

CHAPTER 11

GRIZZLY BEAR RESPONSE TO HUMAN USE



11. GRIZZLY BEAR RESPONSE TO HUMAN USE

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MOVEMENT AND ACTIVITY PATTERNS

Daily activity patterns of grizzly bears have been found to vary widely. Some studies have found grizzly bears to be diurnal (Stemlock and Dean 1983, Wenum 1998, MacHutchon et al. 1998). Others have found grizzly bears to be more crepuscular (Harting 1985, Gunther 1990, McCann 1991). Several authors have suggested this variability is due to grizzly bear's ability to alter their temporal and spatial activity patterns in response to human activity. One study (MacHutchon et al. 1998) found variation with age and sex classes as well as level of human activity. Mattson (1990) believed that grizzly bears response to human activity is a function of several factors including the nature and extent of historical interactions with humans, availability of human foods, demographics and size of the population, and distribution of habitats. One aspect of bears' response to human activity ranges along a continuum from extreme wariness to habituated behavior.

In this study, Gibeau (2000) found no difference in bear movement rate for adult females between the conventional division of day versus night. However, he detected substantial difference when dividing the data by when humans were active or not active. This is consistent with the findings of Olson et al. (1997) that some differences in use patterns are attributable to human activity. Another apparent influence was observed in our intensive movement data which showed that habituated adult female bears did not take advantage of higher quality habitats (Fig. 1) in the same manner that wary bears did. While not statistically significant in this study, some differences in movement rates between wary and habituated adult females when humans were active (Fig. 2) also lend further evidence suggesting the influence of humans. The combination of habituated bears using lower quality habitats and displaying somewhat higher movement rates has obvious implications for the net energy available for growth and reproduction.

While these implications on fitness and reproduction are most acute for habituated bears they are not limited to this subset of the population. Although the sample is small, Gibeau (2000) found movement patterns of the 2 adult females within the control area also demonstrated a response to human activity. Bears within the area of restricted human access used higher quality habitat and traveled less than bears in unregulated areas despite there being less high quality habitat in the restricted area.

Overall, both wary and habituated adult female grizzly bears were affected by human presence. In the relative absence of humans, wary bears were characterized by more efficient use of higher quality habitats with less movement. Increased human presence eroded this habitat optimization to a point where habituated bears traveled further in sub-optimal habitats. Females that have access to predictable and high value foods such as meat and berries attain greater adult size, mature earlier, and have larger litters than those with access only to foods with low nutritional value such as roots (Rogers 1977, Nagy and Haroldson 1990, Hilderbrand et al. 1999, Mattson et al. 1999). Adult females are the reproductive engine of grizzly bear populations, and their success is the key to long term population persistence. Providing adult female grizzly bears with the highest level of protection possible should be a management priority. Managing human impacts on individual grizzly bears and the population is key to this provision.

Mueller (2001, Mueller et al. 2004) found that subadult and adult bears differed significantly in their spatial distribution on the landscape. These differences in spatial distribution may be a result of intraspecific avoidance. Studies suggest that a consequence of intraspecific avoidance is differential distribution of bears by age and sex class (Hornocker 1962, Egbert and Stokes 1976, Tate and Pelton 1983, Mattson 1990). Hornocker (1962) Egbert (1978) and Wielgus (1993) suggested that adult males were dominant, followed by females with young, single adult females, and subadults. Subadult females were the least dominant of all. According to this hypothesis, subdominant animals should avoid dominant animals (i.e. adult males and male-occupied habitats) according to their size and vulnerability to injury or predation, or dominance and aggressiveness (Hornocker 1962, McCullough 1981, Stringham 1983, Wielgus 1993). In areas where humans and grizzly bears coexist, such as the Bow River Watershed, adult grizzly bears avoid areas close to people, probably because such avoidance gives greater security (Gibeau 2000). Subadult bears may use habitat with less security (closer to humans) to avoid adult bears. The closeness of humans may provide refuge and an opportunity for subadult bears to use higher quality foods otherwise pre-empted by dominant adults (Mattson et al. 1987, McLellan and Shackleton 1988, Gibeau 2000). During the pre-berry season,



subadult bears, particularly subadult female bears, in the Bow River Watershed, were found significantly closer to high-use roads and high quality habitat than were adult bears.

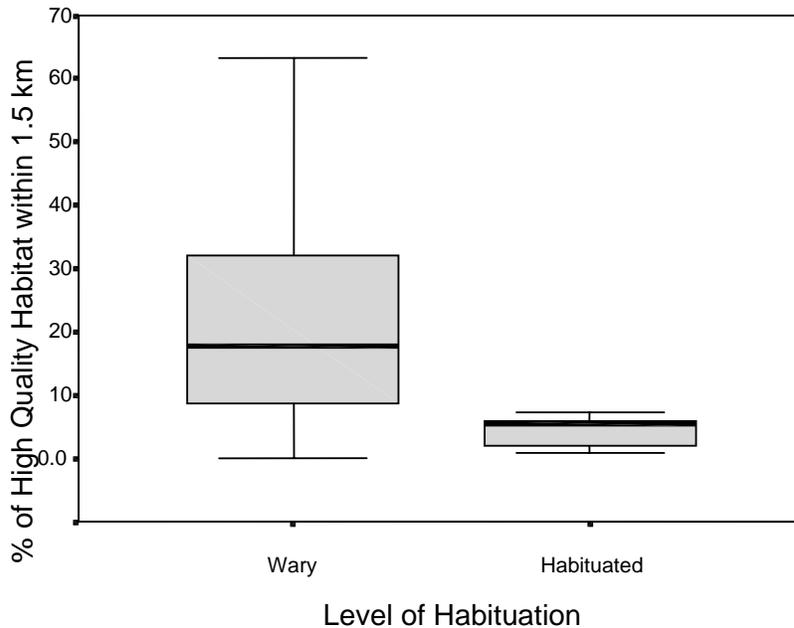


Figure 1. Box and whisker plot of the range of use of high quality habitat for wary and habituated adult female grizzly bear in the Bow River Watershed, Alberta, 1994-1998. The box indicates the median, 25% and 75% quartiles and whiskers are the largest values that are not outliers.

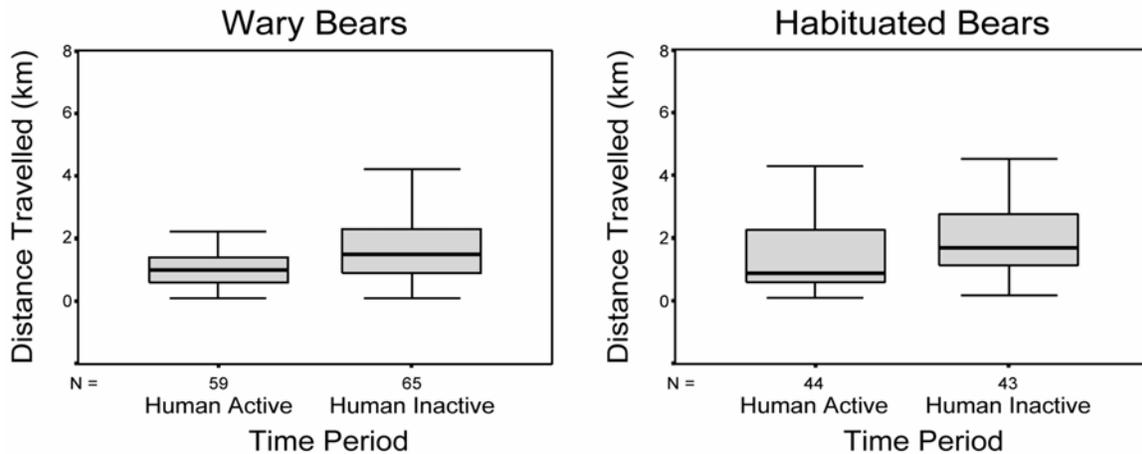


Figure 2. Box and whisker plots of distance travelled by time period for wary and habituated adult female grizzly bear in the Bow River Watershed, Alberta, 1994-1998. The box indicates the median, 25% and 75% quartiles and whiskers are the largest values that are not outliers.

Similar relationships have been found in Yellowstone National Park where adult male grizzlies were less likely to be nearby humans and more likely to use backcountry areas while subadults were more likely to use areas nearest to humans (Mattson et al. 1987, Mattson et al. 1992). Adult females and subadults also tended to occupy areas near humans more than adult males along spawning streams on Admiralty Island (Warner 1987), along roads in the Flathead Valley of British Columbia (McLellan and Shackleton 1988) and along roads in Denali National Park, Alaska (Tracy 1977).

Although spending time near humans in the Bow River Watershed may give subadult bears access to better habitats, it also puts them at significantly greater risk of mortality, both from management removals due to habituation problems and mortality on major transportation corridors such as highways and railroads. Benn and Herrero (2000) reported that 100% of 95 human-caused mortalities in Banff and Yoho National



Parks between 1971-98 occurred within 500 meters of a road or 200 meters of a trail. McLellan et al. (1999) reported that annual survival rates of subadult male grizzly bears in the Rocky Mountains between 1975 and 1997 were less than other age-sex classes, and that subadult male mortality rates due to management and citizen control killing were higher than other age-sex classes. Garshelis et al. (2005) found that for grizzly bears studied as part of the ESGBP subadult female survival was 91-92% and this was not significantly different from adult female survival, 95-96%. Subadult male survival was 69-74% and was significantly lower than adult male survival, 86-89%. Subadult males were 3X more likely to die than adult males. Subadult males tend to disperse to areas outside their natal ranges (LeFranc et al. 1987, Blanchard and Knight 1991, Schwartz and Franzmann 1992, McLellan and Hovey 2001b). Young males may therefore be predisposed to conflict with humans because they are more mobile, tend to use unfamiliar areas, and are often found close to humans (Clevenger and Pelton 1990, Swenson et al. 1998, Pease and Mattson 1999). As a consequence, mortality rates of subadult male bears tend to be higher than for subadult female bears (McLellan et al. 1999).

Their association with human activity also makes subdominant bears significantly more vulnerable to habituation to people than other bears (Gunther 1990). Habituation has major implications to bear populations confronted by even moderate densities of humans (Mattson 1990). Although habituation may increase the efficiency of bear habitat use in some instances by reducing displacement and minimising the frequency of energy-demanding responses, habituated grizzly bears are subject to higher mortality rates in all future years (Meagher and Fowler 1989, Mattson et al. 1992, Pease and Mattson 1999). Studies in Yellowstone National Park have shown that bears habituated to human activity but still eating natural foods were killed 3 times as often by humans as bears that were not habituated (Mattson et al. 1992). In some cases, habituation leads to greater risk of injury to humans (Herrero 1985, 1989). Herrero (1989) found that for all 12 grizzly bear-inflicted deaths that occurred in Glacier National Park, Montana, Yellowstone National Park, and Banff National Park between 1967 and 1986, the bear involved was either food-conditioned and/or habituated. Results from Mueller (2001) indicate that in the Bow River Watershed subadult male and female grizzly bears are prone to interaction with humans. This translates directly to increased risk of human-caused mortality.

Jalkotzy et al. (1999) analyzed habitat use by grizzly bears in the Lake Louise area. Intensive monitoring of the movements of adult females over 24 hour periods in the immediate vicinity of the Skiing Louise lease provided insights into how grizzly bears make use of a human-dominated landscape. They found that female bears did not use ecosites within the Baker and Skoki BMU's between 1994-98 in a random manner. Use of ecosites and consolidated cover types varied seasonally. Cleared ski runs on the Skiing Louise lease were strongly selected for in spring. Wet seeps on and in the vicinity of ski runs with their communities of common horsetail, and various nutritious grasses and sedges, were attractive to bears. Although selection for the type weakened in the summer, attraction to these artificial openings in the summer continued as green-up progressed up the slope. Ski runs were avoided in the fall probably because better food sources were available elsewhere. In spring and summer, adult female bears #30 and #46 tended to be closer to ski runs and the base lodge at night than during the day (Fig. 3).

In addition, both bears tended to be closer to the ski runs than to the base lodge in spring and summer. Use of the Skiing Louise lease in fall was limited to the Temple/Ptarmigan area where bears frequently fed on crowberry.



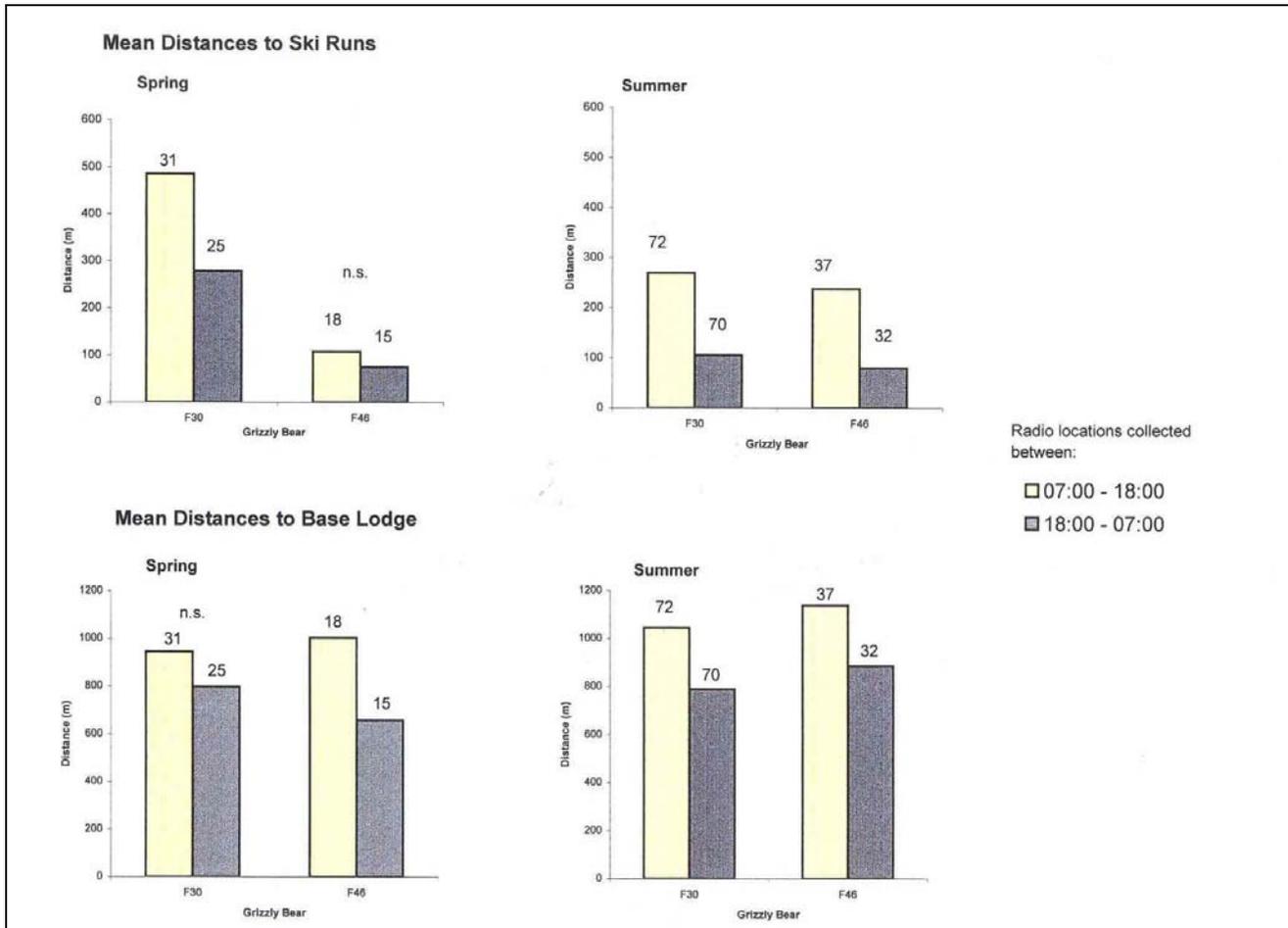


Figure 3. Mean distances between radio locations of adult female grizzly bears and Skiing Louise facilities in spring and summer, 1994-97. Differences are significant ($P < 0.05$) unless indicated (n.s.). Sample sizes are indicated at the top of each histogram. (credit: Jalkotzy, M.G., R.R. Riddell, and J. Wierzchowski, 1999)

RESPONSE TO DEVELOPMENTS

Gibeau et al. (2002) found of the four types of human developments investigated, the Trans Canada Highway (TCH) was avoided most by grizzly bears. Female bears avoided the busy freeway regardless of the habitat quality or time of day. Males, and especially subadult males, were found closer to the TCH when within or adjacent to high quality habitat and during the human inactive period. These observed responses may not be solely due to the TCH, but to the higher overall density of humans associated with the valley that includes the TCH. Several authors believe that grizzly bears become accustomed to predictable occurrences (Herrero 1985, Jope 1985), including traffic (McLellan and Shackleton 1989b) although our results have suggested otherwise for high-speed, high-volume highways. There is a point when the combination of traffic volume and highway configuration overrides a bear's attraction to high quality habitats (Fig. 4a).



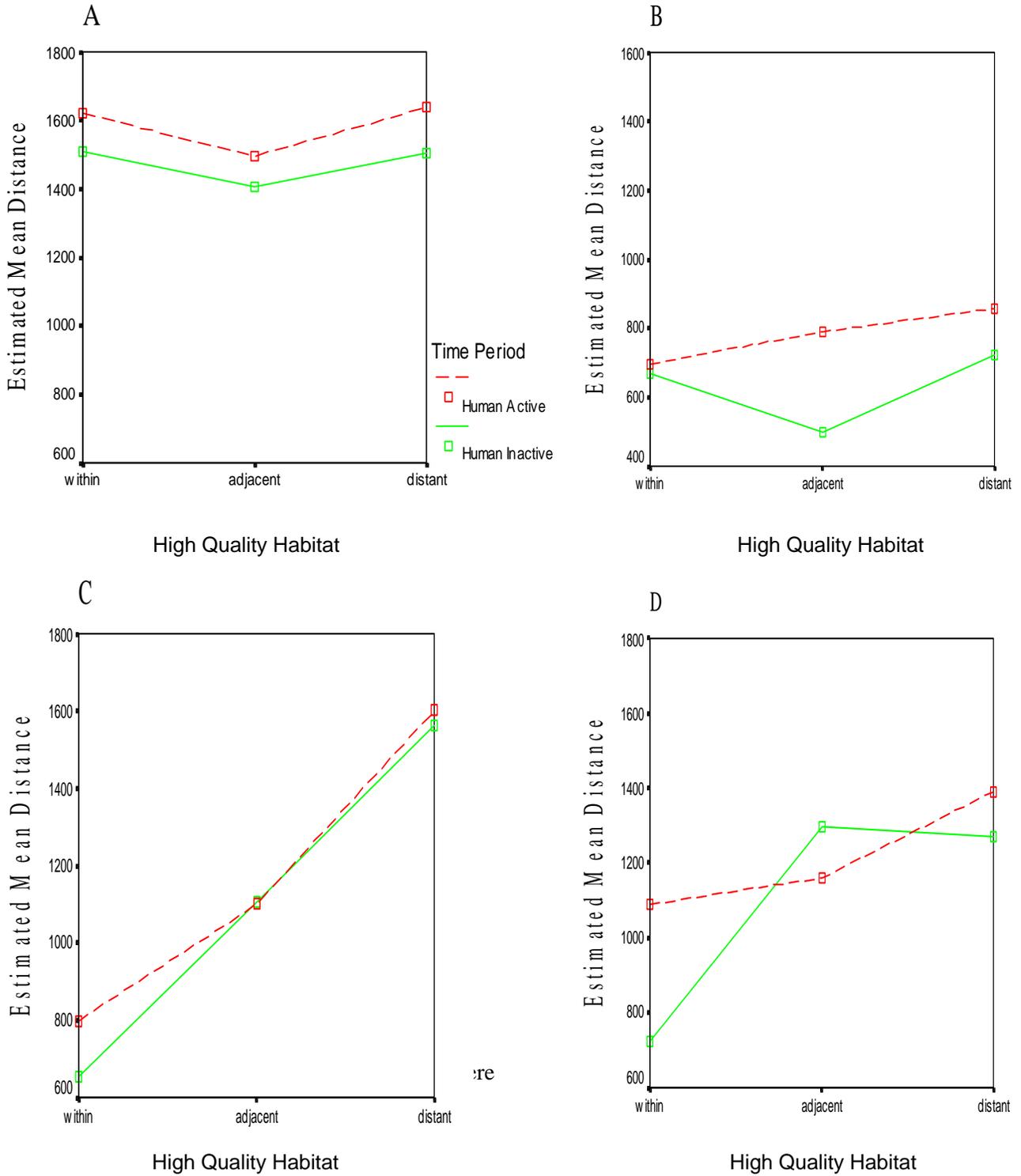


Figure 4. Profile plots of the interaction between high quality habitat and time period for (A) TCH, (B) high use paved roads, (C) high use trails, and (D) high use features, for grizzly bears in the Bow River Watershed, Alberta, 1994-1998.



Avoidance of roads by grizzly bears has been documented by Tracey (1977), Harding and Nagy (1980), Archibald et al. (1987), Mattson et al. (1987), McLellan and Shackleton (1988), Kasworm and Manley (1990), and Mace et al. (1996). We too documented bears further from roads when distant from high quality habitat which we interpret as avoidance behavior. In this environment, however, bears were found closer to paved roads than would be predicted, presumably to acquire high quality food resources. High quality habitat is a strong attractant. Mace et al. (1996) demonstrated that avoidance of roadside buffers by grizzly bears generally increased with traffic levels and road densities, but bears did use important habitats adjacent to roads with low to moderate traffic levels. This neutral use or positive selection toward habitats near roads implied that important habitat resources possibly occurred near roads in their study area also.

Unlike paved roads that were located in valley bottoms and good quality habitats, high use trails were widely distributed throughout all types of habitats within the study area. Gibeau et al. (2002) found bears were closer to trails during the human inactive period when within high quality habitat and further from trails when distant from high quality habitat (Fig 4c). In the Swan Mountains Montana, Mace and Waller (1996) concluded that grizzly bears using hiking trails have become negatively conditioned to human activity and that they minimized their interaction with recreationalists by spatially and temporally avoiding high use areas. Our data suggest the same pattern in the absence of high quality habitat.

Kasworm and Manley (1990) reported that, overall, grizzlies were displaced less by trails than by roads. Our results suggest otherwise for this study area. Gibeau et al. (2002) observed avoidance of high use trails when distant from high quality habitat. This may be a reflection of a greater opportunity for bears to select high quality habitat in the relative absence of humans. In this study area, grizzly bears may not have the opportunity to truly “avoid” paved roads without forfeiting access to much of the high quality habitats.

Gibeau et al. (2002) also found bears took advantage of high quality habitat near development while humans were inactive. While this trend was evident for all types of human developments, it was most pronounced in association with features (Fig 4d). Mattson et al. (1987) and Reinhart and Mattson (1990) found that habitats were substantially under used especially during the day near town-sites and recreational developments. Our results show that grizzly bears were more likely to use roads, trails and human facilities at night or when unoccupied. This is consistent with other studies (Harting 1985, Nadeau 1987, McLellan and Shackleton 1988, Gunther 1990).

Gibeau et al. (2002) concluded from their observations and the literature, that there were significant differences in grizzly bear response to roads, trails and major development features categorized by sex, age class, proximity of high quality habitat and time of day. High human presence is likely to be the reason most grizzly bears are unwilling to use habitats near busy transportation corridors. This avoidance behavior was strongest in the adult segment of the population where we believe males selected for high quality habitats and an absence of humans. Those males that were willing to exploit high quality habitat near roads, did so at night and where hiding cover was present. Adult females were the most risk adverse cohort, choosing to avoid humans instead of seeking out the highest quality habitats. Adult females selected areas with a high degree of security for raising cubs (Gibeau et al. 2001), which in some cases also meant avoiding adult males. With the safest and highest quality habitats taken up by adult males and resident females, subordinate bears including some adult females, were forced to use sub-optimal habitats including those with high human presence. Our data demonstrated that subadults were almost always closer to humans than adults were. Unable to successfully compete elsewhere, these bears were relegated to using habitats close to people and developments. Bears in close proximity to humans are more apt to become habituated to people. While habituated bears appear to successfully use habitats near humans, they also are most likely to die at the hands of humans (Mattson et al. 1992, McLellan et al. 1999).

More detailed analysis of the effects of highways on grizzly bears by Chruszcz et al. (2003) found grizzly bears tended to be closer to roads with low traffic volume than high traffic volume, and that habituated grizzly bears were closer to roads than wary grizzly bears. These results lead them to believe that bears use high quality habitat near roads as they become habituated to highway traffic. On low-volume roads, where vehicle disturbance is less severe, bears adapt to the use of roadside habitat more readily resulting in different patterns of distribution around the two road types. Given the high traffic volumes in our study area, traffic noise is relatively constant, predictable and has no negative stimulus associated with it. Therefore, it is likely bears learn to use habitat adjacent to roads.



The association or indifference of BNP grizzly bears to roads does not suggest that roads do not affect their movements. There is ample evidence that highways can limit bear movements in the Bow Valley and adjacent lands (Serruoya 1999, Gibeau 2000). Although grizzly bears were found closer than expected to low-volume roads, they will not necessarily readily cross all road types or survive crossings. Our results indicate that grizzly bears were reluctant to cross high-volume roads like the TCH and crossings were generally associated with movements into better habitat (Chruszcz et al 2003). Low-volume roads were more permeable to grizzly bears than the TCH.

For both road types in our study area grizzly bears crossed roads in areas where habitat quality was high. However, when grizzly bears crossed high-volume roads they moved into areas of higher quality habitat. This pattern did not occur on low-volume roads, suggesting that there is a trade off between the risks of crossing roads and benefits in terms of access to higher quality habitat. Furthermore, road crossings were more likely to occur in areas where dense vegetation was adjacent to roads (Chruszcz et al 2003). Bear preference for cover when moving near or crossing roads has been observed elsewhere (McLellan and Shackleton 1989; Brandenburg 1996). Cover may be an important requirement for successfully crossing roads and provide security from road-related disturbance.

Two patterns emerged from the Chruszcz et al. (2003) study: the avoidance of high-volume roads in a major transportation corridor, and the importance of high quality habitat in determining grizzly bear movement decisions relative to roads. They found a clear dichotomy in the behaviour of bears relative to high and low-volume roads. The reduced cross-valley permeability caused by the presence of the TCH may result in harmful population effects in view of the great mobility and extensive spatial requirements of grizzly bears (Forman et al. 2002). Because the TCH only acts as a partial barrier (or filter) it is unlikely that isolation effects will occur in this population. However, the cumulative effects of human use and development, railways and highways within the Bow Valley can limit access to important habitats, thereby negatively impacting grizzly bears in the BNP ecosystem (Gibeau et al. 2002).

INDIVIDUALITY AND HABITUATION

Wildlife response to humans and our activities occur in different circumstances and in differing magnitudes (Whittaker and Knight 1998). Wildlife also behave differently in different locations and during different activities, and the learned outcomes of all these interactions affect subsequent interactions (Gilbert 1989). One important yet confounding variable, both in the literature and within our data, was the level of habituation (Whittaker and Knight 1998) of some individuals. Habituation (Herrero 1985) may permit some bears to exploit habitats near roads, trails and developments, especially if human use is spatially and temporally predictable (Tracey 1977, Jope 1985, McLellan and Shackleton 1989a, Olson et al. 1990). Several studies have suggested there are differences among sex, age and reproductive classes in the likelihood and level of habituation to humans (Olson et al. 1990, Mattson 1990). Our observations on responses of grizzly bears to various human developments reflect some of these differences, even though the majority of study bears were not considered habituated.

Social structure may also have a bearing on spatial distribution of a bear population. In Yellowstone National Park, Mattson et al. (1987) demonstrated that cohorts of subordinate bears were found in poorer-quality habitats near developments, probably displaced from better habitat by more dominant classes, particularly adult males. McLellan and Shackleton (1988) also determined that adult males used remote areas whereas adult females and some subadults used areas closer to roads. In Banff National Park, 1985-1998, the female portion of human-caused grizzly bear mortalities was 80% and most occurred near roads (Benn and Herrero 2002). While our results pointed to differential use by sex and age, we were unable to determine whether this distribution is a natural phenomenon or the result of competition for space with humans.

Mueller (2001) found the five subadult bears in the Lake Louise area of Banff National Park showed significant variability in their behaviour patterns around human activity and human development during the study period (Fig. 5). Habituated subadults were more likely to die than were wary individuals.



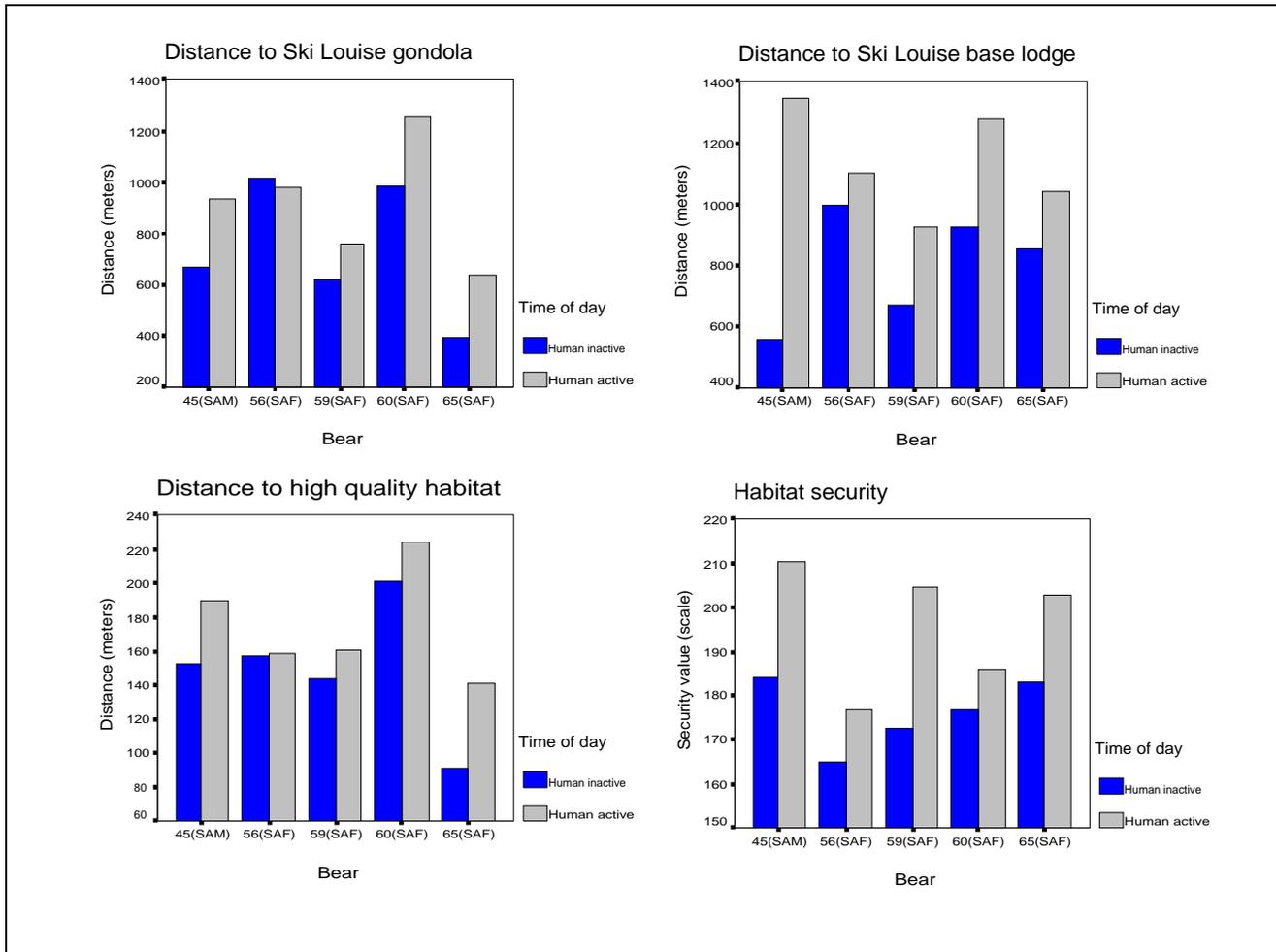


Figure 5. Average distance to the Ski Louise gondola, base lodge, high quality habitat and average habitat security for each subadult grizzly bear during the human active period (0700 h - 1800 h) and human inactive period (1800 h - 0700 h), ski hill data set, 1998-2000.

Differences in individual behaviour play prominent roles in population dynamics (Armitage 1986, Lomnicki 1988). Individual differences may be expressed in social behaviour, recruitment and dispersal (Armitage 1986). Social hierarchies create a major force for dispersal (Christian 1970, McLellan 1990). Population density is also a large component of dispersal. When densities are very low, a higher proportion of subordinate individuals can find suitable areas in the preferred habitat, the number of dispersing animals is reduced, and the survival of subordinate animals is greatly increased (Christian 1970). When densities are high, subdominant, predominantly subadult bears, are forced to disperse from their birthplace and find space in suitable habitat unoccupied by more dominant members of the same species (van Horne 1983). Dispersing subadults may be forced into competition with members of other species or humans as they move into new habitats (Christian 1970). In the Bow River Watershed this may be the case for subadult grizzly bears in general (Mueller 2001, Mueller et al. 2004), but comparisons of individual bears suggest that this may be more likely the case for specific subadult bears.

Genetics and experience both affect the expression of individuality (Fagen and Fagen 1994, Alcock 1989). Stirling and Derocher (1990) suggested that through learning, some bears may develop individual differences in food preferences, or how they respond to disturbances. Lomnicki (1988) argued for the adaptive significance of individual variation within populations. By producing young of varied phenotypes, a female increases the probability that over the long term some of her descendants will survive in varied and unpredictable social and ecological environments (Wallace 1982, Armitage 1986). Results from Mueller's (2001) comparison of individual subadult bears in the Lake Louise area suggest that variability may play a large role in their survival and success in such a developed landscape.



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