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BEAR-USE OF WASTE DISPOSAL SITES AND RELATED PROBLEMS
IN THE MANAGEMENT OF SOME NATIONAL PARKS

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August, 1972

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ABSTRACT

The occurrence of bears at waste disposal sites was studied by means of direct observations in the mountain National Parks during 1970 and 1971. A large number of bears, predominantly grizzly bears, regularly frequented all major sites surveyed. The change from open pit dumping to landfill-type operation at Lake Louise did not alter the sites' attraction to bears nor did fencing hinder their movements at Banff and Jasper landfills. Bear-use of landfills is recognized as a problem because it presents a danger to human safety and leads to destruction of bears. The population of grizzly bears in National Parks is believed to be small and not able to withstand heavy culling. The consistent removal of grizzly bears from waste disposal sites can lead to the reduction of their population below viable size. The present methods of waste disposal in National Parks because they adversely affect the welfare of bears, is considered to be unsatisfactory. Some solutions to the problem are suggested.

INTRODUCTION

A basic purpose of National Parks is to maintain in perpetuity their endemic natural features, the most fragile of which are large mammals. Man's uses of National Parks often conflict with this basic purpose by altering habitat, populations and behavior of large mammals. The continued welfare of grizzly and black bears in National Parks is endangered by their attraction to areas heavily used by humans and by culling them to remove threat to human safety. Bears are attracted to heavy human use areas by large amounts of organic waste dumped at waste disposal sites. Bears using these sites will also look for garbage in adjoining areas and thus come into conflict with humans and their structures." The conflict is most often resolved by the destruction of bears. This action threatens the continued existence of viable grizzly bear populations in Canada's western National Parks. In theory National Parks are the only areas capable of providing sanctuaries to animals conflicting with human interest. If National Parks cannot maintain viable grizzly bear populations then the species' future is in doubt.

The present study was designed to quantitatively evaluate the use of waste disposal sites by bears in Banff and Jasper National Parks and to obtain comparative data for Waterton Lakes, Kootenay, Yoho, Glacier and Mount Revelstoke National Parks.

MATERIALS AND METHODS

Three major waste-disposal sites in Banff and Jasper National Parks were kept under close surveillance during the snow-free months of 1970 and 1971. Several other waste disposal sites in these and other National Parks were checked less frequently (Table 1).

Data on activities of animals frequenting waste disposal sites were collected by direct observations carried out periodically. Observation periods were distributed to give a continuous coverage for the season and to sample all hours of the day. Once it became apparent that most activities took place during the night, daylight hours were sampled less intensively in favour of night hours (Figure 1). Altogether, over 859 hours were spent making direct observations in 1970 and over 679 hours in 1971. Observation periods varied from one to six hours. Stays longer than six hours at any site were broken by rest periods. Data obtained during stays shorter than one hour (regarded as "checks") were also considered in the analysis. An observational time unit of five minutes was established with a minimum of 15 minutes applying to all occurrences of bears and lengths of observation¹. Breaks shorter than 30 minutes in the occurrence of bears was disregarded². Length of observation periods were dependent on weather conditions that affected visibility and on fatigue of the observer. Due to logistic difficulties several observers were used in the collection of data (Table 1).

Observations were aimed at recording activities of individual bears which necessitated individual identification. Bears were described by size, general coloration, body shape and by the manner of their interactions with other bears. Visibility permitting, the pelage was described

¹ A convention based on empirical data.

² Since a 15 minute period could be starting as well as ending at the point of sighting, two points of sightings 30 minutes apart can be regarded as continuous.

Table 1. Total observation time (minutes) and number of observers (in brackets) at various waste disposal sites in the mountainous National Parks in 1970 and 1971. (* denotes locations checked intermittently).

Site	1970	1971
<u>Banff National Park</u>		
Banff sanitary landfill	13,446 (4)	11,195 (4)
17 mile flat dump	420 (1)	*
Lake Louise refuse dump	11,785 (2)	5,120 (2)
Lake Louise sanitary landfill	-	9,805 (4)
Saskatchewan crossing dump	*	*
<u>Glacier National Park</u>		
Incinerator	45 (1)	435 (1)
Beaver River dump	45 (1)	-
<u>Jasper National Park</u>		
Bubbling Springs dump	420 (2)	200 (1)
Jasper sanitary landfill	18,440 (3)	11,675 (2)
Maligne Lake dump	*	*
Miette dump	390 (1)	*
Pocohontas dump	885 (1)	*
Taule Ridge dump	4,395 (1)	2,335 (1)
<u>Kootenay National Park</u>		
Kootenay Crossing dump	1,255 (1)	-
<u>Waterton Lakes National Park</u>		
Incinerator	*	-
<u>Yoho National Park</u>		
Incinerator	30 (1)	30 (1)
O'Hara dump	*	-
	51,556	40,795

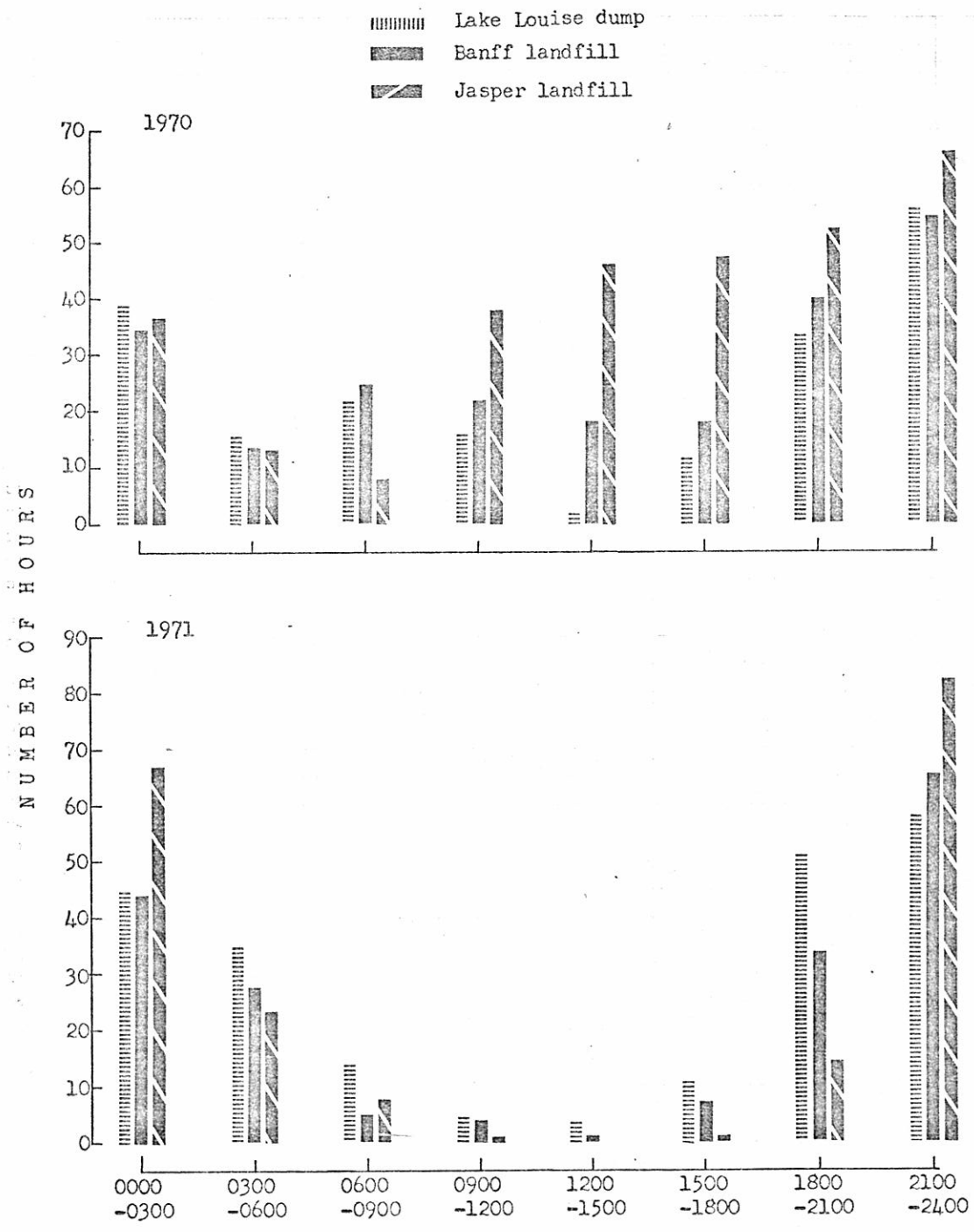


Fig.1 Distribution of total observation time in relation to time of day at three major waste disposal sites in Banff and Jasper National Parks, 1970 and 1971

by overall color, by patterns of dark and light, and by texture. Special markings and unusual features were an aid in individual identification. Individuals that were easily identified were referred to by a given name throughout the summer. Daily descriptions were also recorded for these animals in order to trace seasonal movements and activities of known individuals. Furthermore, the use of various observers required that individual descriptions be recorded in detail on every changeover to provide a continuity in identification. Bears were assigned to age categories of cub of the year (COY), yearlings (YRL), juvenile (JUV), subadult (SUBAD) and adult (AD) and to sexes. Criteria for age were size and social interactions of the animals. Sex identification was attempted only for adult animals and was based on size in the case of males and on the presence of litters in the case of the females. In a few instances females without litters could also be identified. When age or sex identification was not possible, sightings were recorded as unclassified (U/C).

Observations were made on the arrival and departure of the animals, on the occurrence of unusual actions or interactions, and routinely every 15 minutes. Temperature, wind direction and velocity, sky conditions, and precipitation were recorded at the beginning of each observation period, and whenever subsequent changes occurred. The observations were recorded on magnetic cassette tape and were transcribed and edited into hardcover notebooks before new data were collected.

The observer was in a vehicle positioned at various vantage points at the waste disposal areas. Vantage points were often changed to view activities from an optimum location. Distance between the observer and

the animals varied from three to 150 feet. Observations were made with the aid of a 10X binocular and a standard spotlight was used intermittently to verify identifications during very dark nights.

RESULTS

1. Waste disposal sites

1.1. General

Waste generated by commercial and recreational use of the mountainous National Parks is disposed of within the boundaries of those parks. The manner of disposal varies slightly from park to park and is a result of past trials and errors in trying to find a method that coped with the prevailing volume of waste at low cost. Depending on the volume of waste they now handle,, disposal sites in the mountainous National Parks fall into the following categories;

1.1.1. Temporary dumps

These are small dumps that are used only for a few years, and were usually started to handle waste generated by work-camps and other temporary establishments. The sites are selected arbitrarily utilizing natural terrain such as steep hills and creek beds, with primary consideration given to convenience. Their effect on the environment is related to the volume of waste deposited and the length of their use.

1.1.2. Refuse dumps

These are dumps of various sizes, used most commonly in the past. They are similar in nature to temporary dumps but are larger

and are used longer. The sites selected indicate that consideration was given to aesthetics as well as convenience, since most are located out of sight of park visitors. Besides utilizing the natural terrain, gravel borrow-pits are also commonly used. Because of the larger volume of garbage handled, equipment such as caterpillar tractor is used intermittently to compact waste and mix it with gravel. Setting fire to the refuse is another method used to reduce volume, but this practice is now continued by the users rather than the managers of these sites. Due to the larger volumes of waste and the extended length of their use, refuse dumps can have a serious effect on the immediate as well as the total park environment.

1.1.3. Incinerators and associated dumps

Incinerators are closed structures where refuse, mainly organic material, is burnt. Their use is aimed at the reduction of volume and the elimination of unpleasant odors associated with so called "wet-garbage" dumps. They are commonly used in or near urban areas. The type used in parks are small self burning incinerators. The end product of incineration is voluminous enough to necessitate the existence of an adjoining dump where the partly burned waste is stored. The installation of the structure is costly and it also requires attendants to unload the burnt waste. The impact of incinerators on the environment is closely related to their effectiveness in reducing volumes and eliminating odors and noxious fumes. This in turn is determined by the efficiency of the particular incinerator used.

1.1.4. Sanitary landfills

The most recent development in National Park waste disposal is the covering of waste, most importantly, organic waste, with varying thicknesses of dirt. This operation requires the availability of voluminous fill material and is made more economical by the utilization of existing excavations and trenches. Both requirements can be met by large gravel pits, which are in fact used for landfills in National Parks. The operation further requires, depending on the volume, one or more large front-end loaders which move fill over the garbage as it is deposited. Compaction can be achieved by the loaders or heavier machinery such as a caterpillar tractor. Refuse disposal by means of sanitary landfills is aimed at the reduction of unpleasant odors as well as filling up major construction pits for further use. Effectiveness is therefore only achieved by the immediate covering of the garbage, the depositing of the required thickness of fill and the levelling of filled areas, which requires considerable operational time by heavy equipment. The efficiency of the operation is thus determined by its environmental impact and the economics of heavy machine operation.

1.2. Banff National Park

This is the most visited park with the largest volume of waste to be disposed. Due to the large size of the park and the fact that waste is generated at widely separated points, disposal sites are numerous. A recent trend is towards the consolidation of waste disposal into two sanitary landfills.

1.2.1. Banff sanitary landfill

Located near Banff townsite this landfill serves that town, and the heavily used tourist facilities near it. Established in 1970 in a gravel pit it is operated as a sanitary landfill. The site is fenced to keep animals out and visits by tourists are discouraged after closing hours by locking the gate. Before its establishment, the area's waste was dumped at two other sites, operated as refuse dumps, closer to Banff townsite.

1.2.2. 17 mile-flats dump

Located near Eisenhower Junction on Highway 1-A this dump served commercial and other establishments in that area. Officially closed at the end of the 1969 season, it was still used during 1970. It was located next to the road in a borrow pit where waste remained exposed, and was not fenced.

1.2.3. Lake Louise refuse dump

Closed in June, 1971 this dump is located a short distance from Highway 1-A, approximately 3 miles west from its departure from the Trans Canada Highway. Used by commercial, and recreational establishments of the general area, the site is located on a hillside overlooking Bow Valley. Waste was dumped over the rim of a terrace that was bulldozed level and cleared of vegetation. Waste was occasionally compacted by heavy machinery and pushed over the rim gradually enlarging the flat terrace. The dump was continually smoldering as drivers of delivery trucks took it upon themselves to reignite the fire on their visits. The dump was not fenced and was accessible day and night. Tourists were not discouraged

from visiting the site. On the closing of the dump, waste was covered with fill and no more dumping of waste occurred.

1.2.4. Lake Louise sanitary landfill

Located approximately 5 miles west of the former site immediately next to Highway 1-A, this landfill was opened following the closing of the dump. Utilizing a gravel pit, waste was spread and covered with dirt and was compacted by a heavy tractor which was kept constantly at the site. It was not fenced but tourists were barred from driving inside by a gate kept locked after operating hours. The landfill was officially closed at the end of the 1971 tourist season.

1.2.5. Saskatchewan Crossing dump

Located approximately 5 miles north from the crossing at the end of a side road from Banff-Jasper Highway this refuse dump is used by commercial and government establishments of that area. A small borrow pit cut into a mild slope is used for dumping. It is surrounded by the remains of a fence originally built to retain windblown debris.

1.3 Glacier National Park

Protected by its ragged morphology, waste-intensive use in this park is confined to the immediate surroundings of the Trans Canada Highway. Temporary dumps were numerous during the construction of the highway, however since its' completion in 1963 waste disposal has been consolidated into one site.

1.3.1. Beaver River dump

Used for the dumping of all waste generated within the park between 1963 and 1969, this site was operated as a refuse dump. It is located in one end of a still active gravel pit. Presently it is used for the dumping of partly burned waste from the incinerator. Refuse is dumped at the edge of a gravel terrace onto the low-lying original terrain that forms part of the flood-plains of Beaver River and is often under water.

1.3.2. Glacier incinerator

This small incinerator began operation in 1969, and is located near Rogers Pass along-side several maintenance buildings. Because of the absence of a nearby dumping area, partially burned waste from the incinerator is carried to the Beaver River dump.

1.4. Jasper National Park

Similarly to Banff, this park is also going through centralization of its numerous waste disposal sites. In 1970 and 1971 however several sites were still in intensive use.

1.4.1. Bubbling Springs dump

Located along the Banff-Jasper Highway approximately 10 miles south of Sunwapta Falls, this dump was officially closed in 1970 but was intermittently used during that year. It is close to the road in a large borrow pit that is crossed and occasionally flooded by Bubbling Springs Creek. Waste was dumped randomly within its periphery.

1.4.2. Jasper sanitary landfill

Located $3\frac{1}{2}$ miles north of town immediately adjacent to Highway 16 this landfill is also in a defunct gravel pit. Opened in 1970,

it is used for the waste generated in the Jasper area by various establishments and is a successor to the Jasper incinerator and incinerated refuse dump located west of town as well as the refuse dump near Jasper Park Lodge. Waste is deposited in layers up to 6 feet deep and is covered by fill. The site is fenced and entry after hours is barred by a locked gate.

1.4.3. Maligne Lake dump

This is a temporary dump utilizing a natural depression in the ground. It is located at the end of the Maligne Lake Road. Waste is compacted and leveled occasionally by heavy equipment. No fence is present and the volume of garbage is small, generated mainly by tourist establishments at the lake and by visitors.

1.4.4. Miette dump

Located approximately 6 miles from Highway 16 along the Miette Hotsprings road on the steep hillside that descends to Fiddle River, this dump is used by the tourist establishment at Miette Hotsprings. No fence is present and waste gravitates to lower ground rendering use of heavy equipment unnecessary.

1.4.5. Pocohontas dump

This dump is located 1 mile east of Pocohontas beside Highway 16 and is used for waste generated in that area. It utilizes a sudden elevation change in the valley floor, and dumped waste falls to the bottom of the decline. Partial fencing to hold windblown debris is present.

1.4.6. Tangle Ridge dump

Located 60 miles south of Jasper on the Banff-Jasper Highway this dump is used by the nearby maintenance camp and tourist establishments at Columbia Icefields. A section of the old highway cut in the hillside is used, and waste is dumped downhill from the road surface. Partial fencing is present.

1.5. Kootenay National Park

A small dump at Kootenay Crossing was used in this park for dumping waste from recreational establishments during 1970. A gravel pit located near Highway 93 was utilized and waste was piled in the center of the clearing. No fence or gate was present.

A small incinerator is in existence near park headquarters.

1.6 Waterton Lakes National Park

Organic waste in this park is incinerated and the remaining refuse is piled at the same site. The site being level, the unloading and piling of incinerated waste is a man and machine intensive operation. The incinerator is located in an open area north of the townsite.

1.7. Yoho National Park

Much of the waste accumulated in the eastern part of the park has been carried to the Lake Louise refuse dump and the sanitary landfill due to their proximity. Waste from the townsite of Field and from establishments in the western portion of the park are taken to the incinerator situated 7 miles east of Field close to Highway 1 on a hillside sloping down to the flats of Kicking Horse

River. In design and operation this incinerator is similar to that in Glacier National Park but the incinerated refuse is retained on the site. A small refuse dump is also in use close to the Lake O'Hara tourist establishment.

2. The waste

Waste produced by users of National Parks and by residents and business establishments within their boundaries is not different from waste produced by urban centres. In Parks waste originates from three major sources; from tourist use of campgrounds and picnic sites; from commercial tourist facilities and other urban dwellings; and from construction and maintenance work carried out by Park management. Waste arriving at the disposal site can be categorized as garbage consisting mainly of food remains; as refuse made up mainly by containers of various kinds; and as debris resulting from construction. The kinds and quantities of waste deposited at disposal sites varied between hours of the day and throughout the season. The high number of visitors during summer months corresponded with a high volume of waste generated. Composition of the deposited waste was not extensively examined, however in 1970 small samples were taken at Lake Louise dump and at Banff and Jasper landfills (Appendix IV). On the basis of these samples garbage was calculated to make up more than 65% of all waste (by volume) followed by refuse (25%) and debris (8.5%). Of the three major sites sampled, garbage made up the largest portion of waste at Lake Louise dump (75.8%), the lowest at Jasper landfill (60.5%). The average weekly volume of garbage brought

to the sites was calculated to be the highest at Banff landfill (475.5 cubic yards), closely followed by Jasper landfill at 452.2 cubic yards and lowest at Lake Louise dump (201 cubic yards). The daily distribution of deliveries was, however similar at all three sites (Fig. 2). There appeared to be two peaks in deliveries, one in the morning and one in late afternoon. There was no observation of garbage delivered at Jasper landfill after 2100 hours but at the Banff landfill and Lake Louise dump 2.6% and 12% respectively of the daily garbage was delivered after 2100 hours. This garbage remained uncovered during the night.

3. The bears

Both grizzly and black bears frequented the waste disposal sites and fed on garbage. Their occurrence and behaviour varied from site to site.

3.1. Daily and seasonal occurrence

Figures 3, 4 and 5 graphically illustrate the daily occurrence of bears at the three major sites throughout the bear-active period of mid-April to mid-November in 1970 and 1971. The closing of the Lake Louise dump on June 1 and the start of the Lake Louise landfill operation affected the occurrence of bears as illustrated in Fig. 6. Bears quickly located the new disposal site. These figures are a composite of daily sightings and are irrespective of the length and time of observation periods, consequently they indicate occurrence of bears accurately only in the seasonal context.

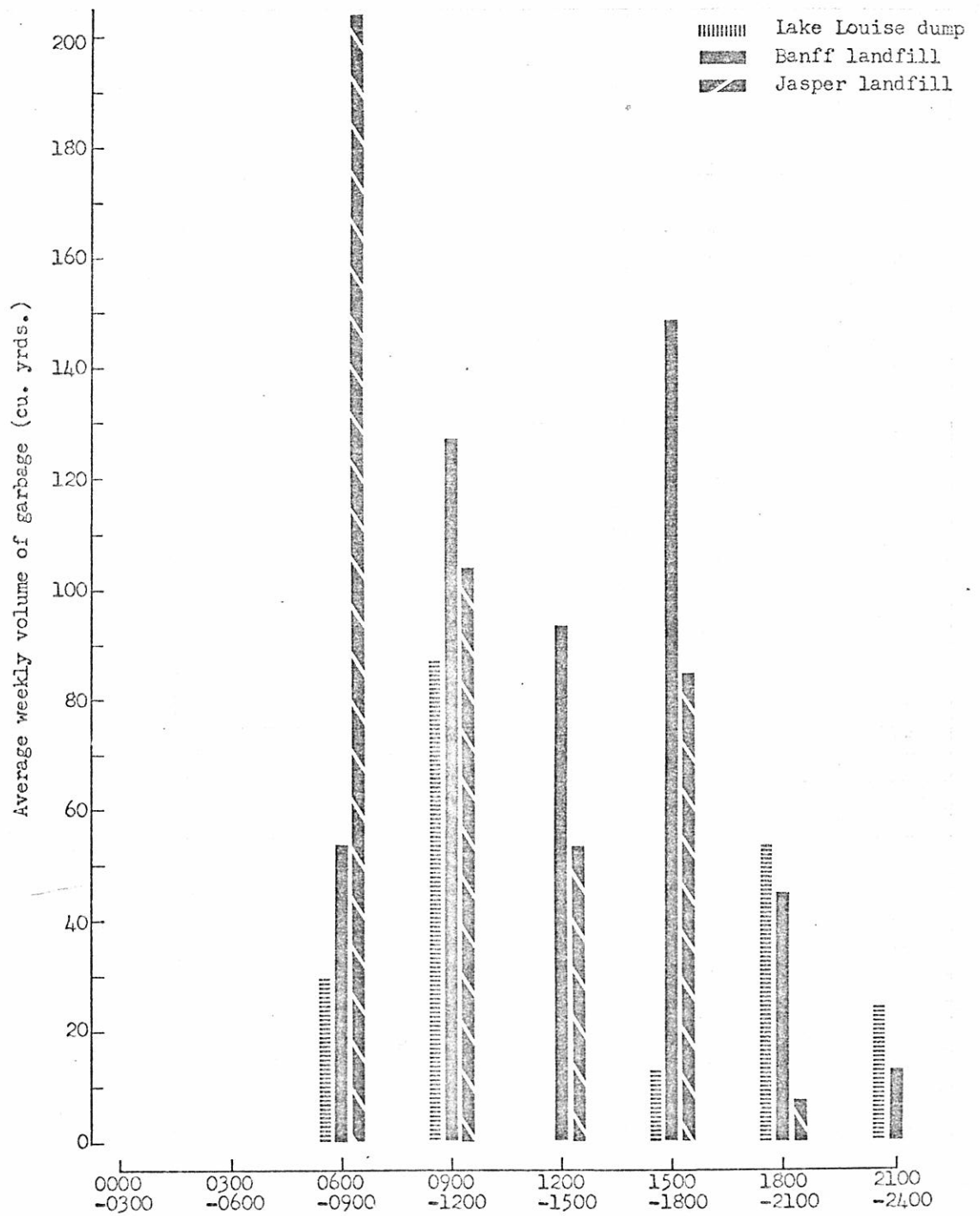
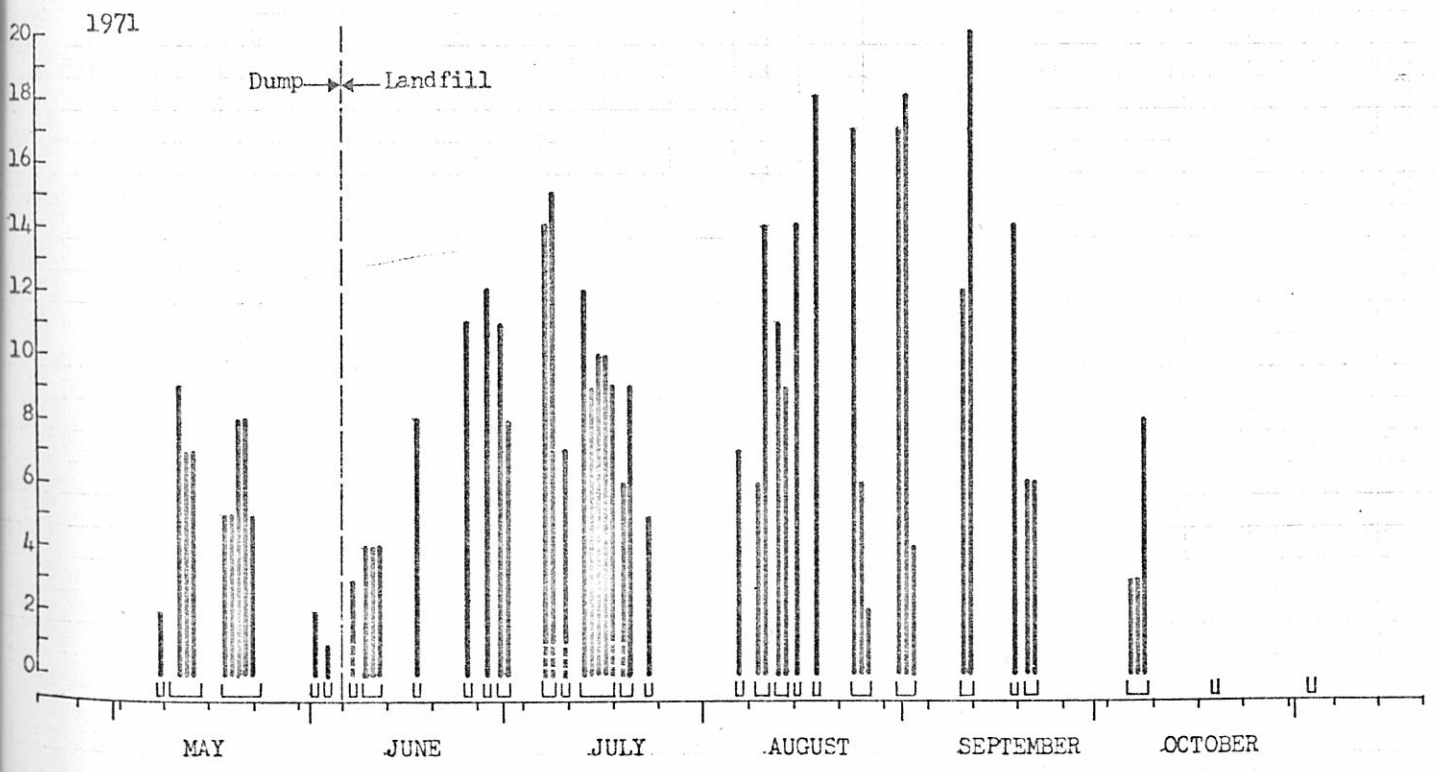
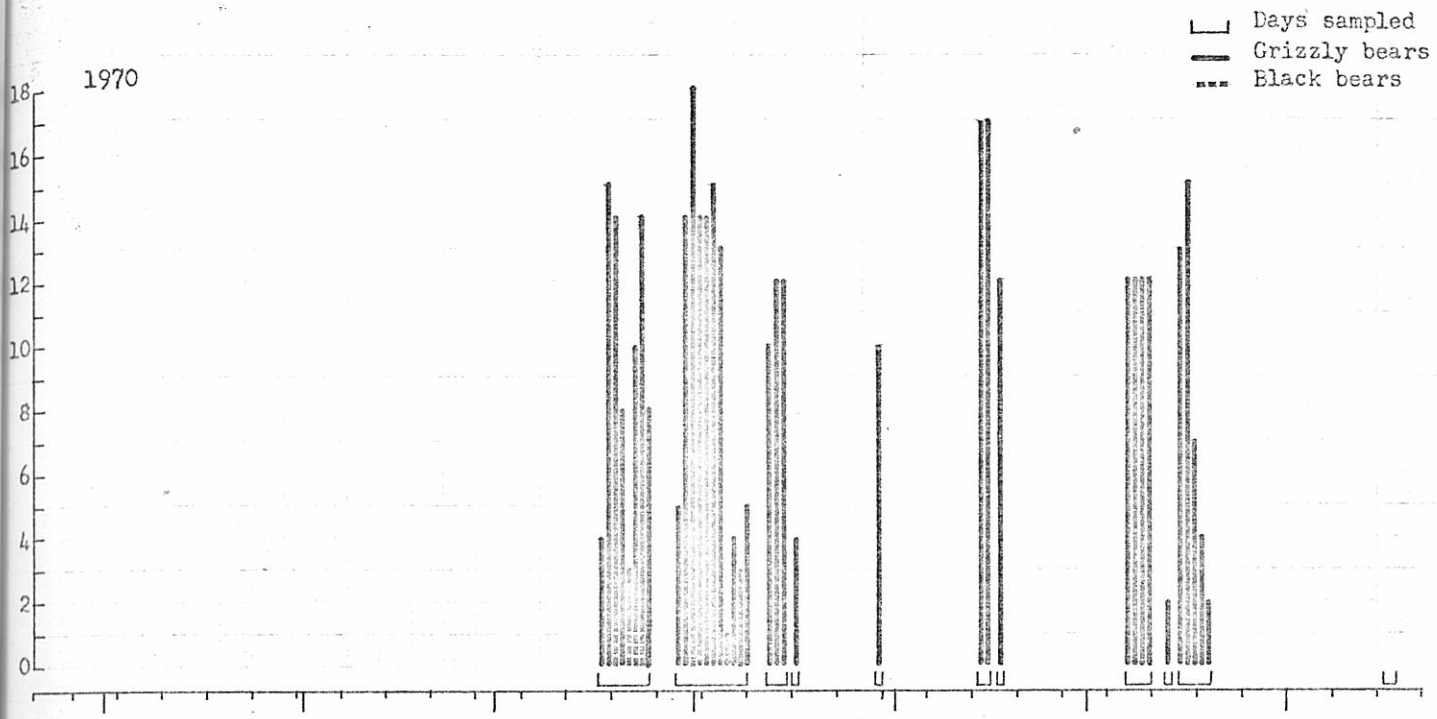


Fig.2 Daily distribution of garbage deposited at three major waste disposal sites in Banff and Jasper National Parks, 1970



8.3 . Daily occurrence of bears at the Lake Louise dump in 1970 and at the Lake Louise dump and sanitary landfill in 1971, in Banff National Park

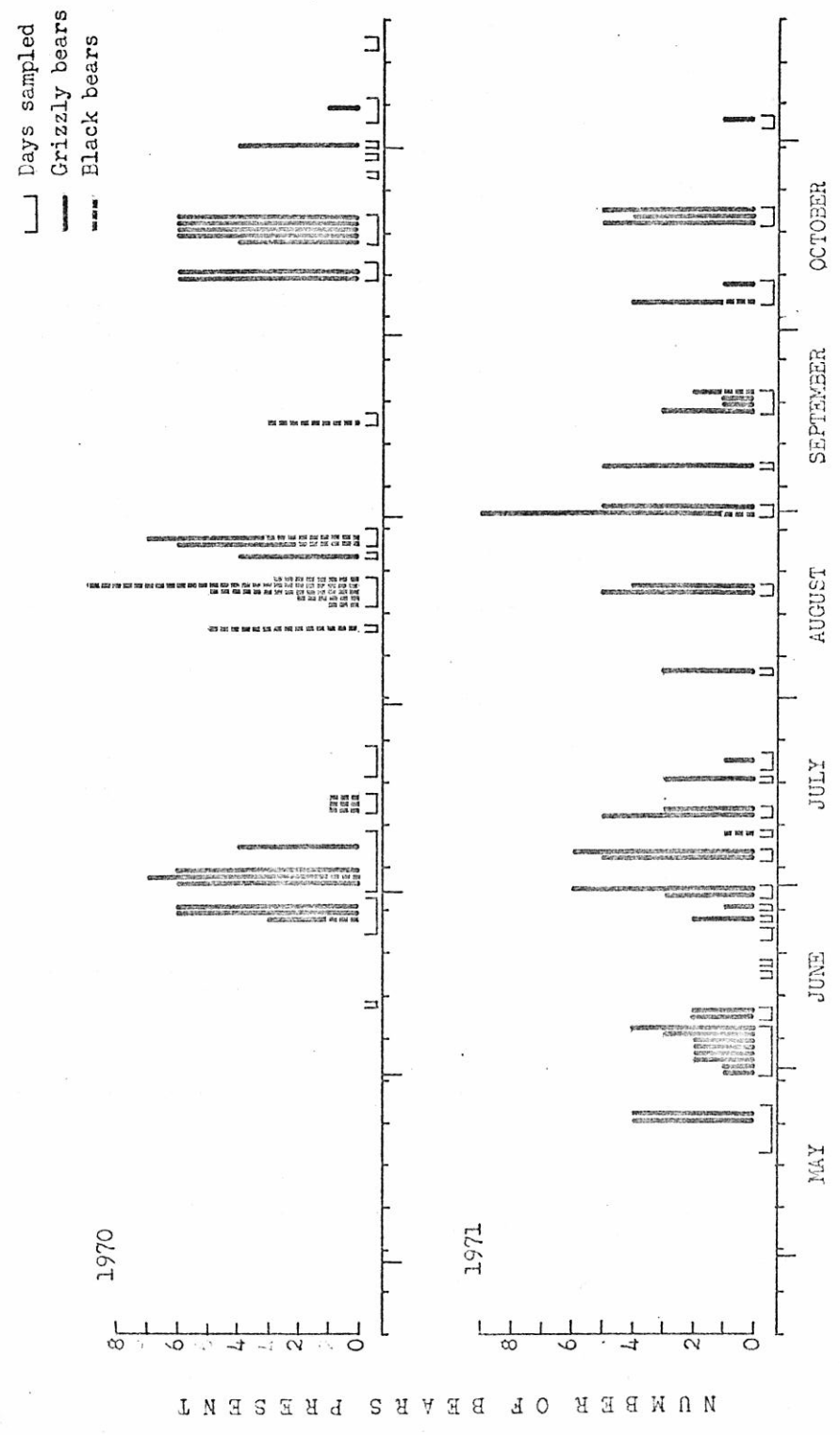


Fig.4 • Daily occurrence of bears at the Banff sanitary landfill, Banff National Park during 1970 and 1971

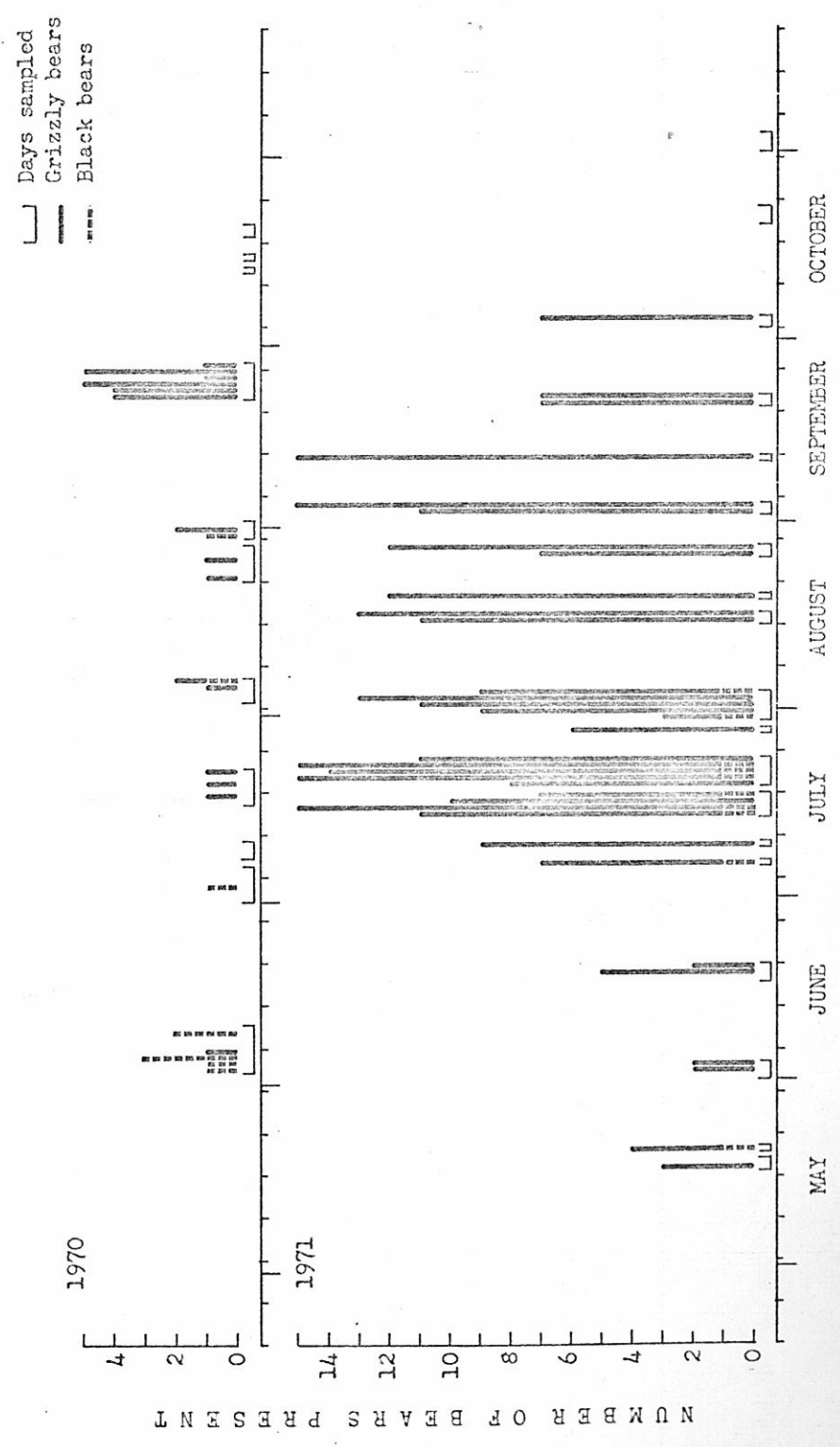


Fig. 5 . Daily occurrence of bears at the Jasper sanitary landfill, Jasper National Park during 1970 and 1971

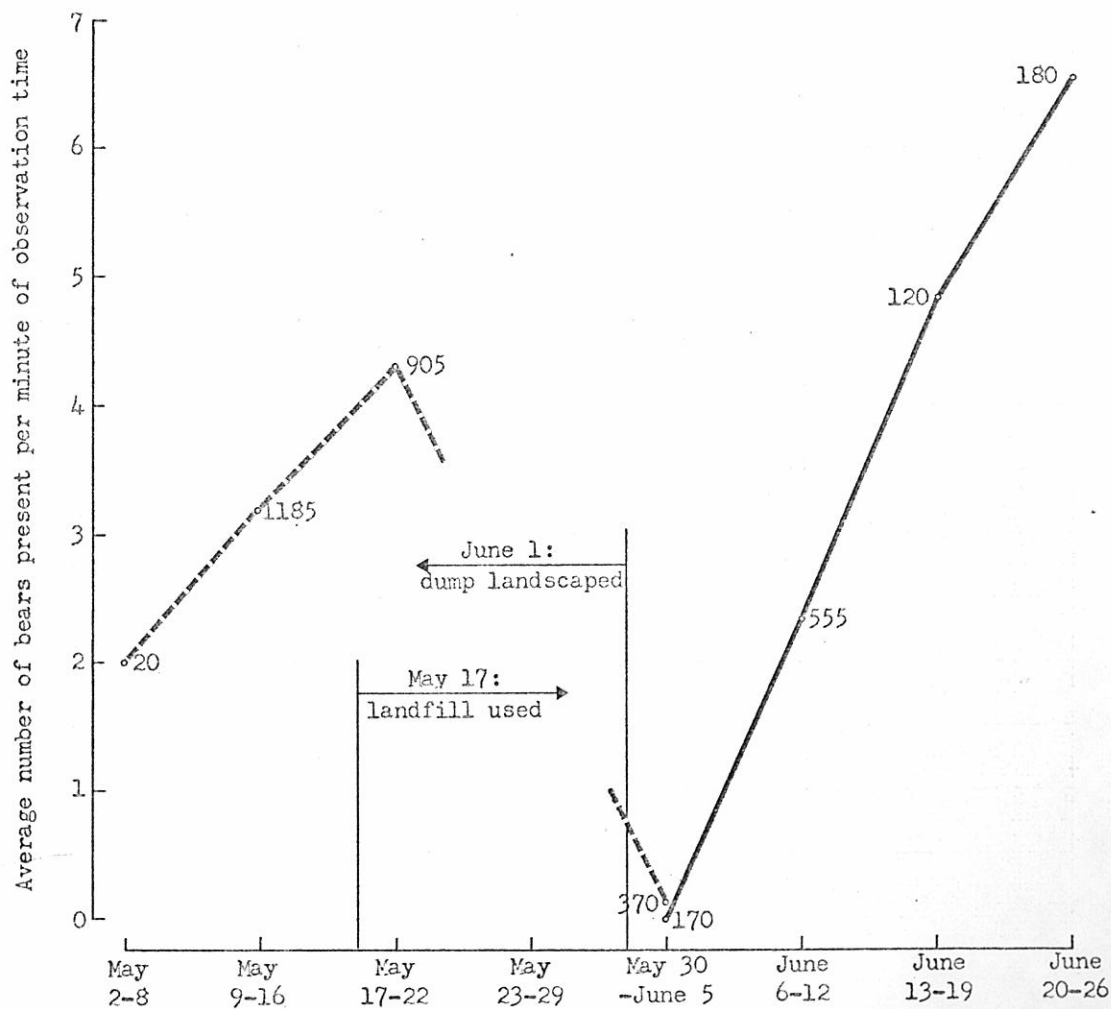


Fig. 6 Bear-use of the Lake Louise Dump prior to its closure and that of the Lake Louise landfill after its opening (Only observations made between the hours of 2100 and 0300 are considered) in 1971.

3.2. Length of stay

The numbers of bears present during the observation periods were constantly changing. To indicate the pattern of change in relation to time of day and in relation to season the numbers of bears present per minute of observation time was calculated and are presented as "bear use" in Appendix I. For easier handling the data were grouped into three-hour intervals for the day and into weekly periods for the season. In all major disposal sites occurrence of bears was highest in the hours preceding and following midnight and lowest during mid-day both in 1970 and 1971 with the possible exception of the Kootenay Crossing dump where insufficient data prevents a reliable conclusion. Figures 7 and 8 compare the pattern of use by both grizzly and black bears in 1970 and 1971 at the major waste disposal sites in Jasper and Banff National Parks. There was a ten-fold increase from 1970 to 1971 in bear-use during the peak periods of 2100 hours and 0300 hours at Jasper sanitary landfill and a slight decrease at the Banff landfill. Bear use of the Lake Louise landfill in 1971 was slightly greater than use of Lake Louise dump in 1970. Use of the Lake Louise dump sharply declined after June 1, 1971 when all waste was covered and the site landscaped. No dumping of garbage was permitted thereafter. The Lake Louise landfill was first used for dumping garbage on May 17, 1971. Bears were not evident until June 7, but their numbers and the extent of their use rapidly increased thereafter (Fig. 6).

3.3 Individual identification

Individual identification was facilitated by the strong social bond between female bears (sows) and their off-springs. Young of

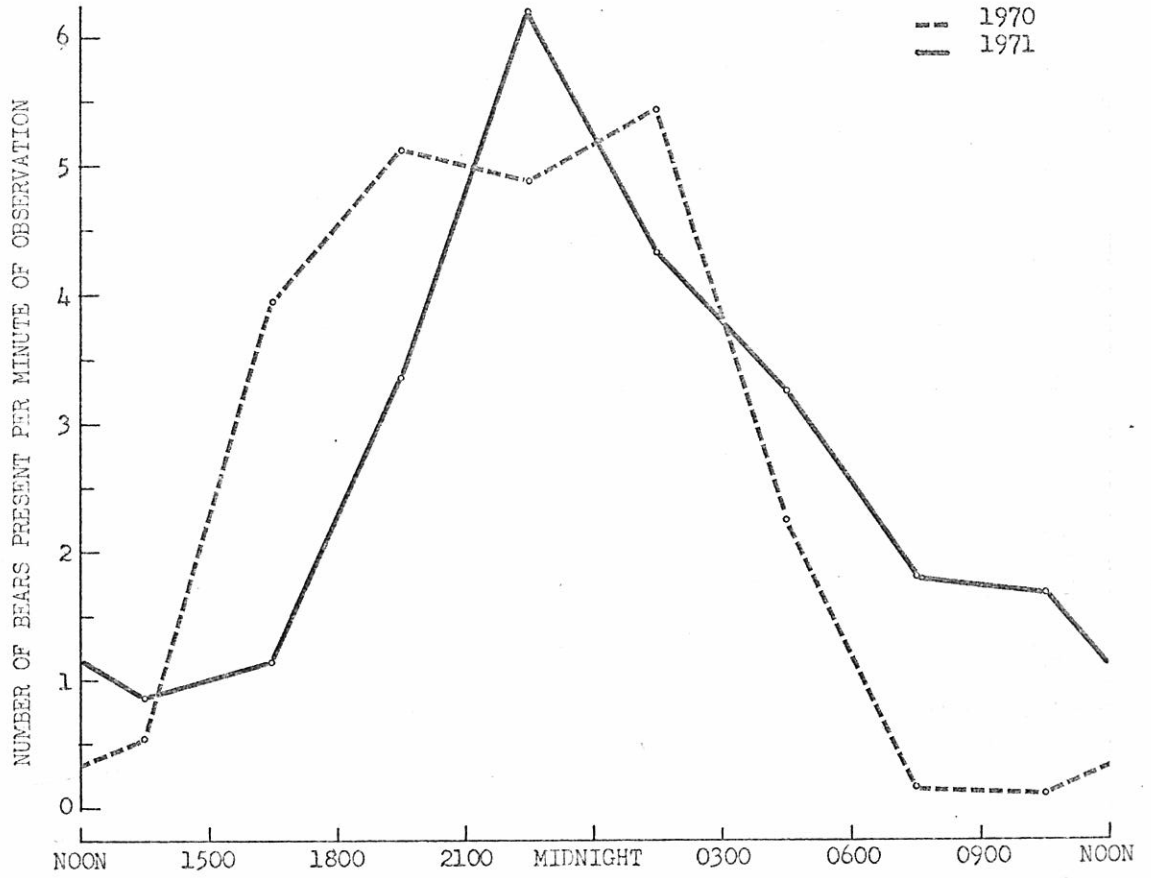


Fig.7 . Bear-use in relation to time of day at Lake Louise dump in 1970 and at Lake Louise dump and landfill in 1971, Banff National Park

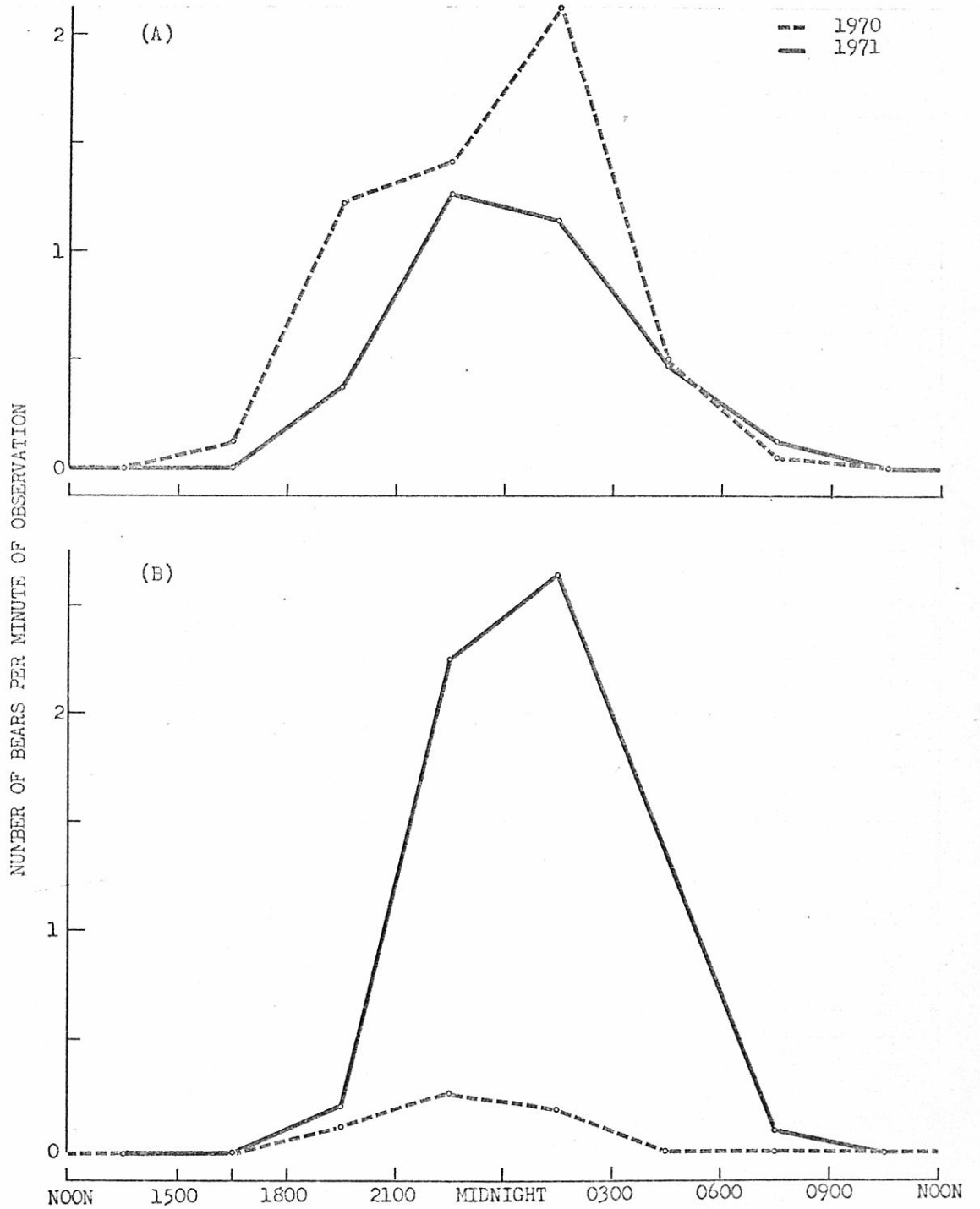


Fig. 8 . Bear-use in relation to time of day at Banff landfill, Banff National Park (A) and at Jasper landfill, Jasper National Park (B) in 1970 and 1971

the year (cubs) and young of last year (yearlings) remain in close proximity of the sow. Young in their third summer were called juveniles. They formed a strong bond between littermates, showed tolerance toward other bears and were seldom tolerated by larger bears. Adult females were identified by the presence of offsprings, adult males by their large size. Single bears larger than and dominant over juveniles but not as large as adult bears were designated as subadults. This latter group may have included breeding-age females as well. Bears that were individually identified but did not fit into the above categories were assigned as unclassified. Appendix II present individual bears and groups of bears observed at the various waste disposal sites and the extent of their use throughout the season. Waste disposal sites in the Lake Louise area attracted the largest number of individual bears both in 1970 and 1971; 29 grizzly bears, 2 black bears and 23 grizzly bears, 2 black bears respectively. Sixteen grizzly bears and 2 black bears were observed at Banff sanitary landfill in 1971 and only 10 grizzly bears and 11 black bears in 1970. There was a sharp increase in the occurrence of individual grizzly bears at Jasper sanitary landfill from 6 in 1970 to 21 in 1971. Black bear numbers dropped from 5 to one over the same period. Other waste disposal sites are smaller and not used extensively enough to permit comparisons.

3.4 Population characteristics

Bear sightings, classified by age and sex are shown in Table 2 and Table 3. In both years the combined numbers of adults roughly equalled the combined numbers of non-adults; 26 adults and 33 non-adults

Table 2. Age group distribution of grizzly and black bears at some waste disposal areas in the Mountain National Parks during 1970.

	Lake Louise	Banff	Mile 17	Jasper	Tangle Ridge	Bubbling Spring	Poco-hontas	Kootenay Crossing	Total No.	Total Percent
Grizzlies:	(29)	(10)	(5)	(6)	(9)	(-)	(-)	(-)	(59)	100.0
Cub U/C	3	1	-	-	5	-	-	-	9	15.2
Yearling U/C	6	5	3	-	-	-	-	-	14	23.7
Juvenile U/C	5	-	1	-	-	-	-	-	6	10.2
Subadult	2	-	-	2	-	-	-	-	4	6.8
Adult ♂	6	1	-	-	-	-	-	-	7	11.9
Adult ♀	6	3	1	-	2	-	-	-	12	20.3
Adult U/C	1	-	-	4	2	-	-	-	7	11.9
Blacks:	(2)	(11)	(-)	(5)	(-)	(1)	(1)	(10)	(30)	100.0
Cub U/C	-	2	-	-	-	-	-	3	5	16.6
Yearling U/C	-	1	-	2	-	-	-	-	3	10.0
Juvenile U/C	1	3	-	-	-	-	1	2	7	23.3
Adult ♂	-	1	-	-	-	-	-	3	4	13.3
Adult ♀	-	1	-	1	-	-	-	2	4	13.3
Adult U/C	1	3	-	2	-	1	-	-	7	23.3

Table 3. Age group distribution of grizzly and black bears at some waste disposal areas in the mountain National Parks, during 1971.

	Lake Louise	(23)	Banff	(16)	Jasper	(21)	Tangle Ridge	(5)	Glacier	(3)	No.	Total Percent
Grizzlies:											(68)	100.0
Cub U/C	2		-		5		-		-		7	10.3
Yearling U/C	3		3		2		3		-		10	14.7
Juvenile	2		4		2		-		3*		11	16.2
Subadult	5		-		-		-		-		5	7.3
Adult ♂	6		4		5		-		-		15	22.0
Adult ♀	4		3		6		1		-		14	20.6
Adult U/C	1		2		2		1		-		6	8.8
Blacks:												
Adult U/C	2		2		1		-		3		5	

* T. Gibbons and S. Stahara

were seen in 1970 and 35 adults and 33 non-adults were seen in 1971. More females with yearling cubs were observed than females with cubs of the year consequently among non-adults yearlings were the most numerous, followed by juveniles, young of the year and subadults. Among adult bears the observed male to female ratio was 1:0.58 in 1970 and 1:1.07 in 1971. Twenty out of 26 identified females were observed with cubs (young of the year or young of last year) with an average litter size of 2.0 (range 1 to 3).

3.5. Behavior

A definite hierarchy was observed among bears visiting the dump sites. Grizzly bears were dominant over black bears. Among grizzly bears, females with young of the year were least tolerant of the proximity of others and were dominant in the vast majority of bear to bear encounters. Large males and sows with yearlings were next in line followed by single adult females. Subadults and juveniles were the least dominant and showed tolerance toward each other.

Most bears appeared at or after dusk and remained for a variable length of time. Their activities consisted of feeding on uncovered garbage, digging for items already covered, and interacting with other bears and humans. Sows with cubs often rested, nursed, and played with their offsprings. Bears visiting Banff and Jasper sanitary landfills were less tolerant of humans and were quickly dispersed by noises of humans and vehicles. Bears at Lake Louise dump and landfill were less weary and some animals were reluctant to move even if efforts were made to disperse them. Often, grizzly

bears were waiting only a few feet away from trucks unloading garbage. Bears moved freely through fences surrounding Jasper and Banff sanitary landfills by digging underneath. At the other dumps there were no obstacles to the bears movements.

The manner and intensity of interactions among bears will be discussed in detail in a later report.

4. Other animals

Wildlife other than bears are also attracted to waste disposal sites. Coyotes were sighted regularly at all dumps as were ravens, crows and gulls (ring-billed and California gulls). Wolverines were seen at Lake Louise dump. These sightings were incidental to observations of bear activities therefore use of dumps by other animals cannot be documented in detail. A tallying of sightings (i.e. entries in the recorded observations) for the season, however shows a definite pattern of use (Figure 9.). The figures indicate only relative abundance since only pronounced changes in occurrence were noted. Coyotes were seen most frequently, in numbers up to ten and the pattern of their occurrence was similar to that of the bears. Feeding on garbage by coyotes was observed, but only intermittently. Most observations were of quickly moving animals. Coyotes interacted with bears most often by standing close to feeding bears and by being chased by cubs. Coyotes were observed more frequently at the Banff landfill than at Lake Louise dump in 1970. Wolverines were commonly sighted at Lake Louise dump in 1970 but it is not known how many individuals were involved. Ravens and crows were also regular users of the dumps, appearing in large

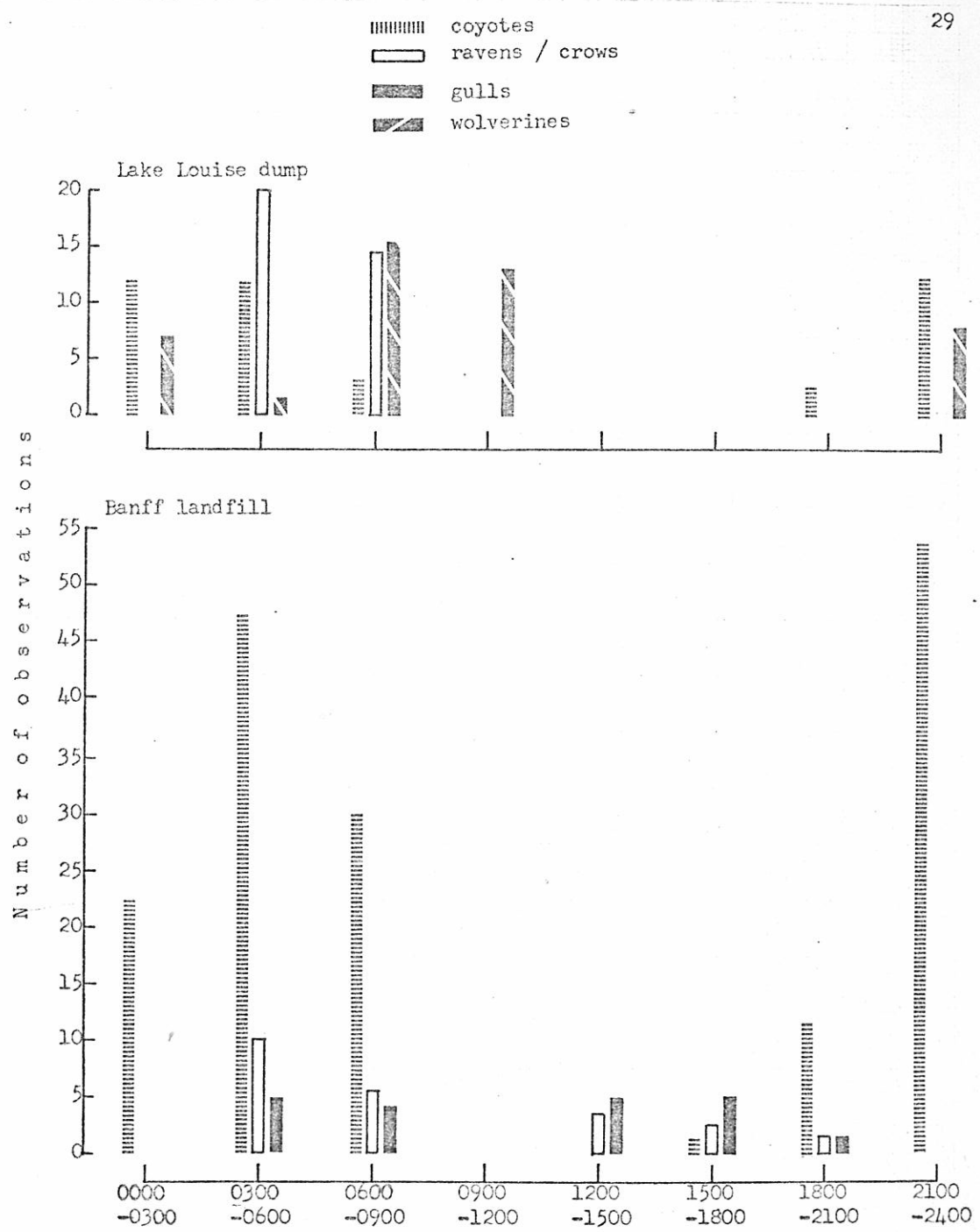


Figure 9. Daily distribution of incidental observations of wildlife other than bears at Lake Louise dump and Banff landfill, Banff N.P., 1970

numbers (up to 36 birds) approximately one hour before sunrise and staying for two to three hours. Ravens and crows were also observed sporadically in the afternoon hours at Banff landfill. Gulls were also commonly sighted at Banff landfill from dawn to dusk but were not seen at Lake Louise dump.

5. Human use

The dump sites in all National Parks are commonly visited by tourists and local residents who wish to observe bears. Entry to these sites is controlled by gates at some locations but the majority of the dumps were open to vehicular traffic during day and night in 1970 and 1971. Lake Louise dump in 1970 was the most commonly visited site (Appendix III). Traffic generated by other than garbage delivery vehicles was sparse during the day and heavy after dusk until about midnight. After midnight, traffic was light but vehicles were observed entering the dump in the morning hours as well. A count of occupants in vehicles entering Lake Louise dump yielded an average of 3.07 persons in each vehicle (sample size 163 vehicles). Vehicles remained in the dump area from a few minutes to several hours. Occasionally up to 20 vehicles were parked side by side in the manner of a drive-in theatre. Most people remained in their cars, however some ventured outside to gain a closer look at the animals. Bears usually departed at the close approach of vehicles and returned when the commotion had settled. Sows with cubs, juveniles and subadults were least disturbed by vehicular traffic.

DISCUSSION

Waste is a byproduct of man's use of his environment. Man may use things as they are or alter them to his liking. It is mainly as a result of this alteration that waste comes into existence. The quantity of waste produced is directly related to the affluence of its producers. Increasing affluence in North America, manifested in the wrapping into disposable containers of all consumer goods has created a continent-wide crisis in waste disposal. The problem of coping with increasing volumes of garbage in National Parks is compounded by increasing visitation. Furthermore, waste disposal in National Parks takes on a special dimension if its effects on the parks biota are considered.

Most of the waste generated in National Parks is highly attractive to wildlife, consequently waste disposal sites are commonly visited by wild animals. All major waste disposal sites surveyed in this study attracted bears in various numbers. The largest numbers of bears were observed at the oldest disposal sites and at sites where the largest amount of garbage was deposited. Wild animal use of man's garbage for food is aesthetically unacceptable. The effect of garbage on the ecology of animals however, is more difficult to evaluate. Garbage represents food to the animals and may not be much different than carrion found in the wild. Substances such as spices and preservatives may be more concentrated in garbage, but ill effects of garbage-feeding on the health of bears has not yet been noted or documented. Physical injury from metal containers and broken glass however has been observed on a black bear at Lake Louise.

A further consideration is the effect of garbage dumps on the distribution and movement of bears. Dumps tend to attract animals from a large area and concentrate them in one location. Such concentrations do occur in the wild as well in response to abundant food supplies such as those observed in Alaska at salmon spawning time. These congregations however, soon disperse after the food diminishes, while those at dumpsites tend to remain all summer. The pattern of seasonal use shows that large boars appear less often and do not stay as long as females with young and immature animals. The extensive use of dumps by maternal groups tends to perpetuate the habit by accustoming the young to the sites through the learning process.

Bear-use of dumps becomes a definite problem when related to human activities. All waste disposal sites in National Parks are in areas of heavy visitor use and the high occurrence of bears in these areas causes incidents that are commonly referred to as "bear problems". Bear problems are common in all western National Parks. They may range from bears upsetting garbage receptacles along park roads, at commercial service centres and in townsites, to bears ripping tents in campgrounds, damaging warden cabins in search of food and ultimately to bears threatening and attacking people. Problem bears then are those which are initially attracted by garbage in heavy human use areas and eventually come into conflict with humans. Bears develop into problem animals through habituation. An animal naturally shy of human scent will lose this shyness of learning that inquisitiveness will be rewarded with tasty morsels at garbage dumps. Since garbage has the smell of humans, garbage-habituated bears may associate human scent with a source of food. The observed high incidence

of maternal groups at dumps suggests that young bears have ample time to learn this association. Juvenile bears on their own for the first time will follow the learned process and seek food at dumps, roadsides and campgrounds. The low position of these young animals in the dominance hierarchy of bears concentrated at large waste disposal sites will force them to seek food elsewhere. Such animals are most likely to raid campgrounds or harass back-country users and other park visitors.

A solution to "bear-problems" involves the removal of any of the three contributing factors: the bears, the garbage, or the humans. Past and present efforts to solve the problem in Canada's National Parks always involved the first factor. The importance of the second factor is fully recognized but attempts to remove it were, and are, unsatisfactory. Removal of the third factor, however has seldom been considered.

In solving the bear problem the removal of the bear factor often meant destruction of animals. In more recent years problem bears have been captured and moved to sites of little human use. Bears are translocated to avoid their destruction, therefore utmost care in their handling is important to ensure their survival after release. Bears are captured in culvert-type traps and are kept in these traps for up to 36 hours. Both the design of the traps and the length of their capture can physically injure the bears. Efforts are being made to reduce injuries of this type. Captured animals are tranquilized to allow measuring and marking them. The tranquilizing drug most often used is Anectine (succinylcholine chloride) which, due to its narrow range of effectiveness presents an added danger to the animals. Weight estimation of bears needs to be accurate when using this drug. Moreover, the response of treated animals

to the drug varies widely and prescribed dosages repeated within 24 hours may be lethal. A better drug, Sernylan (phencyclidine hydrochloride), unfortunately is not available for general application. In past years captured bears were driven to little used areas via park fire roads. Road transport of partially drugged bears however, exposed the animals to possible internal injuries due to their inability to cushion the rough ride through lack of muscular control. The release sites were most often chosen for convenience and thus some sites have been used for the release of many bears. This situation reduces the success of the operation. Most bears relocated in past years exhibited strong homing tendencies. The average translocation operation is likely a traumatic experience for the animal and thus lessens its chances of fitting into the environment of the release site. The bear may find release a continuation of its ordeal in the trap and will attempt to move back to the site of capture which did not diminish in attraction. To ensure success in translocating bears (success means survival of the animal in the new area) it is necessary to handle animals without injury, to choose suitable release sites, to make the sites attractive by baiting with carrion, and most importantly to eliminate the attraction of the capture site. The use of helicopters to move bears while expensive, eliminates some of the chances for injury due to handling. Suitability of some of the release sites is presently being investigated.

The second factor in the occurrence of "bear problems", garbage and its removal is most urgent. Even the translocation of bears is dependent on the elimination of waste which is accessible to bears. Otherwise, the bears will continue to return. The handling of all waste in National

Parks, as elsewhere, is determined by financial considerations. This consideration is valid in National Parks only if the disposal method chosen does not adversely affect the biota of the parks. This study has conclusively shown that waste disposal methods presently employed in National Parks seriously affect the ecology of bears and bring about a situation that could lead to the extinction of grizzly bears in the parks. The elimination of the garbage problem would require the removal of attractions at roadsides, at campgrounds and at commercial establishments, but most importantly the elimination of the attraction of major waste disposal sites. The method of large scale waste disposal in National Parks has changed from open pit dumping and burning to sanitary landfills. This change brought about a vast improvement in the bear problem, but was not sufficient to solve it. Unfenced open-pit dumps like that operated at Lake Louise until 1971 were the cause of most "bear problems". Their elimination was long overdue. Landfills, by consolidating dumping into one area, tend to reduce the opportunity for bears to contact garbage, and when fenced tend to reduce the chance of bears encountering humans.

The landfills themselves, however, still attract bears in large numbers. Uncovered or partially covered garbage was present at all three landfills after operating hours. Bear diggings at the site of freshly buried garbage measured up to 6 feet in depth and up to 12 feet in diameter. Items of garbage buried for several days were also dug out by bears from depths of up to 18 inches. Regular delivery of garbage after operating hours at Banff landfill maintained an ample supply of uncovered garbage throughout the summers of 1970 and 1971. The bears access to the garbage at both Banff and Jasper landfills was not hindered

by the fencing. They dug holes underneath with ease or utilized existing gaps in the fence. Damage done to the fence at Banff landfill indicated that if digging was prevented by burying the bottom edge of the fence in concrete, then the fence itself would be climbed over or pushed down. Electric fencing built around Banff landfill in 1971 did not prove more effective. Although bears preferred to dig underneath, they were also commonly observed to walk through the strands of the fence. Because landfills are located in areas of heavy human use, chance encounters are still a high probability. Bears attracted to the sites but forced out by other bears still find ample food in garbage receptacles at roadsides, commercial establishments, campgrounds and even visitor centres. The sealing of garbage and frequent removal from these sites is an integral part of the solution of "bear problems". Garbage-habituated bears will be difficult to keep away from any waste-disposal site because of their familiarity with it but bears in their wanderings and maternal groups coming for the first time are attracted by the smell of garbage. Thus, waste disposal methods that eliminate or effectively reduce smell must be employed. Such methods are pulverizing, milling and incinerating. Pulverizing mills are very expensive to install and to operate, however the combined waste of Banff and Jasper National Parks is probably sufficient to warrant such an expenditure. Pulverizing reportedly reduces the smell and the mixing of organic and inorganic waste makes the end-product unattractive to wildlife. This end-product is a homogenous substance suitable for secondary uses such as fills in construction. Large European and many American centres employ this method. Incineration is possibly a less costly method. It involves the burning of waste in an enclosed area with various

degrees of combustion. Small self-burning incinerators are presently employed in several of our smaller National Parks. They are unsatisfactory, as was the one in Jasper abandoned two years ago, because the degree of combustion is very low and the partially incinerated garbage is still attractive to wildlife and presents a further disposal problem. In addition, the low temperature burning causes air pollution by fly-ash and unburned particles escaping through the stack. The degree of combustion can be increased by employing forced air or fuel to achieve a high degree of combustion, and by precipitators and/or afterburners which reduce particulate emissions and odors. Because of seasonal variation in the volume of garbage in National Parks a suitable design may be a battery of smaller incinerators, the number in operation also varying seasonally with demand. While efficient incinerators reduce garbage to 10 percent of its original volume, the remaining ashes would still have to be deposited in an adjoining small landfill. The problem of glass containers can be solved by removing them before incineration or by employing low temperature incinerators with high temperature afterburners. Small incinerators could be installed at outlying service centers and campgrounds. Temporary establishments could be equipped with portable models. Particular attention must be given to loading in the design of suitable incinerators to avoid garbage being strewn around the incinerator site. Efficient incineration is a costly procedure.

The third factor contributing to "bear problems" is man himself. Although this factor has been the centre of concern in all past incidents, removal of it has seldom been considered. The recent continent-wide awakening to environmental problems has not much affected solutions to

"bear problems". Man should use National Parks to enrich his life, within confinements necessary to provide for future users as well. One of these restrictions may be temporary exclusion from a given area. This may provide for an over-trampled area to recuperate or for human safety in the case of avalanches or forest fires. The presence of an excitable grizzly sow with cubs of the year in a valley should warrant its temporary closure. Similarly, campgrounds and picnic sites should be temporarily closed if past human use habituated bears to them and the bears are coming into conflict with humans.

The number of grizzly or black bears present in the mountain National Parks is not known. Present efforts to enumerate bear populations are yielding lower than expected figures. It is felt that the Banff-Yoho-Kootenay park complex has a grizzly bear population of less than 75 animals. A slightly larger population (100 animals) is estimated to be in Jasper National Park. Black bears are now possibly less numerous. Individual grizzly bears observed at the major waste disposal sites in Banff National Park represent more than half of the park's estimated population. Garbage-feeding bears are all potential "problem bears" and as such liable for destruction by park management. The destruction of garbage-feeding "problem bears" opens "niches" for new bears to occupy. This situation if continued will lead to a reduction in the bear population beyond viability.

Bear use of waste disposal sites is a problem because it works against the aims and intentions of the National Parks Act. The Act points out that National Parks were established to preserve all forms of their endemic biota in perpetuity. Bear-use of dumps however, will result in "bear-problems" that are still most commonly solved with the destruction of the animal. While the culling of the parks' bear population in this manner is

against the principle of the Act, the resulting reduction in population size in endangering the continued welfare of the bears (both grizzly and black bears) in National Parks, is a violation of the Act itself.

APPENDIX I

Bear-use of waste disposal areas in relation to time of the day and to time of the year in the mountain National Parks during 1970 and 1971 (Bear-use is expressed as the numbers of bears present per one minute of observation time. Length of observation time to indicate sample size is also given).

I/a: Lake Louise dump, Banff National Park, 1970.

Week:	Between hours of								Daily Total/ Average
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
J 12- 18	6.500 180	-	-	-	-	-	0.000 100	3.125 240	3.692 520
19- 25	4.756 720	1.312 160	0.060 330	0.150 300	-	-	0.000 190	3.324 540	2.453 2240
26-A 1	7.020 495	12.666 60	-	-	-	-	0.533 75	4.028 535	5.419 1165
A 2- 8	6.152 360	1.771 460	0.227 680	0.000 465	-	-	1.000 45	5.208 360	2.154 2370
9- 15	3.361 360	1.888 45	-	-	-	-	0.000 240	3.675 540	2.767 1185
16- 22	-	0.571 105	0.000 180	0.000 145	-	-	-	-	0.135 430
23- 29	-	-	-	-	-	-	1.388 90	4.777 135	3.422 225
S 13- 19	6.025 200	-	-	-	-	0.074 135	3.677 450	7.816 300	4.806 1085
O 4- 10	-	-	-	-	2.000 30	7.621 330	11.291 635	9.662 370	9.758 1365
11- 17	-	-	-	2.000 30	0.000 20	1.567 185	7.055 180	5.591 245	4.530 660
18- 24	4.000 60	1.666 120	0.000 120	-	-	-	-	-	1.466 300
N 15- 21	-	-	-	-	0.000 60	0.000 60	-	0.000 120	0.000 240
	5.448 2375	2.242 950	0.133 1310	0.111 940	0.545 110	3.964 710	5.139 2005	4.872 3385	3.820 11785

I/b: Banff landfill, Banff National Park, 1970.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
J 7- 13	-	-	-	-	0.000 120	-	-	-	0.000 120
21- 27	0.393 330	0.666 60	0.000 65	-	0.000 110	0.000 195	0.000 465	0.550 600	0.273 1825
28-J 4	4.444 405	1.575 165	0.000 150	0.000 205	0.000 390	0.000 380	0.000 210	3.388 180	1.280 2085
J 5- 11	0.444 360	0.000 330	0.000 540	0.000 540	0.000 180	0.000 180	0.000 150	0.000 360	0.060 2640
12- 18	0.541 360	0.000 60	-	-	-	-	0.000 60	0.333 360	0.375 840
19- 25	-	-	0.000 30	0.000 150	0.000 100	0.000 60	0.000 60	-	0.000 400
9- 15	-	-	-	-	-	-	0.600 75	1.625 120	1.230 195
A 16- 22	1.125 240	0.538 195	0.088 450	0.000 175	-	-	0.750 60	1.430 360	0.658 1480
23- 29	3.500 120	-	0.000 60	0.000 75	0.000 40	0.000 20	0.800 150	2.069 360	1.557 825
S 13- 19	-	-	-	-	0.000 120	0.076 65	1.194 180	0.000 120	0.485 485
O 11- 17	6.000 60	-	-	0.000 30	-	1.142 105	3.365 630	3.000 450	3.098 1275
18- 24	6.000 180	-	-	0.000 15	-	-	-	6.000 10	5.560 205
25- 31	-	-	0.000 60	-	-	-	0.000 120	-	0.000 180
N 1- 7	-	-	0.000 120	-	-	-	2.000 180	4.000 180	2.250 480
8- 14	-	-	-	-	-	0.000 60	0.000 60	-	0.000 120
15- 21	-	-	-	0.000 105	-	-	-	0.000 180	0.000 285
	2.148 2055	0.500 810	0.027 1475	0.000 1295	0.000 1066	0.117 1065	1.210 2400	1.416 3280	0.932 13446

I/c: Jasper landfill, Jasper National Park, 1970.

Week:	Between hours of:								Daily Average/ Total
	0000-- 0300	0300-- 0600	0600-- 0900	0900-- 1200	1200-- 1500	1500-- 1800	1800-- 2100	2100-- 2400	
M 31-J 6	-	0.000 90	0.000 75	0.000 45	0.000 90	0.000 450	0.000 570	0.085 525	0.024 1845
J 7- 13	0.000 120	-	0.000 90	0.000 570	0.000 650	0.000 360	0.000 255	0.000 230	0.000 2275
28-J 4	-	-	-	0.000 225	0.000 315	0.000 510	0.000 405	0.000 375	0.000 1830
J 5- 11	0.000 525	0.000 390	0.000 195	0.000 360	0.000 360	0.000 185	-	0.000 195	0.000 2220
12- 18	0.000 180	0.000 90	-	-	0.000 30	-	-	0.000 180	0.000 480
19- 25	0.069 360	0.000 75	-	-	-	-	0.000 60	0.000 360	0.029 855
A 2- 8	0.231 345	-	-	-	-	-	0.000 60	0.041 360	0.124 765
23- 29	0.000 90	-	0.000 120	0.000 900	0.000 815	0.000 720	0.000 740	0.034 870	0.007 4255
30-S 5	0.194	-	-	0.000 120	0.000 180	0.000 120	0.000 60	0.194 180	0.083 840
S 20- 26	1.428	-	-	-	0.000 120	0.000 210	0.552 625	1.354 720	0.859 1885
O 11- 17	-	-	-	0.000 60	0.000 180	0.000 210	0.000 240	0.000 120	0.000 810
18- 24	0.000 180	0.000 150	-	-	-	0.000 60	0.000 150	0.000 30	0.000 240
	0.200 2190	0.000 795	0.000 480	0.000 2280	0.000 2740	0.000 2825	0.109 3165	0.258 3965	0.099 18440

I/d: (A) 17 mile flat dump, Banff National Park, 1970.
 (B) Kootenay Crossing dump, Kootenay National Park, 1970.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
J 7- 13 (A)	-	-	-	-	-	0.000 30	-	-	0.000 30
J 19- 25 (A)	3.444 180	0.000 30	-	-	-	-	-	1.277 180	2.179 390
A 26-S 1 (B)	0.000	-	-	1.764 170	2.272 275	3.000 180	0.833 270	0.250 240	1.250 1255
	(A) 3.444 180	0.000 30	-	-	-	0.000 30	-	1.277 180	2.023 420
	(B) 0.000 120	-	-	1.764 170	2.272 275	3.000 180	0.833 270	0.250 240	1.250 1255

- I/e: (A) Pocohontas dump, Jasper National Park, 1970.
 (B) Miette dump, Jasper National Park, 1970
 (C) Tangle Ridge dump, Jasper National Park, 1970.
 (D) Bubbling Springs dump, Jasper National Park, 1970.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 31-J 6 (A)	-	-	-	-	0.500 30	-	-	-	0.500 30
(B)	-	-	-	-	-	0.000 30	-	-	0.000 30
(C)	-	-	-	-	0.000 30	0.000 30	-	-	0.000 60
(D)	-	-	-	-	0.000 60	-	-	-	0.000 60
J 12- 18 (C)	0.000 540	0.044 340	-	-	-	-	0.500 30	0.159 720	0.089 1630
19- 25 (A)	0.000 360	0.000 120	-	-	-	-	-	0.000 360	0.000 840
(B)	0.000 180	0.000 60	-	-	-	-	-	0.000 105	0.000 345
(C)	1.222 180	0.000 120	-	-	0.000 30	-	-	-	0.666 330
(D)	-	1.000 30	-	-	-	-	-	-	1.000 30
A 2- 8 (A)	-	-	-	0.000 15	-	-	-	-	0.000 15
(B)	-	-	-	0.000 15	-	-	-	-	0.000 15
(C)	0.094 530	0.000 180	0.000 60	-	-	-	0.000 60	0.000 270	0.045 1100
(D)	-	-	0.000 15	-	-	-	-	-	0.000 15
23- 29 (C)	-	-	-	-	-	0.000 15	0.000 300	0.736 360	0.392 675
(D)	-	-	-	-	-	-	0.000 15	-	0.000 15
30-S 5 (D)	0.000 15	-	-	-	-	-	0.000 150	0.000 135	0.000 300
S 20- 26 (C)	-	-	-	-	-	-	0.111 180	0.500 120	0.266 300
0 11- 17 (C)	-	-	-	-	0.000 30	0.000 120	0.000 150	-	0.000 300
(A)	0.000 360	0.000 120	-	0.000 15	0.500 30	-	-	0.000 360	0.016 885
(B)	0.000 180	0.000 60	-	0.000 15	-	0.000 30	-	0.000 105	0.000 390
(C)	0.216 1255	0.023 640	0.000 60	-	0.000 90	0.000 165	0.048 720	0.299 1470	0.172 4395
(D)	0.000 15	1.000 30	0.000 15	-	0.000 60	-	0.000 165	0.000 135	0.071 420

I/e: (A) Pocohontas dump, Jasper National Park, 1970.
 (B) Miette dump, Jasper National Park, 1970
 (C) Tangle Ridge dump, Jasper National Park, 1970.
 (D) Bubbling Springs dump, Jasper National Park, 1970.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 31-J 6 (A)	-	-	-	-	0.500 30	-	-	-	0.500 30
(B)	-	-	-	-	-	0.000 30	-	-	0.000 30
(C)	-	-	-	-	0.000 30	0.000 30	-	-	0.000 60
(D)	-	-	-	-	0.000 60	-	-	-	0.000 60
J 12- 18 (C)	0.000 540	0.044 340	-	-	-	-	0.500 30	0.159 720	0.089 1630
19- 25 (A)	0.000 360	0.000 120	-	-	-	-	-	0.000 360	0.000 840
(B)	0.000 180	0.000 60	-	-	-	-	-	0.000 105	0.000 345
(C)	1.222 180	0.000 120	-	-	0.000 30	-	-	-	0.666 330
(D)	-	1.000 30	-	-	-	-	-	-	1.000 30
A 2- 8 (A)	-	-	-	0.000 15	-	-	-	-	0.000 15
(B)	-	-	-	0.000 15	-	-	-	-	0.000 15
(C)	0.094 530	0.000 180	0.000 60	-	-	-	0.000 60	0.000 270	0.045 1100
(D)	-	-	0.000 15	-	-	-	-	-	0.000 15
23- 29 (C)	-	-	-	-	-	0.000 15	0.000 300	0.736 360	0.392 675
(D)	-	-	-	-	-	-	0.000 15	-	0.000 15
30-S 5 (D)	0.000 15	-	-	-	-	-	0.000 150	0.000 135	0.000 300
S 20- 26 (C)	-	-	-	-	-	-	0.111 180	0.500 120	0.266 300
O 11- 17 (C)	-	-	-	-	0.000 30	0.000 120	0.000 150	-	0.000 300
(A)	0.000 360	0.000 120	-	0.000 15	0.500 30	-	-	0.000 360	0.016 885
(B)	0.000 180	0.000 60	-	0.000 15	-	0.000 30	-	0.000 105	0.000 390
(C)	0.216 1255	0.023 640	0.000 60	-	0.000 90	0.000 165	0.048 720	0.299 1470	0.172 4395
(D)	0.000 15	1.000 30	0.000 15	-	0.000 60	-	0.000 165	0.000 135	0.071 420

I/f: Lake Louise dump and landfill, Banff National Park, 1971.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 2- 8	-	-	-	-	-	-	-	2.000 20	2.000 20
9- 15	2.492 670	0.723 705	0.044 225	-	-	1.263 95	1.553 325	4.165 515	1.956 2335
16- 22	4.437 480	2.200 150	-	-	-	0.000 35	1.081 610	4.188 425	2.882 1700
23- 29	-	-	0.000 120	-	-	-	-	-	0.000 120
30- J 5	0.000 150	0.000 105	-	-	-	-	0.190 105	0.272 220	0.120 580
J 6- 12	1.718 320	2.666 180	0.000 15	-	-	-	1.500 30	3.191 235	2.339 780
13- 19	4.833 120	6.277 180	6.000 50	-	-	-	-	-	5.742 350
20- 26	-	-	-	-	-	-	1.000 15	6.555 180	6.128 195
27-J 3	8.000 10	-	-	-	-	-	4.639 180	8.267 300	6.928 490
J 4- 10	8.555 180	10.833 60	-	-	0.000 30	0.111 180	2.018 265	10.888 180	5.256 895
11- 17	5.400 325	4.333 315	0.000 15	-	-	-	3.167 120	9.028 355	5.933 1130
18- 24	7.857 35	3.928 70	-	1.250 120	1.000 180	1.000 180	1.755 225	3.600 100	1.846 910
25- 31	-	-	-	-	-	-	-	-	-
A 1 7	-	-	-	-	-	-	-	6.357 70	6.357 70
8- 14	-	-	4.772 110	3.000 150	-	-	4.183 435	9.800 100	4.748 795
15- 21	-	-	-	-	-	-	6.230 195	7.806 155	6.923 350
22- 28	-	2.000 30	2.483 155	-	-	-	9.285 35	13.000 30	3.314 250
29-S 4	-	0.846 65	1.166 60	-	-	-	7.538 130	12.145 240	8.121 495
S 5- 11	14.944 180	10.722 180	3.666 60	-	-	-	-	11.000 15	11.540 435
12- 18	-	-	-	-	-	-	6.416 180	5.481 135	6.015 315
19- 25	3.227 110	-	-	-	-	-	0.363 55	3.750 120	2.894 285
26-0 2	-	-	-	-	-	-	-	-	-
0 3- 9	.545 110	0.000 60	-	-	-	5.000 75	4.666 120	3.000 75	2.772 440
10- 16	-	-	-	-	-	-	-	-	-
17- 23	-	-	0.000 30	-	-	0.000 30	-	-	0.000 60
24- 30	-	-	-	-	-	-	-	-	-
31-N 6	-	-	-	-	-	0.000 30	-	-	0.000 30
	4.343 2680	3.230 2100	1.797 840	1.722 270	0.857 210	1.112 625	3.128 3025	6.191 3470	3.950 13230

I/f: Lake Louise dump and landfill, Banff National Park, 1971.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 2- 8	-	-	-	-	-	-	-	2.000 20	2.000 20
9- 15	2.492 670	0.723 705	0.044 225	-	-	1.263 95	1.553 325	4.165 515	1.956 2335
16- 22	4.437 480	2.200 150	-	-	-	0.000 35	1.081 610	4.188 425	2.882 1700
23- 29	-	-	0.000 120	-	-	-	-	-	0.000 120
30- J 5	0.000 150	0.000 105	-	-	-	-	0.190 105	0.272 220	0.120 580
J 6- 12	1.718 320	2.666 180	0.000 15	-	-	-	1.500 30	3.191 235	2.339 780
13- 19	4.833 120	6.277 180	6.000 50	-	-	-	-	-	5.742 350
20- 26	-	-	-	-	-	-	1.000 15	6.555 180	6.128 195
27-J 3	8.000 10	-	-	-	-	-	4.639 180	8.267 300	6.928 490
J 4- 10	8.555 180	10.833 60	-	-	0.000 30	0.111 180	2.018 265	10.888 180	5.256 895
11- 17	5.400 325	4.333 315	0.000 15	-	-	-	3.167 120	9.028 355	5.933 1130
18- 24	7.857 35	3.928 70	-	1.250 120	1.000 180	1.000 180	1.755 225	3.600 100	1.846 910
25- 31	-	-	-	-	-	-	-	-	-
A 1 7	-	-	-	-	-	-	-	6.357 70	6.357 70
8- 14	-	-	4.772 110	3.000 150	-	-	4.183 435	9.800 100	4.748 795
15- 21	-	-	-	-	-	-	6.230 195	7.806 155	6.923 350
22- 28	-	2.000 30	2.483 155	-	-	-	9.285 35	13.000 30	3.314 250
29-S 4	-	0.846 65	1.166 60	-	-	-	7.538 130	12.145 240	8.121 495
S 5- 11	14.944 180	10.722 180	3.666 60	-	-	-	-	11.000 15	11.540 435
12- 18	-	-	-	-	-	-	6.416 180	5.481 135	6.015 315
19- 25	3.227 110	-	-	-	-	-	0.363 55	3.750 120	2.894 285
26-0 2	-	-	-	-	-	-	-	-	-
O 3- 9	.545 110	0.000 60	-	-	-	5.000 75	4.666 120	3.000 75	2.772 440
10- 16	-	-	-	-	-	-	-	-	-
17- 23	-	-	0.000 30	-	-	0.000 30	-	-	0.000 60
24- 30	-	-	-	-	-	-	-	-	-
31-N 6	-	-	-	-	-	0.000 30	-	-	0.000 30
	4.343 2680	3.230 2100	1.797 840	1.722 270	0.857 210	1.112 625	3.128 3025	6.191 3470	3.950 13230

I/g: Banff landfill, Banff National Park, 1971.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 16- 22	-	0.000 160	0.000 20	0.000 15	0.000 15	0.000 15	0.000 180	0.000 50	0.000 485
23- 29	1.280 375	0.984 325	0.000 150	-	-	-	-	0.235 340	0.739 1190
30-J 5	1.244 450	0.000 85	-	-	-	-	0.000 180	0.148 540	0.509 1255
J 6- 12	1.305 360	0.083 360	1.000 15	-	-	0.000 180	0.305 180	1.152 230	0.630 1325
13- 19	-	-	-	-	-	0.000 15	0.000 180	0.000 180	0.000 375
20- 25	0.000 180	-	-	-	-	-	0.000 60	0.791 240	0.395 480
27-J 3	1.069 360	0.725 255	-	-	-	-	-	1.212 165	0.961 780
J 4- 10	1.277 180	3.750 40	-	-	-	-	0.000 105	1.625 240	1.368 565
11- 17	3.000	-	-	-	-	0.000 15	0.000 120	1.805 180	1.062 320
18- 24	-	-	-	0.000 150	-	0.000 30	0.333 90	1.444 135	0.555 405
25- 31	-	-	-	-	-	-	-	-	-
A 1- 7	-	-	-	-	-	-	0.583	1.416	1.138
8- 14	-	-	-	-	-	-	-	-	-
15- 21	4.000 15	-	-	-	-	0.000 60	0.000 30	1.194 180	0.964 285
22- 28	-	-	-	-	-	-	-	-	-
A 29-S 4	-	-	-	-	-	-	0.733 150	2.500 170	1.671 320
S 5- 11	-	-	-	-	-	-	0.250 120	2.416 180	1.550 300
18- 18	-	-	-	-	-	-	1.000 40	1.000 180	1.000 220
19- 25	0.833 180	0.333 180	-	0.000 30	-	-	-	1.000 50	0.590 440
26-0 2	-	-	-	-	-	-	-	-	-
O 3- 9	0.527 180	0.000 60	-	0.000 30	0.000 30	0.000 30	1.051 195	1.708 240	0.928 765
10- 16	-	-	-	-	-	-	-	-	-
17- 23	3.166 180	-	0.500 30	-	-	0.000 15	1.607 140	4.383 300	3.195 665
24- 30	-	-	-	-	-	-	-	-	-
31-N 6	0.000 180	0.083 180	0.000 60	-	-	0.000 60	0.000 180	0.000 180	0.017 840
	1.132 2645	0.462 1645	0.109 275	0.000 225	0.000 45	0.000 420	0.363 2010	1.253 3930	0.843 11195

I/g: Banff landfill, Banff National Park, 1971.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 16- 22	-	0.000 160	0.000 20	0.000 15	0.000 15	0.000 15	0.000 180	0.000 50	0.000 485
23- 29	1.280 375	0.984 325	0.000 150	-	-	-	-	0.235 340	0.739 1190
30-J 5	1.244 450	0.000 85	-	-	-	-	0.000 180	0.148 540	0.509 1255
J 6- 12	1.305 360	0.083 360	1.000 15	-	-	0.000 180	0.305 180	1.152 230	0.630 1325
13- 19	-	-	-	-	-	0.000 15	0.000 180	0.000 180	0.000 375
20- 25	0.000 180	-	-	-	-	-	0.000 60	0.791 240	0.395 480
27-J 3	1.069 360	0.725 255	-	-	-	-	-	1.212 165	0.961 780
J 4- 10	1.277 180	3.750 40	-	-	-	-	0.000 105	1.625 240	1.368 565
11- 17	3.000	-	-	-	-	0.000 15	0.000 120	1.805 180	1.062 320
18- 24	-	-	-	0.000 150	-	0.000 30	0.333 90	1.444 135	0.555 405
25- 31	-	-	-	-	-	-	-	-	-
A 1- 7	-	-	-	-	-	-	0.583	1.416	1.138
8- 14	-	-	-	-	-	-	-	-	-
15- 21	4.000 15	-	-	-	-	0.000 60	0.000 30	1.194 180	0.964 285
22- 28	-	-	-	-	-	-	-	-	-
A 29-S 4	-	-	-	-	-	-	0.733 150	2.500 170	1.671 320
S 5- 11	-	-	-	-	-	-	0.250 120	2.416 180	1.550 300
18- 18	-	-	-	-	-	-	1.000 40	1.000 180	1.000 220
19- 25	0.833 180	0.333 180	-	0.000 30	-	-	-	1.000 50	0.590 440
26-O 2	-	-	-	-	-	-	-	-	-
O 3- 9	0.527 180	0.000 60	-	0.000 30	0.000 30	0.000 30	1.051 195	1.708 240	0.928 765
10- 16	-	-	-	-	-	-	-	-	-
17- 23	3.166 180	-	0.500 30	-	-	0.000 15	1.607 140	4.383 300	3.195 665
24- 30	-	-	-	-	-	-	-	-	-
31-N 6	0.000 180	0.083 180	0.000 60	-	-	0.000 60	0.000 180	0.000 180	0.017 840
	1.132 2645	0.462 1645	0.109 275	0.000 225	0.000 45	0.000 420	0.363 2010	1.253 3930	0.843 11195

I/h: Jasper landfill, Jasper National Park, 1971.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 2- 8	-	-	-	-	-	-	-	-	-
9- 15	-	-	-	-	-	-	-	-	-
16- 22	0.000 180	0.417 180	0.000 180	-	-	-	-	1.033 180	0.375
23- 29	-	-	-	-	-	-	-	-	-
30-J 5	0.125 360	0.000 240	0.000 240	-	-	-	0.000 15	0.317 315	0.124 1170
J 6- 12	-	-	-	-	-	-	-	-	-
13- 19	-	-	-	-	-	-	-	0.777	0.319
20- 26	-	-	-	-	-	-	-	-	-
27-J 3	-	-	-	-	-	-	-	-	-
J 4- 10	1.361 180	0.000 180	-	-	-	-	0.000 15	4.714 105	1.541 480
11- 17	3.256	-	-	-	-	-	-	1.065 540	1.933 900
18- 24	4.682 660	3.000 90	-	-	-	-	-	1.661 900	2.942 1650
25- 31	3.000 180	1.571 35	-	-	-	-	0.000 60	1.733 300	1.939 575
A 1- 7	3.083	-	-	-	-	-	-	3.875	3.479
8- 14	-	-	-	-	-	-	-	-	-
15- 21	3.333 180	-	-	-	-	-	-	5.333 300	4.625 480
22- 28	-	-	-	-	-	-	0.250 120	5.806 360	4.417 480
29-S 4	7.500 180	-	-	-	-	-	0.083 120	3.688 240	4.157 540
S 5- 11	6.778 180	5.750 180	4.000 10	-	-	-	-	3.028 180	5.163 550
12- 18	-	-	-	-	-	-	-	-	-
19- 25	3.696 165	2.333 180	-	-	-	-	0.428 140	6.200 100	2.925 595
26-0 2	-	-	-	-	-	-	-	-	-
O 3- 9	1.688 255	0.277 90	-	-	-	-	0.000 90	0.000 270	0.874 705
10- 16	-	-	-	-	-	-	-	-	-
17- 23	0.000 230	0.000 180	-	0.000 15	-	0.000 30	0.000 180	0.000 180	0.000 815
24- 30	-	-	-	-	-	-	-	-	-
31-N 6	0.000 190	0.000 60	-	0.000 30	-	0.000 15	0.000 105	0.000 195	0.000 585
N 7- 13	-	-	-	-	-	-	-	-	-
14- 20	-	-	-	-	-	-	-	-	-
	2.658 4010	1.328 1415	0.093 430	0.000 45	0 -	0.000 45	0.189 845	2.251 4885	2.033 11675

I/h: Jasper landfill, Jasper National Park, 1971.

Week:	Between hours of:								Daily Average/ Total
	0000- 0300	0300- 0600	0600- 0900	0900- 1200	1200- 1500	1500- 1800	1800- 2100	2100- 2400	
M 2- 8	-	-	-	-	-	-	-	-	-
9- 15	-	-	-	-	-	-	-	-	-
16- 22	0.000 180	0.417 180	0.000 180	-	-	-	-	1.033 180	0.375
23- 29	-	-	-	-	-	-	-	-	-
30-J 5	0.125 360	0.000 240	0.000 240	-	-	-	0.000 15	0.317 315	0.124 1170
J 6- 12	-	-	-	-	-	-	-	-	-
13- 19	-	-	-	-	-	-	-	0.777	0.319
20- 26	-	-	-	-	-	-	-	-	-
27-J 3	-	-	-	-	-	-	-	-	-
J 4- 10	1.361 180	0.000 180	-	-	-	-	0.000 15	4.714 105	1.541 480
11- 17	3.256	-	-	-	-	-	-	1.065 540	1.933 900
18- 24	4.682 660	3.000 90	-	-	-	-	-	1.661 900	2.942 1650
25- 31	3.000 180	1.571 35	-	-	-	-	0.000 60	1.733 300	1.939 575
A 1- 7	3.083	-	-	-	-	-	-	3.875	3.479
8- 14	-	-	-	-	-	-	-	-	-
15- 21	3.333 180	-	-	-	-	-	-	5.333 300	4.625 480
22- 28	-	-	-	-	-	-	0.250 120	5.806 360	4.417 480
29-S 4	7.500 180	-	-	-	-	-	0.083 120	3.688 240	4.157 540
S 5- 11	6.778 180	5.750 180	4.000 10	-	-	-	-	3.028 180	5.163 550
12- 18	-	-	-	-	-	-	-	-	-
19- 25	3.696 165	2.333 180	-	-	-	-	0.428 140	6.200 100	2.925 595
26-0 2	-	-	-	-	-	-	-	-	-
0 3- 9	1.688 255	0.277 90	-	-	-	-	0.000 90	0.000 270	0.874 705
10- 16	-	-	-	-	-	-	-	-	-
17- 23	0.000 230	0.000 180	-	0.000 15	-	0.000 30	0.000 180	0.000 180	0.000 815
24- 30	-	-	-	-	-	-	-	-	-
31-N 6	0.000 190	0.000 60	-	0.000 30	-	0.000 15	0.000 105	0.000 195	0.000 585
N 7- 13	-	-	-	-	-	-	-	-	-
14- 20	-	-	-	-	-	-	-	-	-
	2.658 4010	1.328 1415	0.093 430	0.000 45	0 -	0.000 45	0.189 845	2.251 4885	2.033 11675

APPENDIX II

Seasonal occurrence of individual bears at waste disposal sites, mountain National Parks, 1970 and 1971.

II/a: Lake Louise dump, Banff National Park

	JULY															AUGUST															SEPT.															OCTOBER														
	17	18	19	20	21	22	23	24	29	30	31	1	2	3	4	5	6	7	8	12	13	14	16	29	14	15	17	7	8	9	10	13	15	16	17	18	19																							
Grizzly bears:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3																						
♀ + 2 coys																																																												
♀ + 1 coy																																																												
♀ + 3 yrns	4																																																											
♀ + 2 yrns	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3																						
♀ + 1 yrl	2	2																																																										
AD ♀ U/C	1	1									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																																		
AD ♂ 1																																																												
AD ♂ 2																																																												
AD ♂ 3																																																												
AD ♂ 4																																																												
AD ♂ 5																																																												
AD ♂ U/C	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																																		
SAD U/C 1 & 2																																																												
SAD U/C 3																																																												
SAS U/C 4																																																												
JUV U/C 1 & 2																																																												
JUV U/C																																																												
Black bears:																																																												
AD U/C	1																																																											
JUV U/C																																																												
	4	15	14	8	3	10	14	8	5	14	18	14	14	15	13	1	4	3	5	10	12	12	4	10	17	17	12	12	12	12	12	12	2	13	15	7	4	2																						

II/a: Lake Louise dump, Banff National Park

	JULY							AUGUST							SEPT.			OCTOBER																			
	17	18	19	20	21	22	23	24	29	30	31	1	2	3	4	5	6	7	8	12	13	14	16	29	14	15	17	7	8	9	10	13	15	16	17	18	19

Grizzly bears:

♀ + 2 coys	3	3	3	3	3	3		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
♀ + 1 coy																																					
♀ + 3 yrlds		4																																			
♀ + 2 yrlds	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1						3													
♀ + 1 yrl	2	2																																			
AD ♀ U/C	1	1																																			
AD ♂ 1																																					
AD ♂ 2																																					
AD ♂ 3																																					
AD ♂ 4																																					
AD ♂ 5																																					
AD ♂ U/C	1	1																																			
SAD U/C 1 & 2			1	2	1																																
SAS U/C 3																																					
SAS U/C 4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																			
JUV U/C 1 & 2					1																																
JUV U/C																																					

Black bears:

AD U/C																																					
JUV U/C	4	15	14	8	3	10	14	8	5	14	18								4	15	14	8	3	10	12	12	12	12	12	12	12	2	13	15	7	4	2

II/b: Lake Louise dump and landfill, Banff National Park, 1971.

Groups:	LANDFILL																																																									
	DUMP						JULY						AUGUST						SEPTEMBER																																							
	8	11	12	13	18	19	20	21	22	1	3	7	8	10	13	14	15	16	17	19	20	23	6	9	10	12	13	15	18	24	25	26	31	1	2	10	11	18	20	21																		
Q + 2 coys																																																										
Q + 2 yrls																																																										
Q + 1 yrl																																																										
AD ♀ 1																																																										
AD ♂ 1																																																										
AD ♂ 2																																																										
AD ♂ 3																																																										
AD ♂ 4																																																										
AD ♂ 5																																																										
AD ♂ 6																																																										
AD ♂ U/C																																																										
AD U/C 1																																																										
AD U/C																																																										
SAD ♀ 1																																																										
SAD ♂ 1																																																										
SAD U/C 1&2																																																										
SAD U/C																																																										
JUV U/C 1&2																																																										
Black bears:																																																										
AD ♂ 1																																																										
AD U/C																																																										
U/C bears:																																																										

* trapped at Lake Minnewanka

II/b: Lake Louise dump and landfill, Banff National Park, 1971.

Groups:	DUMP					LANDFILL												SEPTEMBER																																		
	MAY					JUNE												JULY												AUGUST																						
	8	11	12	13	18	19	20	21	22	1	3	7	9	10	11	17	25	28	30	1	7	8	10	13	14	15	16	17	19	20	23	6	9	10	12	13	15	18	24	25	26	31	1	2	10	11	18	20	21			
Q + 2 coys																																																				
Q + 2 yrfs																																																				
Q + 1 yrl																																																				
AD ♀ 1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3				
AD ♂ 1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2			
AD ♂ 2																																																				
AD ♂ 3																																																				
AD ♂ 4																																																				
AD ♂ 5																																																				
AD ♂ 6																																																				
AD ♂ U/C																																																				
AD U/C 1																																																				
AD U/C																																																				
SAD ♀ 1	1																																																			
SAD ♂ 1																																																				
SAD U/C 1&2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2			
SAD U/C																																																				
JUV U/C 1&2																																																				

Grizzly bears:

Black bears:

AD ♂ 1

AD U/C

U/C bears:

* trapped at Lake Minnewanka

II/c: Banff landfill, Banff National Park, 1970.

Groups:	JUNE				JULY				AUGUST				SEPT.				OCTOBER				NOVEMBER														
	26	27	28		2	3	4	8	15	16	17		13	17	18	19	20	21	25	27	28		16		11	12	15	16	17	18	19	1	7		
<u>Grizzly bears:</u>																																			
♀ + 1 coy	2	2	2		2	2	2																												
♀ + 3 yrlds	4	4			4	4	4	4				4																							
♀ + 2 yrlds												3																							
AD ♂ 1									1	1		1																							
<u>Black bears:</u>																																			
♀ + 2 coys													3																						
AD ♂ U/C												1																							
AD U/C	1					1						1	2	2	2	1																			
JUV U/C												1	3	1																					
Yrl U/C												1	1																						
	3	6	6		6	7	6		4	1	1	1	1	1	1	1	5	1	2	5	8	3	4	6	7	3	6	6	6	6	6	6	6	4	1

II/d: Banff landfill, Banff National Park, 1971.

Groups:	MAY					JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER					NOVEMBER												
	23	24	31	1	2	3	4	5	6	7	9	10	25	27	29	30	5	6	9	12	13	18	21	5	18	19	31	1	8	17	18	19	20	5	8	18	19	20	5	8	18	19	20
Grizzly bears:																																											
♀ + 1 yr 1																																											
♀ + 2 yr 1s																																											
AD ♀ 1																																											
AD ♂ 1																																											
AD ♂ 2																																											
AD ♂ 3																																											
AD ♂ 4																																											
AD U/C 1																																											
AD U/C 2																																											
AD U/C																																											
JUV U/C 1																																											
JUV U/C 2																																											
JUV U/C 3																																											
JUV U/C 4																																											
U/C																																											
Black bears:																																											
U/C																																											
U/C bears																																											

*1 destroyed by Park staff, May 31, 1971

*2 " " June 7, 1971

*3 trapped by Park staff and moved to Scots Camp, BNP on July 6, 1971

II/d: Banff landfill, Banff National Park, 1971.

Groups:	MAY					JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER					NOVEMBER																	
	23	24	31	1	2	3	4	5	6	7	9	10	25	27	29	30	5	6	9	12	13	18	21	5	18	19	31	1	8	17	18	19	20	5	8	18	19	20	4									
<u>Grizzly bears:</u>																																																
♀ + 1 yr1							2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	2	2	2									2	2	2	2										
♀ + 2 yr1s																																																
AD ♀ 1	1	1							1	1																																						
AD ♂ 1																				1	1																											
AD ♂ 2																																																
AD ♂ 3																																																
AD ♂ 4																																																
AD U/C 1																																																
AD U/C 2																																																
AD U/C																																																
JUV U/C 1																																																
JUV U/C 2																																																
JUV U/C 3																																																
JUV U/C 4																																																
U/C																																																
<u>Black bears:</u>																																																
U/C																																																
U/C bears																																																1

*1 destroyed by Park staff, May 31, 1971

*2 " " June 7, 1971

*3 trapped by Park staff and moved to Scots Camp, BNP on July 6, 1971

II/e: Jasper Landfill, Jasper National Park, 1970.

Groups:	JUNE					JULY					AUGUST					SEPTEMBER						
	3	4	5	6	9	3	18	20	22		5	6	23	26	30	31	21	22	23	24	25	26
<u>Grizzly bears:</u>																						
AD U/C 1											1	1					1	1	1	1	1	
AD U/C 2																	1	1	1	1	1	
AD U/C 3																	1	1	1	1	1	
AD U/C						+			+	+									1		1	1
SAD U/C 1									1				1	1								1
SAD U/C 2																	1	1				
<u>Black bears:</u>																						
♀ + 2 yr1s																						
AD U/C 1																1						
AD U/C						+	+				+											
	1	1	3	1	2	1	1	1	1		1	2	1	1	1	2	4	4	5	1	5	1

II/f: Jasper Landfill, Jasper National Park, 1971.

Groups:	MAY		JUNE				JULY							AUGUST				SEPTEMBER			OCTOBER														
	17	20	1	2	3	18	19	6	9	14	15	16	17	19	20	21	22	23	28	30	31	1	2	3	11	20	21	4							
♀ + 2 cubs 1								3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4						
♀ + 2 cubs 2								3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4							
♀ + 3 cubs																																			
AD ♀ 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
AD ♀ 2																																			
AD ♀ 3																																			
AD ♂ 1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
AD ♂ 2																																			
AD ♂ 3																																			
AD ♂ 4																																			
AD ♂ 5																																			
AD U/C 1																																			
AD U/C 1 & 2	2	2			2																														
JUV U/C 1 & 2																																			
YRL U/C 1																																			
<u>Black bears:</u>																																			
AD U/C 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
	3	4	1	2	2	4	2	10	9	11	15	10	8	8	15	14	15	11	6	3	9	11	13	9	11	13	12	7	12	11	15	15	8	7	7

II/f: Jasper landfill, Jasper National Park, 1971.

Groups:	MAY					JUNE					JULY							AUGUST							SEPTEMBER				OCTOBER											
	17	20	1		2	1	2	3	18	19	6	9	14	15	16	17	19	20	21	22	23	28	30	31	1	2	3	15	16	19	26	27	2	3	11	20	21	4		
Grizzly bears:																																								
♀ + 2 coys 1																																								
♀ + 2 coys 2																																								
♀ + 3 coys																																								
AD ♀ 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AD ♀ 2																																								
AD ♀ 3																																								
AD ♂ 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AD ♂ 2																																								
AD ♂ 3																																								
AD ♂ 4																																								
AD ♂ 5																																								
AD U/C 1																																								
AD U/C																																								
JUV U/C 1 & 2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
YRL U/C 1																																								
Black bears:																																								
AD U/C 1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3 4	1	2	2	4	2	10	9	11	15	10	8	8	15	14	15	11	6	3	9	11	13	9	11	13	12	7	12	11	15	15	8	7	7							

II/g: Tangle Ridge dump, Jasper National Park, 1970.

	MAY		JUNE			JULY			AUG.			OCT.
	18	3	4	27	17	18	19	3	28	29	24	
1970: ♀ + 3 coys									4	4		
♀ + 2 coys							3		3			
AD U/C					1	1	1	3	2	1		1
	-	-	-	-	1	1	4	3	9	5		1
1971: ♀ + 3 yrsls	4	4	4									
AD U/C				1								
	4	4	4	1	-	-	-	-	-	-	-	-

II/h: Kootenay Crossing dump, Kootenay National Park, 1970.

	JULY		AUG.
	30	31	1
♀ + 2 coys			3
♀ + 1 coy		2	2
AD ♂ 1	1	1	1
AD ♂ 2		1	1
AD ♂ 3			1
JUV ♂ 1	1	1	1
JUV ♀ 1			1
	2	5	10

II/i: Mile 17-flat dump, Banff National Park, 1970.

	JULY	
	19	20
♀ + 3 yrsls	4	4
JUV U/C	1	1
	5	5

APPENDIX III

Number of tourist vehicles entering Lake Louise dump, Banff National Park, 1970,
 (Sample size (minutes of observation time) in brackets).

Week	Between hours of:									
	0000 -0300	0300 -0600	0600 -0900	0900 -1200	1200 -1500	1500 -1800	1800 -2100	2100 -2400		
July 12-18	2(195)	-	-	-	-	-	7(90)	21(360)		
19-25	5(185)	2(30)	6(280)	-	-	-	9(60)	24(360)		
26- 1	1(110)	-	-	-	-	-	16(75)	10(240)		
Aug. 2- 8	-	-	8(240)	3(150)	-	-	25(45)	13(105)		
9-15	-	-	-	-	-	-	21(150)	8(60)		
16-22	-	-	2(90)	2(90)	-	-	-	-		
23-29	-	-	-	-	-	-	25(90)	5(120)		
Sept. 13-19	1(15)	-	-	-	-	13(175)	27(450)	12(135)		
Oct. 4-10	-	-	-	-	4(30)	11(195)	1(20)	-		
11-17	-	-	-	-	-	2(15)	-	3(180)		

APPENDIX IV

Seasonal and daily distribution of waste deliveries at Lake Louise dump, Banff landfill, Banff National Park and at Jasper landfill, Jasper National Park, 1970.

Amounts of waste were calculated on the basis of the following assumptions;

- a garbage truck or other large truck holds 10 cubic yards of garbage when full;
- a "pick-up" truck holds 4 cu. yds. when full
- a "bag" holds 1/8 cu. yds.
- a "can" or container holds 1/4 cu. yds.

Source of garbage

P = private, Pb = private business (service station, etc.)
H = hotels, motels, resorts, G = government (campgrounds, townsites, roadside cans, etc.)

Sample periods

A = 0001 - 0300	E = 1201 - 1500
B = 0301 - 0600	F = 1501 - 1800
C = 0601 - 0900	G = 1801 - 2100
D = 0901 - 1200	H = 2101 - 2400

IV(a): Lake Louise dump.

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Week	Sample Period	Sample Size (min)	Number of Deliveries	Amount of Waste (cu. yds.)			Source of Waste
				Garbage	Refuse	Debris	
July 12-18	A	180					
	G	105	2	8			U/C
	H	360	2	5 1/2			U/C
July 19-25	A	180					
	B	120					
	C	330	8	10 3/4		7	G, Pb, P, H
	D	260	8	13 1/2	6		H, U/C
	G	70					
	H	255	5	6 1/2			H, P
July 26- Aug. 1	A	495					
	B	60					
	G	105	4	7 1/4		2	Pb, H, P
	H	540	8	10	2	6	Pb, H, P
Aug. 2-8	A	360					
	B	520					
	C	540	9	16 1/2	4	2	Pb, G, P, H
	D	487	24	52 1/2	12	4	P, Pb, G, H
	G	45	1		2	2	Pb
	H	360	6	12			H
Aug. 9-15	A	180					
	B	30					
	G	200	10	6 1/4			G, H
	H	380	8	8	2		R, P
Aug. 16-22	B	107					
	C	180	1	1 1/4	1/2		H
	D	145	4	7 1/2			G
Aug. 23-29	G	90	1	8			U/C
	H	135	1	8			U/C
Sept. 13-19	A	200					
	F	135	3	4	5 1/2		G, U/C
	G	375	7	13 1/2	3	4	P, U/C
	H	300					
Oct. 4-10	E	30					
	F	270					
	G	315	2	2			U/C
	H	75					
Oct. 11-17	F	160					
	G	180					
	H	180					

IV(b): Banff landfill.

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Week	Sample Period	Sample Size(min)	Number of Deliveries	Amount of Waste (cu. yds)			Source of Waste
				Garbage	Refuse	Debris	
June 21-27	A	330					
	B	60					
	C	65	2	2	6		U/C
	E	110	7	5 1/4	2	7	Pb,H,G,P
	F	220	10	25		5	G,P,H
	G	525	10	13	3		H,P,G
	H	600					
June 28- July 4	A	405					
	B	200					
	C	165	3	24			U/C
	D	180	8	27	6	2	G,P
	E	390	20	29 1/2	24 1/4	5 1/4	G,P,H,Pb
	F	375	13	41	5	1/2	U/C
	G	390	2	1			U/C
	H	360	1	3			
July 5-11	B	270					
	C	540	10	17 1/2	20	2	Pb,P,G
	D	540	32	119	23	13	Pb,P,G,H
	E	180	7	30	12		G,H
	F	180	10	58	14	4	G,H,Pb
	G	115	1		2		U/C
	H	180	1	8			H
July 12-18	A	180					
	B	30					
	G	60	1	8			H
	H	360	1	4			H
Aug. 16-22	A	240					
	B	225					
	C	450	3	2	10		G,Pb
	D	295	16	41	9	2	G,H,P
	G	60	2	4	2	2	H,U/C
	H	360					
Aug. 23-29	A	90					
	C	90					
	D	75					
	G	150	2	7			G,H
	H	360	1	2			H
Sept. 13-19	F	170	6	8		4	U/C
	G	180	3	2	2		P,U/C,H
Oct. 11-17	F	105					
	G	540					
	H	329					

IV(c): Jasper landfill.

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Week	Sample Period	Sample Size(min)	Number of Deliveries	Amount of Waste (cu. yds)			Source of Waste
				Garbage	Refuse	Debris	
May 31- June 6	D	210	1	1			U/C
	E	300	4		9	2	U/C
	F	690	1	7	2	1/2	U/C
	G	615	2	9	9 1/2	1 1/2	U/C
	H	465					
June 7-13	A	130					
	C	90					
	D	570	8	5 1/2	6		P,U/C
	E	720	17	15 1/2	14	3 1/2	U/C
	F	720					
	G	615					
	H	345					
June 28- July 4	A	180					
	B	180					
	C	180					
	D	180	4	6	2		U/C
	E	180	9	15	4		U/C
	F	480	20	60	4		P,U/C
	G	540	1	1			U/C
	H	420					
July 5-11	C	15	2	2	2		U/C
	D	360	20	33	16	90	G,H,Pb
	E	360	15	20	17		H,P,G,U/C
	F	185	16	25	4		H,P,G,U/C
Aug. 23-29	A	90					
	C	109	9	63 1/2	31 1/2		H,G,P,Pb
	D	900	45	245	145	15	G,H,P,Pb
	E	816	35	79	64 1/4	3	P,G,H,Pb
	F	735	49	187 1/2	61	1/2	H,G,P,Pb
	G	900	10	13	7 1/2		Pb,P,H
	H	885					
Sept. 23-26	A	60					
	E	120	2				G
	F	180	1				H
	G	180					
	H	180					