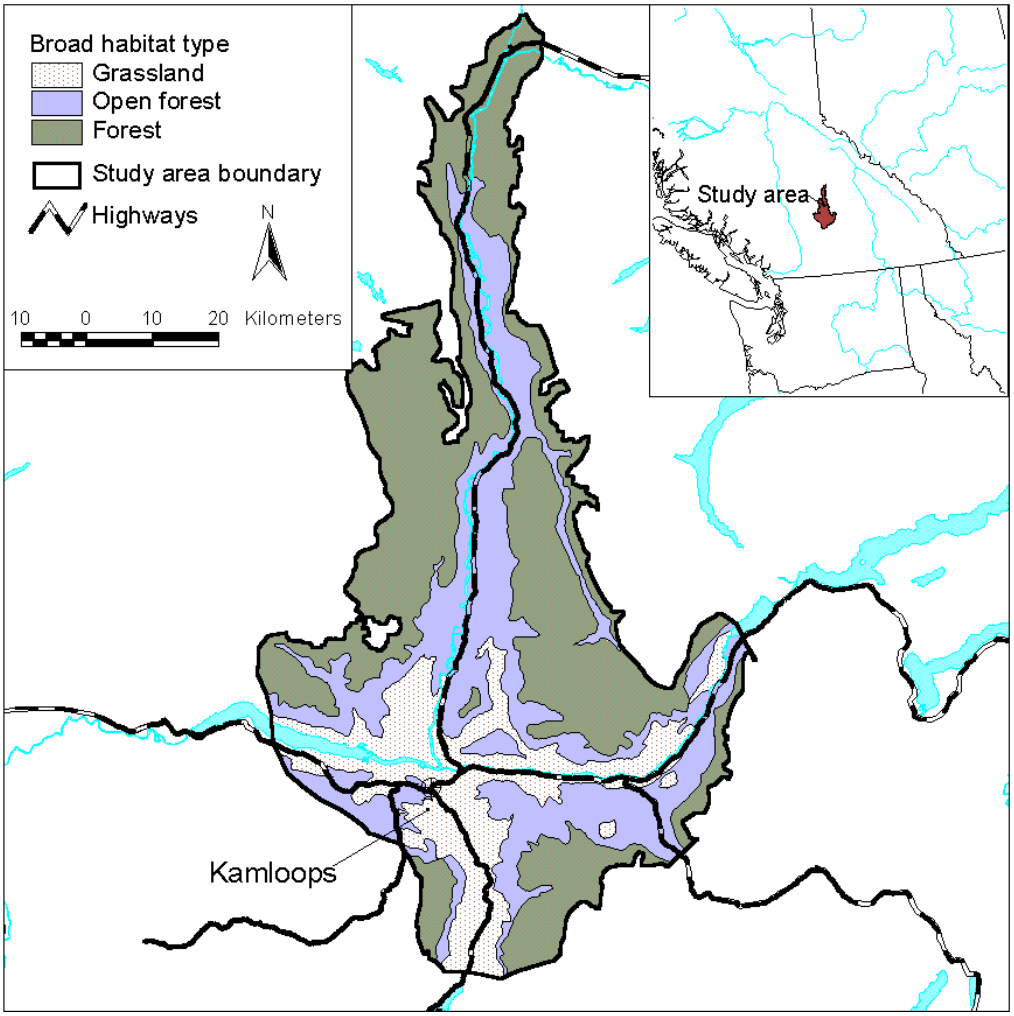

Figure 1. Location, broad habitats, and major highways of the study area near Kamloops, British Columbia. Railways occur in the valley bottoms, parallel to the major highways.

The study area encompasses a variety of land use practices. Roughly 154 km^2 of the area is within a protected area (Lac du Bois Grasslands Provincial Park) in which moderate levels of cattle grazing occur. The Kamloops Indian Band controls approximately 310 km^2 as both Indian

Reserve lands and active ranches with some intensive agricultural development. Most of the valley bottom areas surrounding the North Thompson and South Thompson Rivers are used for intensive agriculture or have been converted to urban areas. Very little unmodified grassland exists within the boundary of the study area. Forested Crown land within the study area is grazed by cattle according to grazing permits issued by the B.C. Ministry of Forests.

Four major transportation corridors pass through the study area. These include the main lines of the Canadian Pacific and the Canadian National Railways, the Trans-Canada Highway (#1), and the Yellowhead Highway (#5). During the peak traffic month of August, traffic averages 18,000 vehicles/day on the Trans-Canada Highway and 6400 vehicles/day on the Yellowhead Highway (B. Persello, pers. comm.). Paved roads are concentrated in the valley bottoms and generally run parallel to the North Thompson and South Thompson Rivers.

Methods

We attempted to capture adult badgers between July 1999 and June 2001 by setting livetraps at the mouth of active badger burrows (Baker and Dwyer 1987). We used off-set, padded 'soft-catch' foothold traps (Victor 1½ coil spring) anchored with a 3 mm diameter cable to a flared anchor pounded 45 cm into the soil. We scented nearby vegetation with commercial canine lure and occasionally baited burrow entrances with approximately 500 g of roadkilled deer or ground squirrel carrion. All captures and immobilizations followed the appropriate Resources Inventory Committee (RIC) standards (RIC 1998a), and methods of physical and chemical restraint adhered to the provincial guidelines for animal welfare. Protocols for handling and radiotagging the badgers were approved by the University College of the Cariboo Research Ethics Committee (Animal Subjects), a committee recognized by the Canada Council on Animal Care.

Captured badgers were immobilized using a 1:1 mixture of tiletamine hydrochloride and zolazepam hydrochloride (Telazol®) prior to transportation to a veterinary clinic for implantation of a radio transmitter. Under sterile conditions, a veterinarian surgically fitted each badger that weighed > 7 kg with an intraperitoneal transmitter with mortality switch (ATS MOD17C or Telonics IMP400/L with high power option).

We measured and monitored badgers while they were immobilized. Sex, body weight, and cranial and skeletal measurements were documented. We classified most badgers as adults or juveniles by examining sexual development and the level of occlusion of the canine teeth. We released each badger from the transfer container at their capture burrow when they had fully recovered from the anaesthetic.

We attempted to locate radio-tagged badgers using standard ground and aerial telemetry procedures (RIC 1998b). From the ground, we recorded directional bearings to badgers using a three-element, collapsible Yagi antenna. When badgers were inactive, we homed in on their signal (White and Garrott 1990). We occasionally triangulated radiolocations using LOAS software (Ecological Software Solutions 2000) when we were unable to home in on the signal

source. We located badgers whenever possible from the ground. When the radio transmitters began emitting signals at the 'mortality' rate, we attempted to collect the carcass for necropsy as soon as possible to determine the cause of death.

Results and Discussion

We observed a high rate of mortality among the badgers that we radiotagged. Six of the 13 badgers died during 4791 radio·days of monitoring, and 1 additional radio-tagged badger died after monitoring ended (Fig. 2). Six of the 7 mortalities of study animals that we documented were the result of collisions with vehicles on highways (n = 5) or with trains (n = 1). We observed one mortality that may have been the result of predation, but the remains that we recovered were insufficient to determine the cause of death. In addition to the 6 radio-tagged badgers, at least 11 other untagged badgers were killed on roads or railways in the study area between 1998 and 2003. Of the 17 road or rail mortalities, 4 were females, 7 were males, and 6 were unidentified. Eight badgers were of unknown age, but 7 were adults and 2 were juveniles. Most of the mortalities occurred during July (n = 8), followed by May (n = 4), June (n = 2), August (n = 2), and October (n = 1).

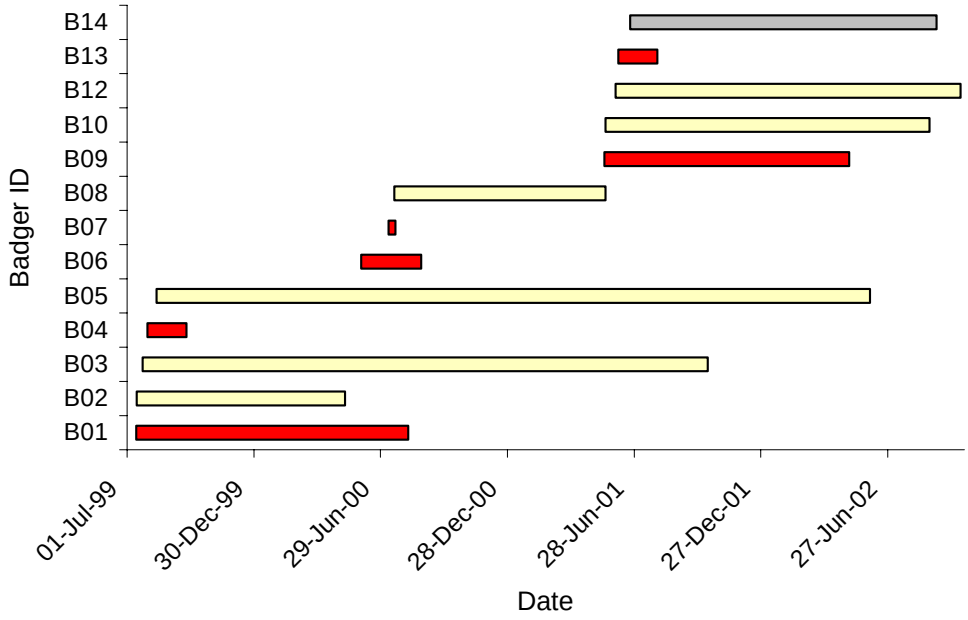

Figure 2. Monitoring history of 13 radio-tagged badgers in the Thompson region of British Columbia. Red bars indicate mortalities that occurred during the study, grey bar indicates mortality that occurred after monitoring ended, and clear bars indicate unknown fates. Six of the 7 confirmed mortalities were the result of collisions with vehicles or trains. B06 and B07 were both females; all other badgers were male.

Transportation corridors were clearly a major source of mortality for badgers in the Thompson region (Fig. 3). A 21-km stretch of the Trans-Canada Highway between Kamloops and Pritchard was responsible for 7 of these mortalities in 4 years. Badgers in our study had large home ranges (Hoodicoff 2003) that usually were located in the valley bottoms. Most of these home ranges overlapped major transportation corridors, such as the Trans-Canada Highway or Canadian National Railway, and thus exposed badgers to the possibility of collisions with vehicles during their normal day-to-day movements.

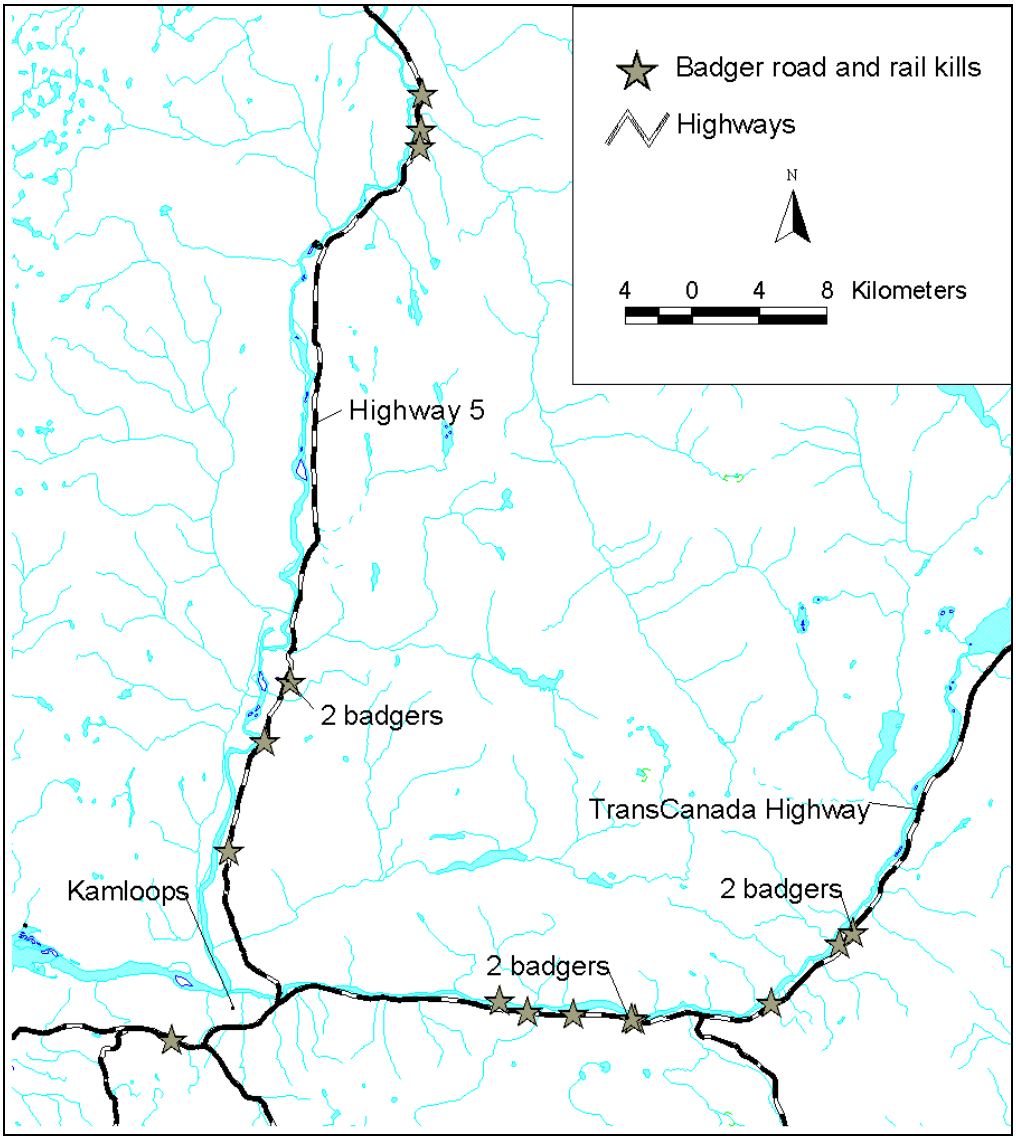

Figure 3. Spatial distribution of documented kills of 17 badgers that occurred on roads and railways in the Thompson region between 1998 and 2003. Several sites had multiple kills.

Badgers may have been exposed to greater mortality risk because of heightened activity during the summer months which coincided with increased traffic volumes along the major

highway routes (Fig. 4). Badgers increased their movements within their home ranges during June and July compared to other times of the year (Hoodicoff 2003). For male badgers, potential mates are a limiting resource, and males must move widely during June and July to sequester access to breeding females (Minta 1993). It is unclear if female badgers in the valley bottoms are less susceptible to road mortality because of smaller home ranges and movements; the one female that we had tagged was killed from a collision with a vehicle. Additionally, Columbian ground squirrels (*Spermophilus columbianus*) and yellow-bellied marmots (*Marmota flaviventris*), which are the primary prey of badgers in the area (Hoodicoff 2003), do not enter hibernation until early August and may be more difficult to catch when active. Thus, badgers may have to forage more widely prior to their prey hibernating.

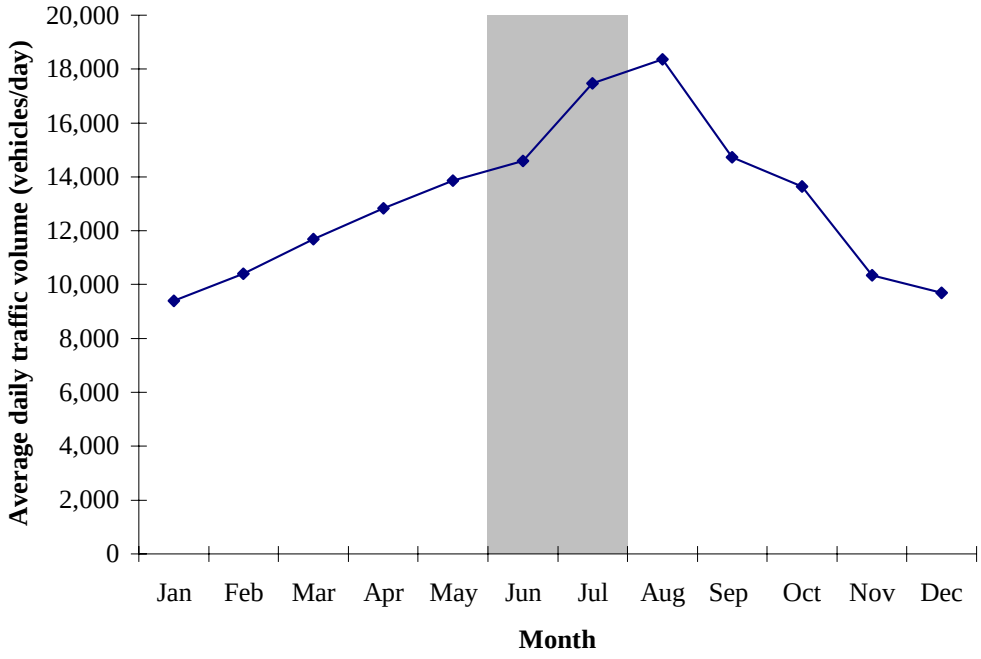

Figure 4. Average daily traffic volume on the Trans-Canada Highway, east of Kamloops, British Columbia. The breeding season for badgers occurs during June and July (in grey). (Traffic data from the B.C. Ministry of Transportation's Traffic Information Management System).

The survival of badgers in the Thompson region may have been related to the density of paved roads within their respective home ranges (Table 1), and more specifically, to the type of roads passing through their home ranges. For example, adult male B10 had a small portion of the Trans-Canada Highway passing through his home range, but most of the other paved roads were municipal roads that had speed limits of 50 km/h. Other badgers had either the Trans-Canada Highway or Highway #5 running through their home ranges. It was unlikely that badgers whose home ranges included a portion of a transportation corridor faced the same rates of mortality as those that did not.

Table 1. Effects of road density and road crossing frequency on mortality among radio-tagged badgers monitored between 1999 and 2002 in the Thompson region of British Columbia. All badgers were male, except for B06 and B07.

Badger ID	*Monitoring period (radio·days)*	*Radio locations*	*Minimum crossings of paved road*	*Home range size[a] (km²)*	*Paved roads within home range (km)*	*Density of paved roads within home range (km/km²)*	*Fate[b]*
B01	391	8	3	—	—	—	Roadkill
B02	299	5	0	—	—	—	Unknown
B03	812	76	26	53.7	57.6	1.07	Alive
B04	56	2	0	—	—	—	Unknown mortality
B05	1025	110	0	34.7	9.1	0.26	Alive
B06	86	62	15	15.6	24.2	1.55	Roadkill
B07	10	13	1	—	—	—	Roadkill
B08	303	33	3	18.1	1.9	0.10	Unknown
B09	352	47	17	37.3	14.4	0.39	Roadkill
B10	465	46	4	21.5	11.1	0.52	Alive
B12	496	33	0	30.5	0	0	Alive
B13	56	2	1	—	—	—	Roadkill
B14	440	56	4	33.4	13.8	0.41	Trainkill

[a]95% fixed kernel estimate from Hoodicoff (2003)
[b]as of last radiolocation

The frequency with which badgers crossed roads appeared to affect the survivorship of each individual. For example, the Trans-Canada Highway passed through the home ranges of B09 and B14, and they both crossed it repeatedly prior to their respective deaths on that highway. An adult female (B06) was recorded crossing Highway #5 at least 15 times before she was struck and killed. However, some badgers successfully crossed major roads repeatedly; B03 was documented successfully crossing Highway #5 at least 26 times, and one night traveled along the highway corridor for 14 km. Perhaps that stretch of highway had more crossing structures, or the badger used a safer location to cross or crossed during hours of low traffic volumes.

In our study, age and, therefore, experience did not seem to be a factor that affected the susceptibility of badgers to collisions with vehicle traffic. B01 was an adult male that had been tagged for more than one year before he was struck on the road in 2000. B03 (another adult male) survived to the end of the monitoring period, despite being observed crossing the highway repeatedly, including one instance where he narrowly avoided being killed. Dispersing badgers, however, may be at greater risk of road mortality because of their inexperience with traffic and wide-ranging movements while transient (Messick 1987). Movements of inexperienced, dispersing badgers may partially explain the pulse of roadkills that we recorded during May.

Concrete roadside barriers may be an unexpected hazard that badgers encountered when crossing highways, particularly when the barriers occurred on only one side of the road surface. We received several reports of badgers running up and down the roadside, attempting to circumvent these barriers. Six of the 20 badgers that we documented were killed in areas with continuous roadside barriers that occurred on only one side of the highway. Changes to the configurations of these roadside barriers may help reduce the risk that badgers face when crossing highways.

Conclusions

In British Columbia, much of the grassland habitat is limited to the lower elevations of interior river systems. Unfortunately, major highway and railway corridors also pass through these habitats. Badgers that occur in valley bottoms are exposed to considerable risk of vehicle collisions because their normal day-to-day movements force them to cross hazardous areas. As a result of the high rates of mortality, badgers that live in valley bottoms may form population sinks despite the apparent quality of habitat in which they live. Badgers that live outside of valley bottoms, however, likely are at lower risk of mortality and may be valuable source populations.

Reducing the mortality of badgers along transportation corridors would involve reducing the rate of collisions with vehicles; however, this may be problematic. Badgers do not appear to cross roads at predictable sites, so placing alternative crossing structures at appropriate locations would be difficult. Also, motorists may have difficulty detecting badgers because they are drab-colored, have a low-slung profile, and are active primarily at night (Messick 1987; Minta 1993).

Limiting the ability of badgers to access surfaces of major highways, in conjunction with providing alternative crossing structures, may help reduce collisions with vehicles. Also, reducing the use of concrete roadside barriers on a single side of the road surface may help reduce the likelihood of badgers becoming stranded on the road surface. Alerting motorists in high-collision areas to the possibility of badgers crossing the road surface may also help reduce collisions. The efficacy of any method that is employed should be closely monitored to ensure that it does not unduly compromise the ability of resident badgers to move about their home ranges.

Acknowledgments

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