

RESPONSES OF GRIZZLY BEARS TO LOGGING TRUCK TRAFFIC IN THE KIMSQUIT RIVER VALLEY, BRITISH COLUMBIA

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Abstract: To assess the impacts of log truck traffic on grizzly bears (*Ursus arctos*) in Coastal British Columbia, the zone of hauling activity (zha) in the Kimsquit River study area was mapped using the sound levels (dB[C]) recorded at 25-m intervals along 200-m transects perpendicular to the road. The logging road bisected the home ranges of 2 adult female grizzly bears that were intensively monitored by radiotelemetry. We obtained 2 years of prelogging information and 2 years of data during logging activity on how these bears used the zha. Two hypotheses were tested to assess the impacts of truck movement: (1) there would be no difference in the pattern of use of the zha by adult female grizzly bears during and not during disturbance and (2) there would be no difference in activity patterns within the zha during disturbance among areas with different vegetative screen types and between areas with and without visual screens. Based on our information, hypothesis 1 was rejected, and hypothesis 2 was not. Additional information is presented that corroborates these findings.

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The coastal forests of British Columbia support some of the most dense populations of grizzly bears in North America. These same forests also produce some of the highest timber values in the province. Extraction of timber from coastal forests has reduced certain grizzly bear populations and, in some cases, extirpated the local population (Archibald 1983). All major coastal watersheds are to be logged within 25 years (B. Downie, pers. commun.). It is the objective of the British Columbia Ministry of Environment to maintain current numbers of grizzly bears in coastal forests. To achieve this objective, the pattern of logging followed by declines in grizzly bear populations must be broken.

In 1981 an analysis of the problem was initiated. The resultant problem analysis (Archibald 1983) identified data requirements that had to be addressed before grizzly bear values could be incorporated into watershed planning for logging. Central to these needs was information on the impacts of logging on grizzly bears in the absence of hunting. This paper presents information on the responses of 2 intensively monitored adult female grizzly bears to road traffic disturbance associated with logging.

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STUDY AREA

The study area is the Kimsquit River watershed approximately 500 km northwest of Vancouver (Fig. 1). It is part of the Kitimat Range of the Coastal Mountain systems and is found in the Coast Mountains Physiographic Region (Holland 1976). The vegetation is described by Hamilton (1984).

The watershed was partitioned into intensive and extensive areas of study based on the opportunities for data collection. The intensive study area, located south of King George Creek, (Fig. 1) was used to measure the response of bears to log truck disturbances. The terrain is rugged in this portion of the study area, with steep mountains rising abruptly from sea level to over 2,000 m. Floodplain width ranges from a maximum of 1.4 km at the estuary to less than 300 m at King George Creek.

Portions of the intensive study area were logged in 1917–18. Forestry development began again in 1979 and proceeded until June 1982, by which time a dryland sort, 80-man camp, and 25 km of logging access roads had been constructed. In addition, 100 ha were clear-cut in 4 cutting areas. Logging recommenced in June 1984. By the end of 1985 an additional 475 ha had been harvested, and 22 km of mainline road constructed. The area was closed to nonresident grizzly bear hunting in 1972 and to all grizzly bear hunters in 1982. In the last 18 years, 1 grizzly bear was known to have been killed by a hunter in the intensive study area.

Access through the intensive study area was provided by the 25 km of logging roads and 20 km of navigable river.

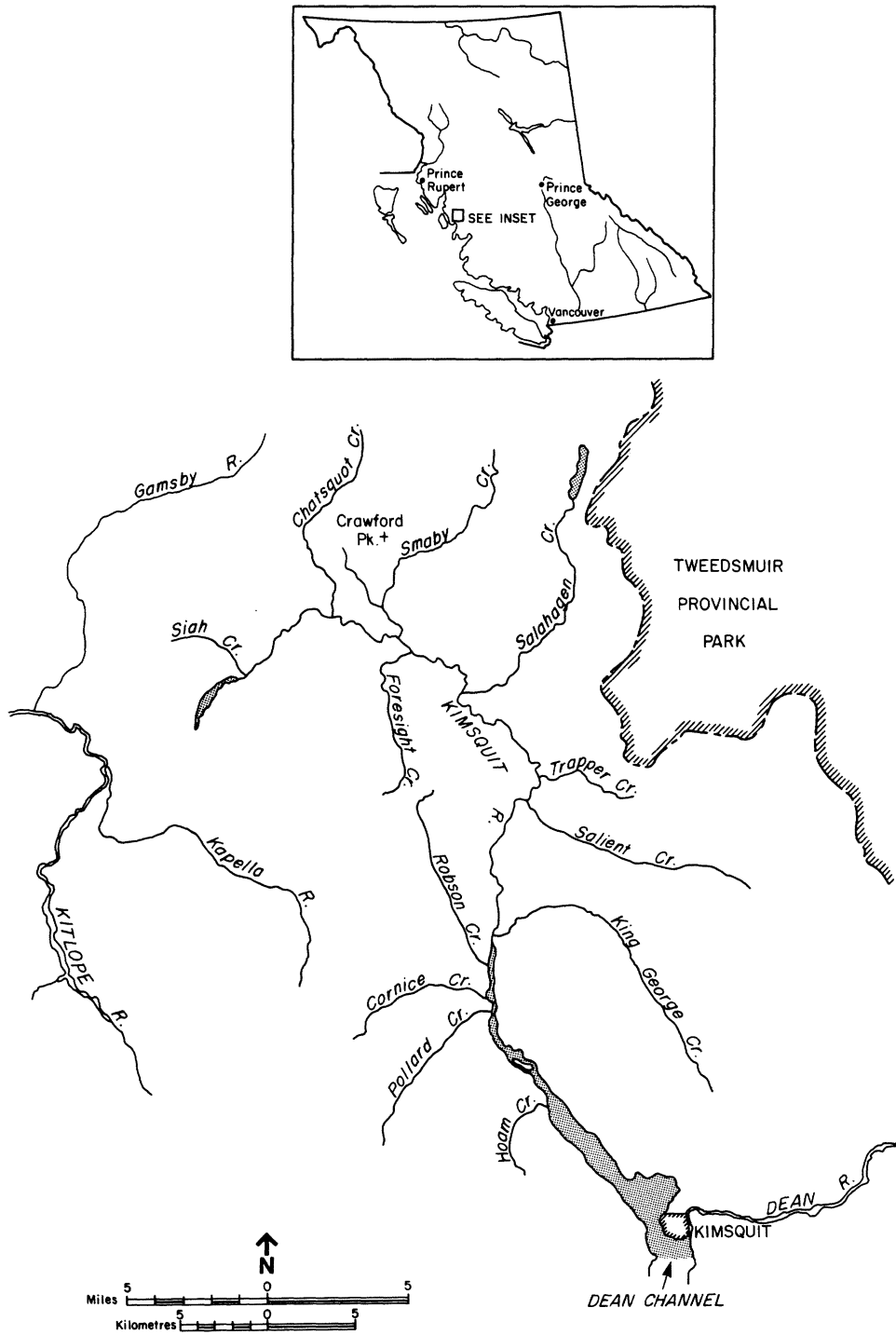


Fig. 1. Location of the study area.

METHODS

The noise associated with hauling logs by truck was used to assess the impact of logging activity on grizzly bears because the main haul road bisected a portion of the home ranges of 2 intensively studied adult female bears; the duration and intensity (number of trucks per day) of hauling was easily and accurately determined; and we believed the impacts of log truck traffic on grizzly bears to be the most significant of all logging activities in the Kimsquit.

The level and extent of hauling noise was measured with a Bruel and Kjaer (Type 2205) sound meter. Eighteen transects were established perpendicular to the road in areas with and without vegetative, and thus visual, cover. Sound level readings (dB[C]) were recorded at 25-m intervals from 0 to 200 m along these transects. Linear regressions were run on each sound transect to determine the distance from the road along each transect that the following noise levels occurred: 80 dB(C), 70 dB(C), and 60 dB(C). Noise levels below 60 dB(C) were not considered relevant because they were often masked by ambient noise. Noise level contours were then drawn around the road at the 80, 70, and 60 dB(C) levels. The road and associated zha were drafted on a 1:20,000 planimetric base map, then digitized and held on computer file (Fig. 2). The accuracy of this mapped zha was tested with 28 recorded sound levels at known locations.

Grizzly bear location information was gathered on the 2 resident radio-collared adult females (bear 8 and 25) whose home ranges were bisected by the road (Fig. 2). Intensive ground monitoring began in May 1983. Once hauling commenced, telemetry sampling occurred every 6 hours on a 24-hour basis. The goal was to obtain 4 locations per grizzly bear per day, 2 during hauling and 2 not during hauling (primarily night time). All grizzly bear relocations determined by ground telemetry, near or within the zha, were visited to verify location and grizzly bear activity (bedding, travel, feeding, marking, or other). Only verified ground relocations and aerial relocations were used for these analyses.

Data were available for 4 years: 2 prelogging years, 1982 and 1983, and 2 logging years, 1984 and 1985. Grizzly bear locations in UTM coordinates were assigned to the classes "during hauling" or "not during hauling," then keypunched.

Data analysis consisted of overlaying the zha and grizzly bear relocations to test the following hypotheses:

1. There is no difference in the use patterns of the zha by the adult female grizzly bears during and not during hauling.

This hypothesis will be rejected if:

- a. There is a 50% change in the number of locations within the zha between years without hauling (1982 and 1983) and with hauling (1984 and 1985).
- b. There is a 50% difference in the number of locations within the zha during and not during logging within a given year.

2. There is no difference in grizzly bear activity patterns within the zha during hauling between areas with different vegetative screen types (e.g., trees vs. shrubs) and between areas with and with-

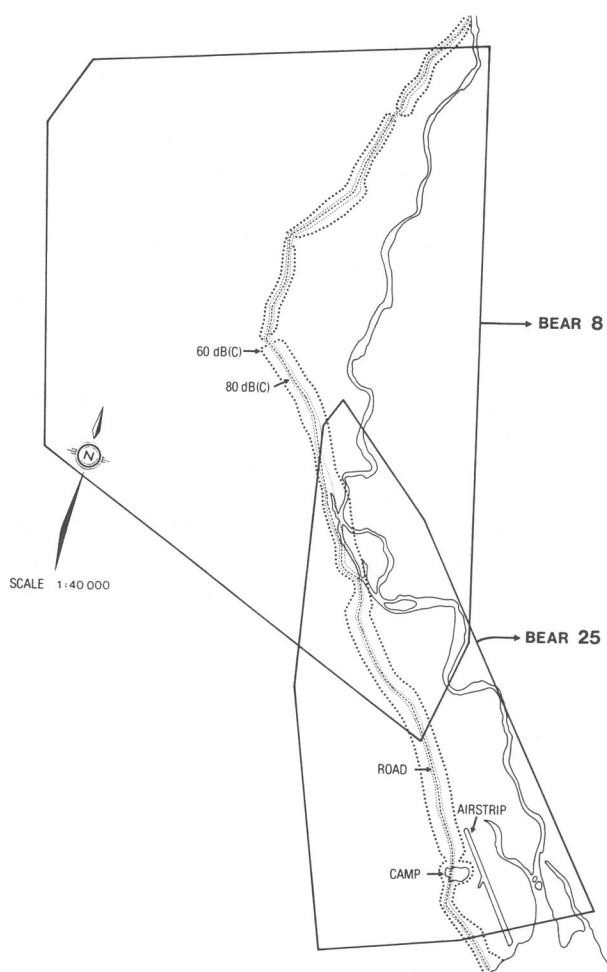


Fig. 2. Zone of hauling activity and the approximate 90% annual home ranges of 2 adult female grizzly bears.

out visual screens (a bear behind a visual screen in unobservable).

The hypothesis will be rejected if:

- a. There is a difference in the number and proportion of grizzly bear activities within the zha at different noise levels.
- b. Grizzly bears use areas within the zha with visual screens and avoid other areas with the same noise levels but no visual screens.

Seven seasons of coastal grizzly bear activity have been identified and defined by Hamilton (this volume). Seasonal home ranges were generated for each grizzly bear using the HOME program (Harestad 1981). An electronic digitizer was used for zha area calculations within each seasonal home range.

RESULTS

Grizzly bear 8 was first captured and instrumented on 17 May 1982, when she was 13 years old. When captured, she was accompanied by 2 yearlings that she abandoned 1 year later. This bear was not accompanied by cubs in 1984 or 1985.

Bear 25 was captured and radio-collared on 8 July 1982 and was also accompanied by 2 yearlings. She was 16 years old in 1982. She was without cubs in 1984 and was accompanied by a single cub-of-the-year in 1985.

The periods of logging and monitoring of radio-collared grizzly bears between 1982 and 1985 are identified in Figure 3. High fire hazard resulted in forest closure and, thus, interruption of logging activity during 1984 and 1985.

The dB(C) readings for 18 transects that were used to develop the zha map are presented in Table 1. The accuracy of predicting in which sound level contour

the known location and known sound level points occurred was 93% (26 of 28) using a 20-dB(C) interval. Consequently, the zha map had 2 bands on each side of the road, 60–80 dB(C) and > 80 dB(C) (Fig. 2). The approximate band width of each of these zones was 50 m for the 80-dB(C) zone and 300 m for the 60-dB(C) zone.

Logging camp records indicate that the average number of daily loads hauled over the 1984 season was 14 and the maximum was 27. On average, logging trucks moved along the main haul road at 30-min intervals and 15-min intervals during peak activity. Traffic was generally irregular with occasional periods of over 2 hours between trucks.

In 1985, hauling distances were greater, and the average daily number of loads declined to 10; the maximum daily haul was 15. Therefore, in 1985, logging trucks traveled the main haul road at 35-min intervals on average and 25-min intervals during hauling peaks.

Hypothesis 1 was rejected based on the information presented in Table 2. Rejection criteria 1 were met in that there was a 78% reduction in the percentage of relocations in the zha between years not during and during hauling (18% in the zha not during hauling, 1982–83; 4% in zha during hauling for 1984–85, Table 2). Rejection criteria 2 were also met for both periods. In 1984 there was an 80% reduction in the use of the zha during hauling (20% in the zha not during hauling vs. 4% during hauling) and in 1985 an 81% reduction (26% in zha not during hauling vs. 5% during hauling, Table 2).

Hypothesis 2 was not rejected because the grizzly bears avoided the zha independent of the presence of visual screens. Bears were only verified in the zha 4 times over 2 years during hauling (Table 2).

A number of independent observations support the thesis that grizzly bears avoided the zha during hauling, independent of the presence of visual screens. In 1983 grizzly bears were observed 41 times feeding on salmon (*Oncorhynchus*) near the road, within the zha. There were no observations of grizzly bears feeding in this area in 1984 or 1985. Grizzly bears did feed at this area posthauling (on a 24-hour basis) and during fire closures.

The minimum number of times that the study animals crossed the road can also be used to support the contention that grizzly bears avoid the zha during hauling. Excluding nonverified ground telemetry locations, between 1983 and 1984 there was a 33% decline in the number of times bear 25 crossed the

Activity	Apr	May	Jun	Jul	Aug	Sep	Oct
1982 logging monitoring ^a	—	—	—	—	—	—	—
1983 logging monitoring	—	—	—	—	—	—	—
1984 logging monitoring	—	—	—	—	—	—	—
1985 logging monitoring	—	—	—	—	—	—	—

^a 1982 monitoring was by weekly fixed-wing flights.

Fig. 3. Periods of logging and monitoring of collared grizzly bears from 1982–85.

Table 1. Decible readings (dB[C]) of 18 transects at 25-m intervals perpendicular to the road.

Transect no.	Decibel readings perpendicular distances (m) from road								
	0	25	50	75	100	125	150	175	200
1	98	79	73	68	64	62	61	59	61
2	97	72	69	66	62	59	59	57	55
3	95	76	70	68	63	61	58	56	56
4	97	78	70	67	64	62	59	57	56
5	97	76	69	67	63	62	59	59	59
6	97	72	69	67	64	61	62	59	57
7	102	80	70	68	66	69	—	65	62
8	100	86	82	78	66	74	74	65	72
9	106	86	75	65	67	69	64	65	55
10	97	75	68	63	61	59	57	56	55
11	98	73	69	68	—	—	—	—	—
12	97	75	69	66	62	59	59	58	56
13	96	80	70	65	62	59	58	—	—
14	97	70	65	63	59	57	55	54	53
15	98	70	69	65	61	—	—	—	—
16	95	78	73	69	64	59	59	58	59
17	95	70	70	66	65	64	61	59	55
18	96	76	71	66	65	62	61	58	57

road (21 vs. 14) and a 39% decline in the number of times bear 8 crossed the road (18 vs. 11).

There was no significant difference among years (1982–85) in the use of the areas within and outside of the zha when there was no hauling ($\chi^2 = 2.010$, $P = 0.1529$). Also, these grizzly bears used the areas in the same fashion between years (1984–85) when there was hauling ($\chi^2 = 0.182$, $P = 0.6520$). However, there was a significant difference in the use of these zones during and not during hauling ($\chi^2 = 12.662$, $P < 0.001$).

DISCUSSION

Although there was little logging activity in the study area between 1979 and 1982, we assumed that these adult female grizzly bears were unaccustomed to human activity when we began radio-monitoring in 1982. We also assumed that hunting had not been a significant factor in altering the behavior of these bears, although they may have been hunted in the past. We believed that the behavior of these adult females reflected that of undisturbed and un hunted grizzly bears.

Although we predicted that grizzly bears would initially avoid logging activity, we fully expected that they would habituate to logging disturbances and resume the activity patterns observed prelogging. We were surprised at the magnitude and duration of the response of the grizzly bears to logging activity.

Other investigators have reported that grizzly bears may avoid areas of human activity. Harding and Nagy (1977) reported that 16 of 17 radio-tracked grizzly bears ventured no closer than 1 km from a petroleum exploration camp on Richards Island, N.W.T. Tracey (1977) found that grizzly bears avoided the area adjacent to the road in McKinley Park. Zager and Jonkel (1983) also reported that grizzly bears avoided areas where roads were used.

Our data showed that these 2 adult female grizzly bears were alienated from the zha during hauling. For 14 hours per day, 3%–23% ($\bar{x} = 7\%$) of each grizzly bear's seasonal home range was unavailable to them. Clearly, these grizzly bears preferred to be outside the zha during hauling, but the importance of the alienated area is indicated because grizzly bears used this zone in the absence of logging truck traffic (Table 2).

In areas where grizzly bears have large seasonal home ranges, their exclusion from a band of habitat surrounding some human activity may not cause a problem. However, in areas such as the coast, where grizzly bears have small home ranges, or in areas where area-concentrated food sources of limited distribution are within the activity zone, this exclusion could limit access to important food sources. If there is a survival cost associated with avoiding this zone, grizzly bears will probably move into it and become habituated to the disturbance.

The fact that some grizzly bears will eventually

Table 2. Verified locations of 2 grizzly bears with respect to the zone of hauling activity, during and not during hauling, in the Kimsquit River area, 1982-85.

Season ^a	1982-83						1984						1985					
	Not during hauling			Not during hauling			Not during hauling			Not during hauling			Not during hauling			Not during hauling		
	Bear 8		Bear 25	Bear 8		Bear 25	Bear 8		Bear 25	Bear 8		Bear 25	Bear 8		Bear 25	Bear 8		Bear 25
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
2	0	4	0	3	4	14	3	9	0	0	0	0	0	0	0	0	0	0
3	3	11	3	16	0	2	0	4	1	6	0	2	0	0	0	0	2	0
4	8	20	4	24	2	7	1	4	0	13	0	6	5	0	1	5	3	1
5	6	15	5	21	1	9	4	9	0	7	0	5	5	13	5	19	0	2
6	6	22	1	26	1	3	1	5	0	6	0	5	0	9	2	6	0	8
7	0	3	0	4	0	2	0	1	1	2	0	2	—	—	—	—	—	—
Totals	23	75	13	94	8	37	9	32	2	34	0	20	10	22	8	30	0	15
Pooled in:out %	18:82		20:80		4:96		26:74		5:95									

habituate to human activity is well known. Archibald once observed 6 grizzly bears feeding shoulder to shoulder in a burning garbage dump with a large caterpillar tractor working directly above them while observers lobbed beer bottles at them. It is hard to imagine a more disturbing scenario for a grizzly bear. The fact that these bears continued to use this dump despite all the noise and harassment suggests that there was a real survival benefit associated with feeding at this site.

Joep (1985) reported that backcountry grizzly bears in National Parks habituated to hikers and that this reduced the number of fear-induced full charges by grizzly bears in areas heavily used by hikers. Herrero (1985) suggests that these habituated bears may possibly be dangerous to humans in back-country situations, particularly if they have learned to feed on people's food. If these habituated bears prove not to be a problem to people while camping in the back-country, this type of habituation in National Parks may be advantageous for grizzly bears. However, any type of habituation outside of National Parks likely leads to a reduced survival probability because of increased vulnerability to legal or illegal hunting and problem bear control.

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