HUMAN-RELATED BEHAVIOURAL DISTURBANCE TO NORTHERN LARGE MAMMALS: A BIBLIOGRAPHY AND REVIEW

THE
ALASKA HIGHWAY
GAS PIPELINE PROJECT

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HUMAN-RELATED BEHAVIOURAL DISTURBANCE TO NORTHERN LARGE MAMMALS: A BIBLIOGRAPHY AND REVIEW

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GENERAL INTRODUCTION

The disturbance of wildlife by northern development, and the factors associated with it, has emerged as a major environmental concern in the last decade. Although much research and discussion has been devoted to the subject, a large proportion of available information is contained in unrelated works, government reports, company documents and inquiry proceedings. Consequently, it is an exceedingly difficult literature to access. The primary purpose of this report was to gather, under a single cover, a listing and description of the relevant writings about disturbance. Hopefully, it will serve as a useful guide to the literature. The second purpose of this report was to utilize the broad literature base which was generated in reviewing what is now known about human disturbance of certain northern species. A brief discussion is included concerning methodological problems and needed research.

CRITIQUE OF DISTURBANCE RESEARCH

Definitions

Behavioural disturbance is herein considered to be any behavioural response to human-caused stimulus which results in actually or potentially reduced reproductive fitness. If human action results in an animal acting in a manner in which it would not otherwise have acted and if this alteration is thought to cause a reduction in that individual's capacity to produce viable offspring, then behavioural disturbance has occurred. The issue is confused by the occasional unavoidable use of the term "disturbance" to describe the human-caused stimulus itself.

Recently, the term "harassment" has often been used for behavioural disturbance. This is unfortunate because harassment implies that the disturbing stimulus occurs relentlessly for continuous and extended periods of time or is repeated time after time. Behavioural disturbance need not have this long-term aspect in order to be of biological significance. An animal frightened from its favoured range by one instantaneous, traumatic experience cannot be said to have been harassed. Behavioural disturbance may well have occurred, however. Harassment should be retained as a term referring to a particular subclass of behavioural disturbance.

Another aspect of behavioural disturbance is that the response must cause the reduction in fitness rather than the stimulus itself. Hunting, fast-moving vehicles, and predators are not considered as behavioural disturbances in their capacity to proximally kill animals. They are, however, behaviourally disturbing factors in the sense that they may cause altered distribution, enlarged adrenals, and energy loss all of which may reduce life expectancy and reproductive output.

Behavioural disturbance becomes manifested in animals in three distinct, analyzable modes; overt behavioural response, physiological response,

and demographic responses. In the following discussion, the adequacy with which current research deals with each of these manifestations will be treated. A short discussion of needed research follows.

Overt Behaviour

To date, almost all disturbance studies have dealt with overt behavioural responses to disturbing stimuli. This is simply because behavioural responses are readily observable and present few methodological difficulties. Many of the more ambitious natural history accounts of large mammals since the time of Ernest Thompson Seton have discussed the reactions of animals to human presence and activities. Most of these accounts are anecdotal and serve little more than to illustrate the broad outlines of species-typical responses and, often, the great variability of response within a single species. Such accounts evolved into more rigorous accounts in the 1950's with analyses of flight behaviour (e.g., 5, 6). With the development of increasing concern about the environmental effects of man's activities in the late 1960's and the 1970's such studies become more sophisticated. In this period, research has centred on the behavioural responses of animals to roads, aircraft, industrial activity and development, snowmobiles and hunting.

What is commonly forgotten or ignored in these studies is that disruption of normal behaviour is not necessarily bad in itself. Violent behavioural responses to human activities are perfectly acceptable, outside of a moral context, if they fail to lead to population declines. For behavioural disturbance to be of practical concern, it must be demonstrated that it does, or does not, have demographic consequences. Failure to provide this link is, without question, the major failing of current research.

The behavioural and demographic aspects of human activities are more closely linked in some realms than in others. Clearly, the reaction of deer to passing vehicles bears a very close relationship to road kill. In the majority of studies, though, the link is implied and tenuous. Aircraft disturbance of northern species is a cause for major concern in the development of northern pipelines. Yet there is virtually no firm evidence that aircraft actually are capable of disrupting fecundity and survival to the extent that populations suffer. The theoretical arguments for the existence of such adverse effect are convincing in their broad aspects but must be verified and quantified in order to allow suitable management decisions.

One of the most studied aspects of an overt behavioural response to disturbance is flight behaviour. The relevant questions are at what distance do animals respond, what factors influence that distance, what is the nature of the response, and how damaging is the response? There is a tendency in such research to assume that various species act similarly in modality of response differing only in the intensity of their responses. This leads to inappropriate comparisons between species. For example, mountain sheep and grizzly bears often react strongly to

distant aircraft by running long and hard. They are consequently considered to be the two northern species most susceptible to aircraft disturbance. Moose however, often do not run from aircraft but continue feeding and are consequently felt to be the species least affected by aircraft. But this conclusion fails to take into consideration the moose's peculiar manner of reacting to moderately disturbing stimuli. Upon being disturbed, moose often engage in intense displacement feeding while edging slowly, and apparently randomly, to dense cover. Upon reaching the edge, they look back and dash off into the brush indicating their true level of alarm. That moose are often seen to feed while overflown by aircraft may not, therefore, indicate a lack of reaction but just the opposite. The conclusion about the moose's lack of responsiveness to aircraft may be based on a false apprehension of moose behaviour. This quibble could easily be put to rest by simply placing a ground observer in position to observe the moose's behaviour after departure of the aircraft. This simple method showed that muskoxen, which often form a defensive circle in response to aircraft, occasionally run and walk for several miles following the disturbance.

Another problem is that experimental disturbances have often not adequately simulated real-life disturbances to allow conclusions about behavioural alterations in real-life situations. The compressor station noise simulator tests reproduced only one of the disturbing aspects of a real station. That simulated compressor noise does not drive animals away does not mean that a real compressor station will not do so. Perhaps even worse, the simulation does not test the converse proposition. McCourt et al. (323) found that sheep withdrew from the area but the conclusion could not be drawn that the compressor noise drove them away since there was also considerable helicopter and human activity involved in setting up and maintaining the simulator. These simulations actually tell us very little about how animals will react to a real compressor station. Aircraft disturbance studies were, in many cases, actually simulations of aircraft activity associated with pipeline activities. In this, most failed to adequately mimic the real-life situation. Whereas flights along a pipeline would be frequent, predictable in location, and associated with landings and ground activity, simulated flights were generally isolated and unexpected. Such studies do indeed tell us something about species-specific reactions to aircraft but not to aircraft used in the specific manner of pipeline-related activities. These discrepancies between real and simulated disturbances do notvitiate many of the valuable conclusions generated by the experimental approach. However, the validity and generality of such conclusions have been over-rated (71).

Yet another problem is the tendency to equate intensity of overt behavioural response to the intensity of its biological effect. A major lesson of the physiological studies is that behaviour is a very poor indicator of general arousal as indicated by cardiac and enzymatic

events (250, 308, 404, 421). This has been explicitly understood in some studies (e.g. 340). Geist (175), and following him, Horejsi (219) and Mackenzie (310), ascribe this lack of correspondence to Pavlov's concept of "active inhibition"[1] wherein an animal becomes so highly aroused that it remains catatonically rigid and therefore exhibits no observable behavioural response. This appears to be a misinterpretation of Pavlov's original concept. Active inhibition should only be applied to situations in which the animal is restrained or otherwise cannot escape a stimulus. The animal learns that struggling and running do not provide relief from the adverse stimlus and therefore remains rigidly immobile in "frozen flight". Since wild animals are obviously unrestrained, the application of the concept seems inappropriate. The proper Pavlovian category is more likely the "What-is-it?" reflex wherein an animal responds to an unidentified and potentially dangerous stimulus by internal excitation and external immobility until the proper response can be assessed (350).

More than 140 of the articles cited in the accompanying bibliography refer to altered spatial distributions relative to man and his activities. The underlying assumption in most of these references is that prior to disturbance, animals are distributed in such a manner as to maximize their fitnesses and that deviation from this optimal distribution will necessarily result in population declines. Should this not be accepted, either axiomatically or empirically, then distributional changes would simply be unimportant.

In the most dramatic cases, the assumption is clearly correct. If obstructions bar the movements of migrating animals preventing them from utilizing important portions of their accustomed range, population declines can and do occur (25, 26, 385). In less obvious cases, however, the point has not been adequately demonstrated. Stating that animals have no adequate habitat into which they can disperse is tantamount to saying that the population is being density controlled. In fact, northern large mammals (excepting sheep) are most likely not often resource limited suggesting that at least some degree of distributional alteration could be accommodated without drastic demographic consequences. That animals should shift their distribution pattern at all is tentative evidence that adequate alternate habitat exists since range shifts are cited as being more common under these circumstances (42, 82, 422). The entire question could bear a far more thorough examination.

Physiology

The study of physiological responses of wild animals to disturbance is a field of research still in its infancy. The background has been developed

[1] Pavlov, I.P. 1928. Lectures on conditioned reflexes. Vol. I. Internat. Publ., N.Y.

in laboratory and capture studies on the effects of psychological stress on blood constituents, body temperature, and heart rates but until recently, little work had been done on wild species or in natural situations. The importance of these studies lies in (a) the fact that significant physiological responses to disturbances occur in the absence of behavioural responses, and (b) the elucidation of causal pathways linking disturbance to the demographic processes of survival and fecundity.

There appears to be a trend in disturbance studies towards examination of physiological processes. Such research must, however, be adequately planned or it will fall into the same pitfalls as the study of behavioural responses. Physiology in itself tells us nothing about reproduction and survival and, hence, population effects. An increase in heart rate in response to an aircraft is certainly a more sensitive indicator of arousal than is overt behaviour, yet may be, in itself, an even poorer indicator of the biological significance of the disturbance.

Population Dynamics

As stressed above, the real question of disturbance studies is "What is the effect of human-related disturbances on population levels?" This question has generally been addressed tacitly by making the a priori statement "If significant behavioural or physiological alterations occur due to disturbance, then there must be, as a result, significant biological effects detrimental to the population". In the cases in which such significant alterations occur, the a priori statement need only be defended to make the case. However, in the cases in which no alterations were observed due to disturbance, it has often been concluded (primarily by decision-makers) that there are, as well, no biological or population effects about which one need worry. This is known to logicians as the "fallacy of affirming the consequent"[2] wherein true premises lead to deductively invalid conclusions. In actuality, there is a potentially infinite universe of manners in which human activity can influence animal populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors. In other words, the only way in which population responses can be shown not to be influenced by disturbance is to study population dynamics.

One of the very important questions which arose during the Berger Commission hearings was whether the population responses to disturbance are additive to those due to more "natural" mortalities. If the population is density (resource) limited, birth-rates lowered by disturbance can be offset by longer lifespans (and conversely) with the result being that disturbance will affect actual population levels to a lesser degree than the summation of natural and artificial mortalities. Disturbance effects would not be additive. The question of population regulation is a thorny one to which biologists have no set answer. Lent (285) and Calef (70) feel that caribou mortality due to disturbance will be

2 Hempel, C.G. 1966. Philosophy of natural science. Prentice-Hall, Englewood Cliffs, N.J. 116 pp.

supplemental to natural mortality while Bergerud (49) feels they will tend to offset each other. This question is unresolved and deserves more argument and empirical study.

There are many manners in which disturbance affects the birth and death processes. Laboratory studies indicate that artificially induced stress can lower fecundity and render the offspring less fit even to the second generation (16, 117, 350, 499). Disturbance can cause abortion (2, 354, 368, 369, 390, 403, 521) and abandonment or trampling of the neonate (104, 136, 260, 284, 285, 286, 289, 334, 335, 389, 390, 412, 537). It can cause mortality through muscle degeneration (86, 209, 298, 547, 550), necrobacillosis (142, 368, 390), lung damage (28, 368, 384) or loss of disease and parasite resistance (199, 225, 226, 237, 246, 394). These are, however, all isolated observations which cannot be incorporated into a general model of disturbance effects on population processes.

The most convincing evidence for the effects of disturbance on population dynamics is historical in nature. Every major caribou herd which has come into contact with civilization has undergone population reduction (71, 103). Calef (71) and Bergerud (48) have discussed the problems in assigning causality to these declines. Nevertheless, Berger (43) found the evidence "compelling". Even if the diffuse concept of "civilization" could be implicated as the cause of these declines, it would be very difficult to extricate the effects caused by habitat loss, behavioural disturbance, hunting and the interactions between these factors. At present, there is no unassailable evidence that behavioural disturbance per se actually has resulted in population declines of caribou.

Interaction Effects

Behavioural disturbances do not act either in isolation or solely in the present. They interact with, and are modified by, previous experiences. The influence of previous experience has, in most studies, either been overlooked or ignored largely because of the difficulties in dealing with historical factors. Geist (179) states that the bulk of harassment studies are unimportant and ungeneralizable for this reason. The results of this failure are evident in the diverse conclusions reached by workers dealing with separate populations of the same species. For example, McCourt et al. (323) found that one population of Dall sheep apparently reacting adversely to simulated compressor station noise. Reynolds (410) found another population to be quite insensitive to the same stimulus. That the two populations had different disturbance histories is evident in the observations that McCourt et al.'s population was extremely sensitive to aircraft (280) while Reynolds' population was not (410). Similar discrepancies can be seen between the snowmobile studies of Bollinger et al. (58) and Dorrance et al. (126), between Bury et al. (69) and Bury (68) (sec. 322), and between the bear observations of Harding and Nagy (205) on the one hand and Linderman (303) on the other. Such differences are often of a magnitude that they obscure the effects of observer bias and species differences.

Future studies must make as concerted an effort as possible to assess the extent to which previous aversive stimuli have modified present behaviour.

Hunting represents the most powerful and all-pervading behaviour-modifying influence. For example, Dorrance et al. (126) demonstrated the effect of hunting on habituation of deer to snowmobiles. Geist (172, 176), Horejsi (219) and others have argued forcefully that mountain sheep populations cannot simultaneously be utilized in consumptive and nonconsumptive manners. The same is true for any large mammal species particularly those that are highly social and/or live in open habitat.

Needed Research

From the present perspective, it is easy to fault previous behavioural disturbance studies as being incidental to other work, randomly chosen, methodologically flawed and as drawing unwarranted conclusions. These are smug criticisms easily afforded by hindsight. In fact, we now know vastly more about wildlife disturbance than we did a decade ago when the data base was not adequate even to allow the formulation of pertinent questions. A "hit and miss", incidental approach, or "rough-cut test" in Cowan's (105) terminology, was perfectly acceptable at the time and yielded a basic knowledge of wildlife disturbance. We are not so naive now as we were 10 years ago, however, and to continue the same mode and scale of research as was carried out then is not now warranted. There is now little call to harass wildlife simply to count the number of times they panic. There certainly remain a few unanswered questions which might be answered in this manner (435) but continued large scale studies would merely belabour the obvious at the expense of the animals themselves.

The need for a fresh approach to the problem has been widely recognized. Several teams are now involved in monitoring the physiological responses (primarily cardiac) to disturbances. As argued above, though, these studies are in danger of proceeding in the same unsystematic manner as earlier studies and would be susceptible to the same criticisms.

What is now required is an integrated study of wildlife responses to actual development at the behavioural, physiological, and population level. That an actual development be utilized as a disturbing stimulus is necessitated by the equivocal results obtained from uncertain stimulus spectra of simulations and their short life-spans. Baseline data should be gathered in the area of the proposed development prior to the onset of construction. Frequencies and levels of disturbing stimuli should be continuously monitored. Behavioural, physiological and demographic responses should be monitored during the construction stage and for at least 10 years during the maintenance phase. Behavioural data should be collected and quantified much as at present. Heart rate responses should be investigated utilizing the long-range heart rate

transmitters which are just now becoming technologically feasible. Blood samples unaltered by the stress of capture could be collected utilizing a remote-control blood sampling collar developed by Dr. G.A. Bubenick of the University of Guelph. Population levels, hunter kill, birth rates and mortality should be monitored regularly.

The results of these various aspects should be integrated into a computer simulation model utilizing disturbance levels as driving variables, physiological and behavioural responses as intermediate variables, and demography as output. This computer model would aid a coordinating team in delineating specific research needs and would ensure a level of integration not otherwise possible. No illusions should be maintained about the predictive power of such a model, though. Output can only be expected to be as good as input and input interactions will prove exceedingly difficult to evaluate.

The Alaska Highway Gas Pipeline and the Dempster Lateral could be utilized as natural laboratories for research into actual effects of development. It is to be hoped that government, industry, and universities could cooperate in developing and carrying out appropriate segments of a broadly-based research project as outlined above.

SPECIES ACCOUNTS

There already exist several excellent literature reviews assessing human-related disturbance to wildlife (39, 149, 151, 152, 175, 310, 361, 557). Any further attempts at literature review must, to some extent, represent a duplication in effort. The feature of the present review which affords it some degree of uniqueness is the more comprehensive nature of the literature search on which it is based.

The present review is intended to serve as nothing more than a compendium and integration of present knowledge little emphasis has been placed upon critical assessment of research results. This is justified by two factors. First, a critical review based on over 500 articles would be so voluminous and tedious as to be virtually unreadable. Thoroughness of critique has, therefore, in a very real sense, been sacrificed to completeness of review. Secondly, research validity is not a clear black and white question. The adequacy of research must always be assessed relative to the particular problem to be solved. Since this review was not directed at precise questions, an assessment of research adequacy is not appropriate.

Grizzly Bears

Grizzly bears are usually considered as being among the most responsive of northern species to aircraft disturbance. They are more sensitive than moose or caribou (323). Bears often run wildly possibly causing overheating (270) or they may hide in tall vegetation or in their dens (204, 380). Because of the lack of hiding places, aircraft disturbance is considered as being more severe in the tundra (239).

Harding and Nagy (205) found that 61% of 36 bears responded to fixed-wing aircraft by running and/or hiding. Eighty-eight percent of 15 bears ran and/or hid from a helicopter. Klein (264) found 80% of 15 bears to react strongly to fixed-wing aircraft. Quimby (393) reported 58% of observed bears to react strongly to fixed-wing aircraft and 71% to react strongly to helicopters. Helicopters then seem to be significantly more disturbing than fixed-wing aircraft.

Bears may react to aircraft at great heights and horizontal distances. Appendix B in Ruttan (427) cites instances of bears running from aircraft .4 - .9 km distant and from aircraft at elevations of 1000 m. McCourt et al. (323) found that altitude had little effect on the level of response. The responses of bears depend on several factors. Feeding bears show little fear (427) which may be related to Krott and Krott's (268) suggestion that hunger overcomes fear in European brown bears. Grizzlies are reported to be relatively insensitive around the den-site (270).

Previous experience plays a very important role in the responses of bears to aircraft (270). Aircraft are often used in capture and tagging operations. Previously captured bears are usually more sensitive (205) since they seem to associate aircraft with capture (380). Slaney and (453) report that before being tagged, three of 10 bears sighted remained

bedded. After tagging, all ran. Some bears simply do not react to aircraft regardless of previous experience (303).

Tracy (496) found that bears avoided the road in McKinley Park and that, within 200 m of the road, 56% of the bears reacted to passing traffic. Noises were particularly disturbing to these bears. Clarke (98) mentions that during construction of the Banff-Jasper Highway, grizzlies withdrew from the area but subsequently returned. He suggests that this is a general pattern. Schultz International (43) stated that the Dempster Highway will be particularly disturbing to bears.

Whereas bears commonly scavenge in garbage dumps, they do not necessarily become habituated to man. Their acceptance of man is linked to that specific site. The same bear may react with fear to a human in the backcountry (108). Alaska brown bears have partially abandoned a traditional fishing area in response to increasing presence of photographers (141, 184). The Inuvik-Tuktoyaktuk area supports fewer grizzlies than surrounding areas due to human presence (302). Kregosky (267) characterizes grizzly bears as shy species which will alter their distribution to avoid hikers. Riegelhuth (411) however, does not see human presence in the backcountry of the national parks as affecting grizzly survival. How much of the grizzly bear's fear of man is learned is not clear. The Lewis and Clark Expedition shot many grizzly bears which were "charging." This might well indicate a lack of fear for man in the pristine state (242).

A major concern is that pipeline construction will cause den abandonment (44, 204, 361). If this should occur in winter, mortality would be certain. It would still be serious at other times of the year since suitable den-sites are uncommon (381). Craighead and Craighead (107) found that bear dens in Yellowstone were located far from areas of human activity. They suggest that this may be an adaptation to an Indian hunting technique of killing bears in the den. They report that the amount of disturbance required to cause den abandonment varies from individual to individual. An approach to within 100 ft is adequate to elicit abandonment in some cases. Their data suggest that den abandonment is most common in the fall. Harding and Nagy (205) report that four years of seismic activity on Richards Island, N.W.T., caused two dens to be abandoned. A black bear has been reported not to have abandoned a den within 100 yds of road construction (249).

Wolves

The reaction of wolves to aircraft seems highly dependent on previous experience. Wolves quickly habituate to aircraft when they are not hunted from the air (67, 264, 270, 331). Wolves which are hunted from the air are, however, panic-stricken by aircraft (433) but this reaction is apparently lost very quickly after discontinuance of hunting (264). Wolves are particularly loathe to leave a kill (218) perhaps because they are so engorged. There exists only one study with an adequate sample

size of wolf sightings from aircraft but these data are in raw form (125). This study from the northern Yukon indicates that 93% of 29 wolves overflown at 200' or less reacted observably while 41% of 66 wolves overflown at altitudes of more than 200 ft reacted.

The information dealing with human presence is similar to the aircraft information; wolves can live with man if allowed. Wolves travelled the outskirts of Fairbanks in 1967 when its population was 30,000 (396) and did not alter the timing of visits in relation to human activity at a dump in remote Ellesmere Island (186). The most deleterious effect of disturbance is den abandonment. In Jasper National Park this is cited as a major concern (83). In Alaska, wolves will often move their dens an average of 3 km in response to human disturbance (88). Dens within 1 km of human activity are usually abandoned while ones 2.4 km or more from roads or campgrounds are generally viable (88).

Moose

It is generally agreed that moose tolerate man's presence and adapt well to human disturbance (98, 118, 270, 387). This is illustrated by flight distance. Whereas moose unhabituated to human presence usually run from a man on foot at distances of 150 yards (118, 329), habituated individuals allow approaches within 20-25 yards (118, 329, 468). In the Soviet Union, moose are used as draft animals.

The flight behaviour of moose is peculiar and inadequately understood. They rarely react immediately and overtly to disturbing stimuli unless that stimulus is very intense. Instead they continue feeding while moving, apparently randomly, towards dense cover. While doing so, they rarely look directly at the stimulus. Upon reaching cover, they usually look back and then run off into the woods indicating their true state of alarm (120, 169, 495, 329, 445). When nervous, moose feed intensely (169) for short durations, their movements become tense, comfort movements increase in rate 10-fold, the elimination rate increases 4-fold, and the rate of breathing increases by 4 times (468). These are all very subtle changes in behaviour which are not noticed by a casual observer. This subtlety of response has certainly led observers to underestimate the reactivity of moose to disturbances (495). Cows with calves tend to be more easily disturbed (495) and tend to hide more than they run (6, 329). Calves are cited as being more sensitive to disturbance than other classes (359) while yearlings are very unwary (387). Bulls in velvet are far more wary than ones in the rut (6). Moose are cited as being more wary at dusk and dawn (6) but this may be simply due to the fact that they become more reactive later in their rest periods (469).

Several authors state that moose do not react strongly to auditory stimuli (169, 359, 387, 444). This may be true only for loud unfamiliar sounds however, since they seem to react strongly to more subtle noises associated with predation; such as grass rustling, and twigs breaking (329). Cannon blasts were however, found to be somewhat effective

in keeping moose away from areas where they were undesirable while train whistles were cited as having little effect (395) or as being treated as a threat (272). There is general agreement that smell is the sense most involved in disturbance reaction (359, 387, 444).

Moose are generally considered as the northern ungulate least affected by aircraft disturbance (218, 240, 264, 270). This conclusion is based on a very slim data base. Klein (264) found moose to be less reactive than caribou based on a sample size of 16 moose sightings. McCourt et al. (323) found that more than half of the moose overflown at 200 ft or less reacted strongly. Over 600 ft there was no reaction. This is based only on 46 observations. The most extensive body of data is contained in Appendix A of Doll et al. (125) but is in raw form. The reactions of 197 individuals are recorded. At aircraft heights of 200 ft or less, 82% of 38 moose exhibited no reaction, 5% mild reactions, and 13% strong responses. At heights of 200 - 600 ft 84% of 117 individuals showed nil reaction, 13% moderate responses, and 7% strong reactions. Above 600 ft, none of the 42 moose observed showed any reaction. Moose occasionally react aggressively towards helicopters (428). It is generally agreed that cows with calves are more sensitive than bulls or lone cows (240, 264, 495).

The generally held opinion that moose are not adversely affected by aircraft cannot be accepted with any degree of certainty. The studies have been few and the sample sizes inadequate. None of the studies incorporated a ground observer to record what the behaviour of the moose was after the aircraft had departed. If, as suggested above, the normal reaction to disturbance is to graze intensely while moving slowly into deep brush where it breaks into a run, then it is little wonder that a nil reaction was recorded so frequently. It is just possible that the individuals apparently unconcerned by overflights actually ran for miles after the aircraft had left, as has been reported in muskoxen. Clearly, more rigorous studies on the moose's reaction to aircraft are required.

Moose are generally thought of as being rather sedentary animals. Research in Alaska indicates however that they undertake seasonal migrations and that any disruption of their migration, such as a pipeline or highway, could adversely affect moose populations over huge areas (290, 291). Little information seems to be available on moose reactions to highways although they are known to travel along plowed roads in winter (118). Information on moose reactions to pipelines is available from two sources. Van Ballenberghe (511, 512, 513) spent several years observing moose reactions to the Trans-Alaska Pipeline. He found that moose rarely move over a buried pipeline but will pass rather freely under an elevated one if it is high enough off of the ground. A total of 1068 crossings were recorded with most occurring where clearances were of 6 - 8 ft. Most of these crossings were with little hesitation or paralleling of the line. However, even rather minimal snow depths decreased the proportion of successful crossings by reducing the apparent clearing height. When snow was deep, areas with significantly greater

clearances were utilized. The other source of information is from the Davidson Ditch, a 48-inch pipeline in the Chatanika Valley north of Fairbanks, which was completed in the 1920's. It is elevated 5 ft above the ground. Before crossing, moose tend to parallel the line for half a mile or more. This is in an apparent attempt to circumvent the pipeline. Cows with calves are the least successful in crossing (215, 512). This suggests that, even after 50 years, moose will not habituate to an inadequately designed pipeline.

Little information is available on the manner in which moose alter distribution patterns in relation to human disturbance. Moose apparently avoid active seismic lines by 1 km while any seismic activity within 250 m in open terrain causes them to leave the area (220). In McKinley Park however, 80% of moose observed from the road were within 200 m (495). This is surprising in that the intensity of response to road related disturbance was negatively correlated with distance from the highway (495).

Very little work has been done on the moose's physiological response to disturbance. LeResche et al. (295) have investigated how various blood parameters respond to the stress of capture. White muscle disease, or myoglobunuria, is known to kill moose which have been severely stressed (547). Russian researchers found that the presence of a person or a dog can lead to an increase in heart-rate of 2.4 times even though there is no accompanying behavioural response (421). This is further evidence for the inadequacy of gross behaviour as an indicator of arousal in moose.

Nothing is known about the demographic response of moose to disturbance. LeResche (289) suggests that disturbance at or shortly after calving can lead to depressed calf survival.

Elk

The preponderance of work on elk has dealt with the major disturbances caused by roads and vehicular traffic. In Montana, elk were found to utilize habitats characterized by tall vegetation where logging roads were open to travel. In areas where such roads were closed, elk tended to use a broader range of vegetation heights (4). Morgantini (351) found that the opening of a previously closed road caused disorientation and retreat from favoured grassland habitat. Avoidance of roads has been reported for distances of one mile (314), 250 m (383), .2 - .8 km (386), .2 km (422, 423), 300 yds (524, 525) and 1/4 mile (526, 529). The degree of avoidance is dependent on traffic levels with closed roads being used more by elk than open ones (197, 314, 315, 386). However, Burbridge and Neff (66) and Neff (364) found no distributional changes in response to road closure in Arizona. It is suggested that southern elk are not as disturbed by roads and traffic as are northern elk (364). Tule elk in California are very selective in their alarm patterns. They are more alarmed by strange vehicles than familiar ones (325). Elk avoidance of roads and vehicles is almost certainly largely attributable to most elk hunters being road hunters.

Elk seem to be quite affected by snowmobiles. They are reported to retreat into dense timber when snowmobiles are 1/2 (502) or 3/4 (503) mile away. Snowmobiles disrupt normal activity patterns (501) and drive elk completely off of winter ranges (503).

Elk also seem very susceptible to human presence although elk unused to people may pay them little attention (6). Elk are far more wary of people outside of their vehicles than of the vehicles themselves (325, 524, 529). Elk shift distributions away from centres of recreation (89) usually maintaining distances of at least 1/2 mile (524). In a California state park, elk vacated an area of heavy recreational use during the calving season even though it was the best range available (300). After control hunting was halted in Yellowstone National Park, elk ceased to avoid people (222) while in Rocky Mountain National Park, elk are presently so accustomed to humans that even planned disturbances cannot alter their distribution (431).

Hunting for elk is very intense throughout the West. This activity seems to influence all other disturbance reactions. Hunting season increases flight distance (6) and alters elk distribution (5, 279, 351, 353). Morgantini (353) found hunting to drive elk from grasslands to woodland and alpine habitats thereby causing overgrazing of marginal habitats. Intense control hunting of red deer in New Zealand drove surviving animals into marginal habitats and made them very wary of man (36). Upon cessation of hunting, elk and red deer gradually grow less wary (222) but the recovery process may take six or more years (127).

Very little work has been done on disturbance physiology or mortality in elk. Prolonged fear is known to inhibit antler growth in red deer (63). An old hunter's tale (425) describes how elk, relentlessly harassed by hunters, drop from exhaustion and apparently stress-related shock. When 150 - 200 elk were driven from their winter range in Idaho by snowmobiles, many died from shock attributable to stress (503). Elk seem to be susceptible to mortality from myopathy due to fear and shock modified by overexertion (298).

There is little information available on elk reaction to aircraft. Bull elk are reported to show little reaction to helicopters (218). Cows with calves were somewhat more reactive (218). Flight distance was greater in open habitats (218). Elk in California cannot be driven by aircraft (325) and are apparently able to differentiate sonic booms from danger-signalling gunshots by the jet noise following the boom (325).

Likewise, there is little information on disturbance effects to demography. The evidence is indirect. A trial range program was not successful in terms of increased elk numbers until snowmobiles were excluded (8) while development of roads, not hunting or habitat, is considered as causing declines in elk in logged areas (276). A comparison of the hunts of 1961 and 1973 in Idaho showed that development of logging road systems resulted in a decline in elk numbers (484). A senior U.S. Bureau of Land Management official attributes elk declines in the western U.S. to noise and harassment (503).

Little information exists on the crossing of barriers by elk. Elk tend to cross seismic lines only in forested areas (220) and cross small roads at night when traffic volume is low (525, 529). Interstate 80 in Wyoming acts as a complete barrier to elk (524).

Caribou

With the passing of the bison and the great African herds, the annual migration of thousands of caribou remains as one of the world's most stirring natural phenomena. A consequence of these migrations is, however, a high susceptibility to human disturbance. The persistence of major caribou migrations to the present day is largely attributable to the usual remoteness of caribou ranges and consequent insulation from human impact. The recent interest in northern development, with its potential for "opening" the North, has therefore spurred considerable research work into the effect of human disturbance on caribou. The resulting literature is voluminous - over a half of the references in this bibliography refer to the genus Rangifer.

The reindeer of northern Europe and Asia and the caribou of North America are considered to be members of a single species represented by a number of relatively distinct subspecies. Of chief interest in this review are the barren-ground caribou, the woodland caribou (often referred to as the mountain caribou) and the domestic reindeer.

A large part of the research on disturbance of caribou has dealt with aircraft disturbance. To date, six separate teams have carried out major research projects on this problem. These are: Klein (264), Calef and Lortie (74, 75, 76), Surrendi and DeBock (74, 113, 473, 434), Miller and Gunn (336, 337, 338, 339, 340), and two programs by Renewable Resources: one led by McCourt (323, 324, 409) and one headed by Fischer (146). The detailed conclusions of these studies vary due to the causal complexity of the problem, the various herds and sub-species studied, the different observers with their respective biases, the several aircraft types employed, the different data collection and analysis techniques used, and simply because there is a galaxy of imponderable and unpredictable factors. An in-depth evaluation and comparison of the detailed findings would not only be tedious and voluminous, but also largely fruitless. Within the turmoil of detail, almost any particular conclusion can be methodologically faulted and most can be found to be contradicted by one or more of the other studies with no means being available to resolve the discrepancy. However, by employing a broadly-based and largely uncritical review technique which dispenses with much detail, the major principles of aircraft disturbance to caribou can be established.

It is universally accepted that distance of the aircraft from the animal is the most significant factor influencing the level of response of caribou. A simple summing-up of research findings is surprisingly difficult, though. First, caribou response is dependent not only on the vertical and horizontal distances of the aircraft, but also on complex interactions of the distance factor, subspecies, season, group size, previous activity, aircraft type, herd experience, and habitat type as well as inexplicable aspects of caribou psychology. Aircraft distance may be the most important factor, but it is only one of many in a multi-dimensional causal complex which is not amenable to simple description. A second problem lies in a lack of uniformity between studies in the collection, analysis, and presentation of data which renders inter-study comparisons very difficult at a detailed level. A third problem is that, in some cases, written presentations are deficient in the provisions of pertinent background information such as sample sizes and proportions of observations made under various data-influencing conditions.

To provide an overview of the original findings from the seven non-overlapping studies available (76, 146, 264, 323, 324, 340, 473), Figure 1 graphs the reported percentages of "strong" and "panic" responses to aircraft at various distances. This is a rough presentation in that all influencing factors are disregarded and that the "strong" and "panic" responses are variously defined by the authors. In cases where aircraft distances were defined as less or more than a fixed distance, the fixed value was used. Where distance intervals were reported, the mid-point was utilized. Wherever adequately defined, distances refer to altitudes above ground level.

Figure 1 serves to illustrate the great variability in caribou response to aircraft at any particular distance although the degree of scatter (variance) is exaggerated by the simplifying assumptions employed. The free-hand fitted curve indicates that the severity of response decreases rapidly with increasing aircraft distances of less than about 80 m and that, above 80 m, there is a much less pronounced effect of distance on response and an apparently greater variation in response levels noted between studies. Some studies noted isolated strong reactions even at great altitudes.

One of the major gaps in knowledge of caribou response to aircraft is the relationship between vertical and horizontal displacements on response levels. Clearly, both have an effect or response and are of very real concern in planning and legislating flight constraints. Some studies have attempted to minimize the effect of horizontal distance by flying as close as possible to directly over the animals. How closely this was realized is never reported. McCourt & Horstman (324) grappled with this problem by presenting distances as "diagonal feet"; the hypotenuse of the triangle formed by the horizontal and vertical displacements. While this is far preferable to simply ignoring the effect of horizontal distance, it implies that vertical and horizontal displacements are interchangeable. There is, in fact, no reason to believe that aircraft

at a 500 ft elevation and 1000 ft away will disturb caribou identically to aircraft 1000 ft up and 500 ft away horizontally. In the only explicit study of the effect of vertical and horizontal distance components, Fischer et al.'s work (146) and the helicopter landing studies of Miller & Gunn (340), that caribou response drops off with increasing horizontal distance in an apparently more straightforward manner than it declines with increasing altitude. This suggests that it might be well to pay more attention to the establishment of adequate flight corridors than to legislating minimum flight ceilings.

Caribou react differently to aircraft during various seasons of the year. Of the several studies which have examined this question, only McCourt et al. (323) were unable to detect a seasonal effect. Seasonality is only one in a complex of factors affecting responsiveness which leads to difficulties in drawing simple conclusions from the various studies. This is further complicated by some studies being presented in terms of phenological seasons whereas calendar dates are used in others. Since caribou vary widely from year to year and from place to place in the timing of phenological events, drawing parallels between studies is difficult. As well, few studies have been year-round and since results are presented in relational terms, comparisons are not easily made. For example, if one study finds winter to be a more responsive season than spring while another finds winter to be a more sensitive period than the calving season, then the position of the spring and calving seasons relative to each other is uncertain. Another problem lies in the biases introduced into the various analyses as discussed by Fischer et al. (146).

To deal with these difficulties, the seasonal comparisons reported in the various studies (74, 146, 264, 324, 473) have been introduced into a contingency table (Table 1). If the "row season" was reported as being a more sensitive one than the "volumn season" a +1 was recorded. In the opposite case, a -1 was recorded. In the cases in which no seasonal differences were noted or no data were available, a 0 was recorded. The summation of the row was then divided by the number of reports to remove the bias of differential sample size. The resulting value then represents a rough integration of reports pertaining to the seasonal responsiveness of caribou to aircraft. Winter is quite clearly the most commonly reported season of greatest sensitivity followed by the calving period. Summer and fall are the least critical seasons. Spring and the post-calving period are intermediate. With some exceptions, this corresponds rather well with reports of seasonal variations in responsiveness to a broader range of stimuli (26. 27, 46, 47, 48, 49, 72, 92, 93, 105, 166, 240, 254, 281, 285, 378, 419, 426, 435, 452, 453, 477, 491, 492).

The class of activity in which caribou were engaged immediately prior to aircraft disturbance also has an effect on sensitivity. Assessing the results of the various studies which have investigated this effect (74, 76, 146, 264, 473) involves identical problems as those encountered in

	Winter	Spring	Calving	Post-Calving	Summer	Fall	Sum	Sample Size	Mean Score	Rank
Winter	-	+4 (4)	+3 (5)	+2 (4)	+3 (3)	+3 (3)	+15	19	+.79	1
Spring	-4 (4)	-	0 (4)	0 (4)	+2 (4)	0 (3)	-2	19	-.11	3
Calving	-3 (5)	0 (4)	-	+2 (4)	+3 (3)	+2 (3)	+4	19	+.21	2
Post-Calving	-2 (4)	0 (4)	-2 (4)	-	+1 (4)	0 (2)	-3	18	-.17	4
Summer	-3 (3)	-2 (4)	-3 (3)	-3 (4)	-	-2 (2)	-12	16	-.75	6
Fall	-3 (3)	0 (3)	-3 (3)	0 (2)	+2 (2)	-	-4	13	-.31	5

Table 1. Summary of published data on seasonal responsiveness of caribou to aircraft. For each report, if row headings exceeded column headings, a +1 was recorded. If row headings were less than column headings, a -1 was recorded. If data were not available a 0 was recorded. Larger row scores indicate greater sensitivity. Parenthetical values are number of citations. Based on references 74, 146, 264, 324, 473.

reviewing the effects of seasonality. Hence, an identical contingency table approach was employed (Table 2). This analysis indicates that, in general, the order of sensitivity, based on previous activity, is as follows: travelling -> feeding > bedded > standing.

Group composition also influences responses to aircraft. There is no divergence in the findings that groups with calves react more than do groups without calves (146, 264, 340).

In general, larger groups respond more severely to aircraft than do smaller ones. McCourt et al. (323) found larger groups to react more than smaller ones at elevations less than 300 ft. McCourt & Horstman (324) examined the group size effect in five seasons and at two aircraft distance categories. In each of the four cases in which statistically significant differences existed (winter < 300 ft, calving < 300 ft, calving 300-600 ft, and summer 300-600 ft) larger groups reacted more strongly. Surrendi & DeBock (473) found no group size effect in flights below 60 m but above this height, groups of more than 100 animals usually reacted more strongly. Fischer et al. (164) found larger groups to be more sensitive in late winter and during the post-calving season although there were no size effects during the pre-calving and calving seasons. Klein (264) found large groups to react more severely while Calef, DeBock and Lortie (74) could see no group size effect although this may be a result of the manner in which they combined data sets. These conclusions are puzzling in that ground observers often state that large aggregations of caribou are not easily disturbed (e.g., 121, 206, 254, 281, 477; but see 496).

One of the most important remaining problems relating to aircraft disturbance of caribou is the effects of various aircraft types since proper aircraft selection might significantly reduce disturbance (435). A general concensus exists that helicopters are more disturbing than fixed-wing aircraft (46, 76, 133, 240, 261, 264, 323) but nothing is known about aircraft types within the helicopter and fixed-wing categories.

Because all forms of Rangifer undertake some form of seasonal migration, obstructions to free movement is of particular concern. In reindeer, migration routes are learned and may be abandoned after only one year of disruption (135). In general, abandonment of traditional routes is a gradual process (35, 45a, 260, 266a) which is intensified by increased levels of disturbance (70, 73, 255, 260), and poor physical condition (260). Re-establishment of routes is slow (255, 45a, 379a). Such abandonment is often accompanied with range deterioration and population declines (260, 266a, 230, 285). It is also feared that delays or deviations in migration caused by the necessity of overcoming obstacles might result in calving in suboptimal areas (286, 341, 537) or disruption of calving synchrony (111, 285, 341). Obstructions to caribou movement

	Bedded	Feeding	Standing	Travelling	Sum	Sample Size	Mean Score	Rank
Bedded	-	-4 (6)	+2 (4)	-4 (6)	-6	16	-.38	3
Feeding	+4 (6)	-	+1 (4)	-1 (6)	+4	16	+.25	2
Standing	-2 (4)	-1 (4)	-	-4 (4)	-7	12	-.58	4
Travelling	+4 (6)	+1 (6)	+4 (4)	-	+9	16	+.56	1

Table 2. Summary of published data on responsiveness of caribou when interrupted during various activities. In each report, if row headings exceed column headings, a+1 was recorded. In the opposite case a -1 was recorded. If data were not recorded or if the responses were equal, a 0 was recorded. Larger row scores indicate greater responsiveness. Parenthetical values are sample sizes. Based on references 74, 76, 146, 264, 473.

cited are pipelines, highways, railways and other barriers such as fences, power transmission lines, rivers and lakes.

Information concerning the reactions of reindeer and caribou to elevated pipelines comes from (a) Child's two simulations of pipelines at Prudhoe Bay (92, 93, 94, 95), (b) Child and Lent's simulation of an elevated pipeline on a reindeer range (91, 96), (c) observations of the Joint State/Federal Fish & Wildlife Advisory Team's (JFWAT) 3-year study of caribou reaction to the Trans-Alaska pipeline (77, 78, 79, 80), (d) from isolated, often viva voce, accounts from the Soviet Union (11, 12a, 145, 265, 266, 474, 480) and (e) experiences with water pipelines in Scandinavia (520).

In Child's two Prudhoe Bay simulations (92, 93, 94, 95), 18 and 8% used ramps over the pipeline, 6 and 7% passed under the pipe, 34 and 10% reversed direction, and 42 and 75% circumvented the mock-up. Smaller groups and ones under female leadership crossed more effectively. Cow-calf units were observed to be separated for periods of up to two hours in 19 of 42 cases. Contrary to Bergerud's predictions (47), caribou crossed much more effectively when insect harassment was intense. Child & Lent's reindeer study (91, 96) indicated that reindeer react to a pipeline much as do caribou.

The JFWAT observations (77, 78, 79, 80) are particularly important in that they are the only systematic observations of caribou reacting to an actual pipeline development. Prudhoe Bay was found to be essentially abandoned as a calving area while there was a distinct avoidance of the pipeline corridor by cows with calves probably due largely to the effect of the activity on the haul road. Within the corridor, the rate of northward migration was significantly slowed. The avoidance of the entire corridor area made it impossible to assess the proportion of successful crossings. There were some indications that the herd was undergoing a split into eastern and western components. Despite all of these apparently deleterious factors, herd growth continued.

The Soviets have apparently attempted to impress visiting experts with the ease with which reindeer have accommodated to elevated pipelines in Siberia (145, 480, 481). However, these accounts are largely at odds with Russian language publications and personal communications. Skrobov (451) describes the confusion resulting where reindeer migrations met an industrial complex in Norilsk. The animals milled about and were able to cross elevated pipelines only in ravines or where snow had drifted over the pipe. Significant range shifts resulted. V.N. Andreev, the most renowned Soviet reindeer biologist, reported to D.R. Klein that experimental crossing structures were largely failures (11, 12a). Elevated areas with long lead-in fences allowed only about 25% of reindeer to cross the pipeline. Finally, extensive drift fences were constructed

to channel the reindeer completely away from the area. Surprisingly, the herd continued to expand. Villmo (520) stated that hydroelectric water pipelines are barriers to reindeer movements in Scandinavia.

To date, there have been no observations of caribou or reindeer reaction to actual or simulated buried pipelines. Since caribou utilize ramps over elevated pipelines more than they use underpasses and because the buried pipeline will appear much like natural features such as eskers, it is expected that buried pipelines will represent significantly less of a barrier to caribou movement (26, 75). Of the pipeline's attributes, berm height (if present) and steepness and visual discontinuity with the background are expected to be the major factors influencing crossing success. More important will be the associated facilities, such as roads, and the general level of associated activity as suggested by the observations that caribou tend to avoid the entire Trans-Alaska pipeline corridor (77, 78, 79, 80, 419).

Railroads have presented significant obstacles to caribou movements, particularly in Scandinavia and Siberia. Parovschikov (379a) reports several instances of range fragmentation by railways. Skrobov (451) mentions caribou paralleling railroad tracks in the Taimyr. Klein (260) states that reindeer in Norway exhibited an increasing reluctance to cross a railway as train traffic increased. Over a period of years this resulted in range bisection and population decline. Banfield (25) reports that after 1957 or 1958, caribou remainded entirely west of the Hudson Bay railroad after which the herd declined by 50% (266a). Bergerud (45a) states that cessation of movement across a railway in Newfoundland was associated with a population crash. There was no reestablishment of movements across the railway as the population numbers gradually increased.

The presence of roads presents several problems. These include the barrier to movement presented by the physical aspects of the road, fear of vehicles, channelling of movements, and increased access providing greater levels of human activity, particularly hunting. All of these aspects interact.

Caribou would appear to be initially disturbed by roads themselves but are capable of habituating to them much as to any natural barrier such as rivers and eskers (46). Mountain caribou in British Columbia exhibit apparently unaltered traditional movement patterns across several major highways (159, 203, 243, 244). This did appear to require a period of habituation, however. Tracy (496) reports caribou crossing the McKinley Park road with apparent caution and often altered directions of movement. Surrendi and DeBock (473) suggest that the unaccustomed road surface is tactilely disturbing. Not all attempts at crossing are successful. Horejsi (221) noted 21% of groups which attempted to cross the Dempster Highway being turned back or broken up. Surrendi and DeBock (473) found

69% of attempted crossings of the Dempster to be successful. Crossings were more cautious in timbered areas. Crossing success is negatively correlated with traffic volume (70, 98, 260, 473). Sections of highway with steep berms or banked snow are less readily crossed (243, 473).

Caribou usually react adversely to traffic. On the Dempster Highway, Horejsi found that 48% of individuals ran from a pick-up truck while 36% trotted away. Within 100 m of the McKinley Park road, 61% of caribou reacted visibly to a shuttlebus while the percentage dropped to 10% at distances of more than 400 m (496). Roby (419) found the distance maintained by caribou from the Trans-Alaska Pipeline haul road to be negatively correlated with traffic volume suggesting habituation. However, the level of response to vehicles was positively correlated with traffic frequency. He found that cows and calves tended to avoid the entire area. Both Roby (419) and Tracy (496) found cows and calves to react more strongly to passing vehicles than did bulls. Reindeer and caribou which feed close to roads are reported to interrupt grazing for each passing vehicle (419, 520). Bergerud (46) suggests that the noise of passing vehicles is not disturbing to caribou while Horejsi (221) implies that it is primarily the large, fast-moving object which is disturbing.

Roads are often suggested to cause detouring of migrations and hence range abandonment and population decline (230, 239, 292, 307, 432). This is often associated with heavy hunting pressure along roads (27, 73, 109, 536) and intensifies with increasing traffic volume (260, 292). Closely related to this is the problem of preferential travel along winter roads and seismic-cutlines due to the easier travelling condition with potentiality of range abandonment and/or increased energy expenditures (175, 183, 240, 260, 266a, 323, 407, 414, 510). However, there exists no empirical evidence for detrimental effects of seismic lines.

Without doubt, the most detrimental effect of roads to caribou is that they allow easy access and hence all of the attributes of civilization including hunting. Some consider the caribou to be an obligate wilderness dweller with solitude as a distinct habitat need (e.g. 285, 286) while others feel that caribou, like other large mammals, can co-exist with man if allowed to do so (46, 47, 48, 104, 171, 176, 179). Caribou have not, however, been afforded the "privilege" to co-exist and wherever a road has been opened up into caribou range, population declines have resulted (103, 285, 286, 355, 434, 449, 537). This has occurred even in McKinley Park where hunting is prohibited (285). Population declines can in no case be causally linked to increased human access simply because caribou populations are characterized by wide numerical fluctuations of unknown causation (71, 48). In a legal sense, however, the evidence is compelling (43).

Other features may present barriers to caribou movement. Natural historians have often noted the great agitation at stream crossings. Power lines in Scandinavia present a surprisingly efficient barrier to reindeer movements primarily due to the noise associated and the reluctance of reindeer to pass under objects (260, 266a, 520). Fences are reported to be rather ineffective in channelling caribou movements (260, 341, 384) yet early hunters used low fences and discontinuous cairns to manipulate the movements of migrating caribou and reindeer (17, 347a, 384, 523a).

A major problem remaining concerns the differential responsiveness of Rangifer subspecies. Of particular concern is the degree to which disturbance findings from reindeer and Alaskan, barren-ground, and Peary caribou can be applied to woodland caribou. There exists virtually no empirical evidence suitable for comparing detailed subspecific differences in disturbance behaviour. Bergerud (43) suggests that subspecific differences are attributable to environmental conditions. There is, however, evidence to suggest that genetic elements can (201, 288) and do (269, 443) influence differential response to disturbance.

Reindeer are less wary and susceptible to aircraft disturbance than are caribou (70, 269), while domestic reindeer are less easily disturbed than wild ones (433). Ringberg (415a) reports a population of reindeer having developed extreme winter docility perhaps as an energy conservation measure. Jakimchuk (239) and Bergerud (47) state that data from reindeer cannot be applied to caribou.

Woodland or mountain caribou differ from other caribou types in undertaking less extensive seasonal migrations and in being less gregarious. They are thought, therefore, to be less susceptible to the effects of obstructions to movement and to socially disruptive disturbances and to be better at reacting to situations in an individualistic manner (266a). Being less "high-profile" than tundra-living, mass-migrating caribou, they are certainly more susceptible to gradual, unnoticed population declines as has been occurring in the south-western extremes of their range (156, 159). Mountain caribou apparently habituate well to roads (159, 203, 243, 244). They are, however, easily disturbed (376) and may be more wary of man than other subspecies (47). Some of the best descriptions of the reaction of mountain caribou to human presence are contained in Stelfox and Bindernagel (465). They suggest that mountain caribou are far more susceptible to disturbance during periods of summer heat stress.

There has been much speculation about the effects of disturbance in caribou but the few data which do exist pertain largely to reindeer. Necrobacillosis, or foot-rot, is a common disease of agitated, exhausted reindeer in the U.S.S.R. (142, 368, 390). Working reindeer which are allowed to become chilled may contract emphysyma (368) while lung damage

was tentatively attributed to herding reindeer by snowmobile in Scandinavia (384). There have apparently been no reports of muscle degenerative diseases in Rangifer. The experiences of reindeer husbandry suggest that even very subtle disturbances can result in reduced weight gains (33, 259, 405, 304). Geist (173, 175, 180) has stressed the theoretical implications of increased activity due to disturbance causing caribou to expend more energy than they ingest. Thomson (491, 492) felt that Norwegian reindeer during the hunting season were in such a negative energy balance. However, the only reliable evidence for disturbance related energy loss resulting in mortality in any species comes from bats (231). The energy problem becomes complicated by known cases of range deterioration resulting from altered movement patterns (12a, 260, 266a). Disturbance in reindeer is known to decrease fecundity and fawn survival. Exertion late in pregnancy leads to abortion (368) while weight losses of 17-24% may result in fetal resorption (390). Careless use of snowmobiles in herding leads to calf and pregnant cow loss in Scandinavia (260) while wolf harassment in the U.S.S.R. causes barrenness and fawn loss (354). Caribou and reindeer both exhibit a strong cow-calf bond and abandoned calves are usually reclaimed (281, 284, 289, 334). It is usually primiparous mothers which abandon their calves (136, 309, 390). Miller and Broughton (335) found three calves which were apparently trampled to death during flight.

Deer

The majority of deer studies have dealt with white-tailed deer which differ more from the congeneric mule deer in ecological and behavioural characteristics than do some other congeneric species such as Dall and bighorn sheep. The broad aspects of the deer's behavioural and physiological responses to disturbance are valid for both species however.

White-tailed deer can be driven from their home ranges by dog (and presumably wolf) harassment (99, 167, 430, 440, 475, 482), hunting (430, 459), human activity (217), and snowmobiles (126, 229). In most cases, the deer are reported to have returned rapidly. Repeated cattle roundups in Texas, however, caused some bucks to develop a chronic and spontaneous range abandonment pattern (217). In some cases, both white-tailed and mule deer failed to leave their home ranges in response to intense disturbances of various types (58, 110, 316, 415). In fact, white-tailed deer in the southern U.S. appear to show a higher degree of home range fidelity than do northern deer (217). This may be related to the observation that home range abandonment is greater where cover is suboptimal (317).

Both mule and white-tailed deer adapt quite readily to roads and traffic. Mule deer live within 1/2 mile of Interstate 80 in Wyoming and use areas within 100 yds of the highway where noise levels of 70 dB are common (529). Rost (422) and Rost and Bailey (423) noted only a .2 km strip along the highway which was avoided by mule deer in Colorado. The degree of avoidance of highways appears to be dependent to some extent

on the desirability of the grazing on the right-of-way relative to adjacent areas. If adequate alternate habitat is available, white-tailed deer tend to avoid highways (42, 82). Mule deer cross highways readily, particularly if the berm is low enough to allow them to see over (82). One radio-telemetered doe crossed I-80 29 times in 14 months (529). White-tailed deer will crawl under roadside fences with clearances of 23 cm (180). Eight-foot high fences were found to be rather effective in keeping deer off of highways (549) but the sections of fence must be long enough as deer often parallel the fence for 0.6 km or more (400). Highway underpasses are used reluctantly by mule deer in Colorado. Sixty to 65 percent of local deer utilize the structures but the high number of approaches per successful crossing and the proportions of certain behavioural traits indicate the agitation that the deer experience (398, 400, 401, 402). Underpass use increased for several years (476, 398) indicating habituation. The width of the underpass was not considered critical to crossing success (486).

Snowmobiles tend to frighten deer (523) but not so much as elk (501). Mule deer, like elk, are reported to react to snowmobiles at a 3/4-mile distance (503). The degree to which deer behaviour is altered seems highly dependent on whether the deer are hunted. Hunted white-tailed deer subjected to snowmobile traffic changed their home range size, the movement patterns and the distance to the nearest trail. An unhunted population, however, merely moved away from the trails during periods of peak activity (126). This study concludes that hunted deer will never habituate to snowmobiles (126). The deer's change in distribution as a result of snowmobile traffic has been shown to occasionally drive white-tailed deer into habitat types having inferior thermal characteristics (229) which increase heat loss.

Hunted white-tailed deer either increase (317) or decrease mobility (110) perhaps dependent on the amount of cover available. Hunting increases flight distance (41) with flight distance being less in groups. Hunter kill statistics show that young males are the least wary age-sex class (313).

Deer which have been recently captured exhibit a decreased ability to digest rations (320) while capture itself can result in hemodilution, serum enzyme alterations (440) and death from myopathy (547). Excitement causes increases in body temperature (493). One particularly inhumane series of experiments found that dogs chasing semi-restrained deer led to the death of two pregnant does and one fawn (440). Heart rates and body temperature increased and blood characteristics were changed (440). Several studies have been done on heart rates of disturbed deer. The freezing response of young fawns is accompanied by a decrease in heart-rate termed bradycardia (237, 345). As fawns mature and the freezing response is lessened, the bradycardic response to disturbance gives way to increased heart rates termed tachycardia (237). Tachycardia was found to be higher in response to rustling grass than to wolf howls, lawnmowers, airplanes or other deer (345).

Muskoxen

Muskoxen are often greatly disturbed by aircraft. Muskoxen react either by immediately forming their typical defensive circle, by running to high ground and then forming the circle, or by simply stampeding wildly (342). In the defensive circle, bulls may experience motivational conflicts and initiate intraspecific aggressive actions (461). Ground observations show that muskoxen which react by forming a defensive circle often run and walk for miles after the aircraft has left the area (98, 190, 191). In the first year of their studies, Miller and Gunn (337) found that only once did muskoxen run more than 1 km and all groups resumed normal activity within 4 - 17 minutes. However, 75% of all overflights under 325 m above the ground and less than 3 km distant, caused stress. In the next year of their study, they found that 94% of all groups responded to overflights while normal activity was resumed within 4 - 26 minutes (351). In their completion report (340) they state that 44% of all individuals reacted to overflights. Group size and composition, sun position, wind direction, previous activities and terrain, and flight altitude and horizontal distance all affected response. They recommended that minimum flight altitudes be set at 300 m from December to April and at 600 m for the remainder of the year. Riewe (412) states that muskoxen stampede at flight altitudes of less than 2000 ft. Horizontal distance of the aircraft has a great affect on muskox disturbance to distances of 1 km (146), 1/2 - 1 mile (420), or 3 km (337, 340). Muskoxen do habituate to repeated overflights (224, 340).

The effects of aircraft disturbance is based largely on circumstantial evidence. Gray (192) states that muskox groups split and individuals flounder in deep snow. He states that this can cause range shifts and calf abandonment (192, 284, 286) and is particularly hard on old bulls, pregnant cows and individuals in poor condition (191). Abandoned calves are not easily reunited with their mothers as in caribou (286, 412). Heavy helicopter traffic is felt to have caused a between-year shift of 16 miles in summer range (420).

Muskoxen seem even more sensitive to people on the ground than to aircraft (340). Gray (191) reports that approach on foot will cause muskoxen to run off in a tight group. Calves are sometimes abandoned and readily attach themselves to humans (412). Inuit hunters state that muskoxen will simply not remain in an area where there are too many people or too much activity (413).

Since there are few roads over muskox range, the only ground vehicles muskoxen are subjected to are snowmobiles and the larger, slower Nodwells used in seismic operations. Snowmobiles cause agitation in muskoxen (37, 38, 191) perhaps because they bear some resemblance to

wolves (37). On the Seward Peninsula, harassment by snowmobiles apparently resulted in a range shift of 25 miles (283).

The only industrial activities that muskoxen have been subjected to is seismic work which is generally reported to have a negligible effect on muskoxen (37, 38, 194, 454, 455). Beak found no noticeable effects of seismic operations on group size, or distribution (37, 38). Seismic blasts were observed to have no effect on muskox behaviour at 1-1/2 miles (455) and 4 miles (190). Muskoxen within 1/2 mile of activities did show disturbed behaviour (455) and muskoxen were observed to move out of the way for seismic crews (37, 38) but in one case only 1-1/2 miles (412). Area residents however report large scale distribution changes due to seismic activity (412, 413).

Mountain Goats

Little seems to have been written about mountain goat disturbance. Helicopters cause intense responses in mountain goats (21, 85). Ballard (22) recorded the lowest number of goats ever on his study area two days after using a helicopter for a survey rather than a fixed-wing aircraft. This suggests range abandonment. Mountain goats run into the cliffs and press themselves up against rock walls in response to loud noises (174). Geist (174) thinks this to be an adaptation to rock fall.

Mountain goats in Glacier National Park repeatedly crossed a major highway in gaining access to a salt lick. Crossing success was associated with light traffic, large groups and an old, adult female as leader. The goats showed habituation to the disturbance. They came to accept the tourists but continued to treat the highway and moving vehicles as a threat (446, 447, 448). This ready habituation to humans on foot was also noted by Basner (34).

Pendergast and Bindernagel (385) comment on goat declines in areas opened to coal mining in British Columbia. They argue that the goats have not simply moved to other ranges due to disturbance since other suitable ranges already maintain goat populations.

Mountain Sheep

Mountain sheep, and Dall sheep in particular, are considered to be among the most sensitive of animals to aircraft disturbance (151, 152, 330, 551). Geist (176) has stressed the learning abilities of sheep. As would be expected, then, sheep show great variability in response to aircraft largely due to differential experience. At one end of the scale, Feist et al. (143) mentions an instance of sheep running from a helicopter one mile distant and another instance of response to an aircraft at an elevation of 1500 ft. In the latter case, the sheep ran for 1-1/2 miles. Linderman (302) cites a case wherein a group of rams ran into the cliffs in response to an aircraft at an elevation of 7000 - 8000 ft and 1 - 2 miles away! The ewes of the same group did not react.

Price (391) cites a case of sheep running from aircraft 1 km distant. Horejsi (218) states that sheep almost always run before a helicopter is closer than 1/2 mile. Several authors mention that sheep are usually running when first observed from an aircraft (218, 256) indicating the great horizontal distance at which sheep may react. Lenarz (280) found that 85% of sheep reacted to helicopters at 300 - 500 "diagonal feet". At the other end of the scale, Reynolds (410) found that helicopters at distances greater than 150 yards had little effect. Frequent censusing in Alaska resulted in Dall sheep becoming so habituated that they had to be repeatedly "buzzed" to get them to stand for counting (367). MacArthur et al. (308) found that heart rate responses to aircraft were minimal unless the stimulus was very close.

When sheep do react they often react very intensely. If escape terrain is available, they generally retreat into it. If none is available, they may run more than 1-1/2 miles (143). Horejsi observed ewes and lambs running more than a mile until they were obviously exhausted (218).

There is general agreement that helicopters disturb sheep more than do fixed-wing aircraft (9, 219, 261, 264, 323, 330, 370, 391, 551). This may be due to the modulated, "rotor-popping" sounds and their capability for low, slow flight and close approach (9, 262, 391). Jones et al. (247) feel that sheep are relatively insensitive to sound and it is the novelty of a close, flying object that is threatening.

The effect of previous experience on sheep reaction to aircraft is illustrated by the varying reports of age-sex class specificity of response. Some authors state that rams are more affected (e.g., 302) while others report that the "ewe classes" are more responsive (268, 367). This may be due to sex differentials in hunting pressure.

There is little solid evidence to confirm any biological effects of aircraft disturbance although considerable circumstantial evidence exists. Certainly the intense running observed must have bioenergetic significance. Myopathy has not been reported in mountain sheep although heart ruptures apparently occur in response to exertion and fear (375). Linderman (302) thought that aircraft had driven sheep from their summer ranges and salt licks. He states that even if sheep do not react to aircraft overtly, there are always subtle indicators of nervousness. Repeated overflights are reported to make sheep "spooky" (184). The combined influence of aircraft, human activity and simulated compressor station noise drove sheep from their range on Mt. Goodenough (323). Nichols (367), however, found no distribution affects from his intense aerial censusing although he did mention the possibility of an influence on lamb survival. An outfitter, K. Heynen, stated that helicopters had

driven sheep from his guiding area (517). Kiger (256) noted no instances of falls or other detrimental factors during flight from aircraft.

It is felt that the worst effects of aircraft can be minimized by making the flights predictable (177, 471, 551) and at an adequate height. What constitutes an adequate height seems quite dependent on the horizontal distances involved.

There is a considerable body of literature suggesting the mountain sheep are incapable of living in close association with man even if man's presence is only as a recreational backpacker (57, 114, 115, 122, 128, 129, 202, 248, 299). Virtually all of these citations refer to desert bighorn sheep. The desert bighorn is living on the very limits of mountain sheep range and is consequently only marginally adapted to its habitat. Even minor human disturbances may be sufficient to tip the scales toward population decline. Nevertheless, these studies illustrate an aspect of sheep biology which cannot be ignored in more northern sheep. An important point is that the often documented cases of sheep surviving human interference (e.g., 471, 498) usually refer to situations wherein there is actually relatively little disturbance. As human use increases, sheep populations often decline very gradually (299).

Sheep declines as a response to human presence are complicated by hunting. Virtually all healthy sheep populations outside of parks are presently hunted. Heavy hunting itself can cause range shifts as hunted animals seek more secluded and inferior habitats (170, 172, 174, 176, 219). Sheep populations cannot be simultaneously managed for both consumptive and non-consumptive uses. Hunting teaches fear of man and sheep then react to recreational users as they would to a hunter. Even light recreational use can cause disturbance levels which are intolerable (172, 176, 219, 471).

In contrast to these conclusions, Geist (176, 177) suggests that sheep can live with a great deal of human disturbance if they are afforded protection. The situations in McKinley (498), Banff and Death Valley (541) illustrate this well. The sheep must, however, be habituated slowly and carefully (176) and be afforded complete protection.

Few major roads traverse sheep habitat and therefore there is little literature regarding sheep response to ground vehicles. Tracy (496) found no distributional effects associated with the McKinley Park road except that lambs were never seen within 200 m. Response intensity was correlated to distance from the road, though sheep crossed the road cautiously. In Utah, sheep remain an average of 11 miles from a major highway and were observed crossing it only 5 times in several years

(545). MacArthur et al. (308) found that the heart rates of sheep habituated to a road only increased when they were within 200 m of it. The most serious aspect of roads is access (177). Summerfield (471) could find no instances from Alaska in which a road was built and there was not a subsequent decline in local sheep numbers.

In general sheep seem to be relatively insensitive to noise per se (247). Geist (174) suggests that sheep are sensitive to rumbling sounds due to their resemblance to the sounds of avalanches or rockfall. Sheep tend to assess the situation rapidly and return to normal behaviour quickly (174). Domestic sheep are not particularly bothered by sonic booms (138) while bighorn sheep habituated to man cannot be frightened by honking horns, gunshots, shouts (541) or cracker-shells fired over their heads (personal observation). Sheep were observed to habituate within a day to dynamite blasts 3-1/2 miles away which produced sound levels of 105 dB on the range (287). Nevertheless, the noise emanating from compressor stations along a gas pipeline has been a major cause for concern (e.g. 31, 370). The sounds of such a station have twice been simulated on sheep ranges (323, 410). In one case, sheep exhibited altered activity patterns and ultimately vacated the area (323). In the other case, the sheep were not noticeably affected (410). These tests tell us remarkably little about sheep response to compressor station noise. In the situation in which sheep showed no response, the population was extremely refractory to disturbance not even reacting to helicopters further than 150 yards distant. The other population was an extremely sensitive one which was probably as frightened by the activity and helicopter flights as by the simulated noise. Geist (175) suggests that the question of compressor station noise is a pseudo-problem and that sheep will certainly accommodate the noise itself. The real question is whether they can accommodate the accompanying activity.

It is unknown whether pipeline construction and maintenance will cause disruptions in traditional range movements of Dall sheep. Mutch (361) developed an impact statement on the premise that sheep would withdraw from 50% of their habitat within 8 km of pipeline construction and subsequently return. Although reasonable, there is little evidence for such a figure. Summerfield and Klein (472) found that sheep remained on the lambing range within one mile of construction activity on the Trans-Alaska Pipeline and that there was no decriment in lamb production (472).

Little work has been done on the physiological responses of sheep to disturbance. Handling of domestic sheep and capture of wild ones are known to affect various blood parameters (59, 139, 404), rectal temperature (154) and heat production (188, 189). The stress of capture was observed to depress lymphocyte responsiveness thereby making bighorn sheep less capable of immune reactions (225). This is presumably one reason why many bighorn sheep succumb to disease after the stress of

capture. Mackenzie (310) and MacArthur et al. (308) found that heart rates of domestic and bighorn sheep accelerated during disturbance and were often accompanied by no overt behaviour alterations. Pregnant domestic ewes subjected to psychological stress often develop pregnancy toxaemia leading to abortion (403). While "capture myopathy" or "white muscle disease" has not been reported in mountain sheep, two cases of heart rupture were reported in response to fear and overexertion (375).

INTRODUCTION TO THE BIBLIOGRAPHY

The bibliography consists of 564 alphabetically-ordered references dealing with behavioural disturbance and its effects. Each citation includes a short annotation and a set of keywords. Indices I - IV allow location of particular subjects through cross-referencing of the keywords.

Scope

The animals treated are large, northern New World mammals; specifically Dall sheep, mountain goats, caribou, grizzly bears, polar bears, musk-oxen, mule deer, elk, and wolves. Any species as small or smaller than a wolverine was excluded. Because congeneric species provide useful comparative information, the genera of the above-mentioned species were considered as the operational units. Therefore, references dealing with animals clearly not northern in distribution (e.g., white-tailed deer, desert bighorns) were included. References to other species were included when they served to illustrate important, general points.

Something that becomes clear upon reading about behavioural disturbance is that many writers lack a clear grasp of the theoretical aspects of the subject. The bibliography therefore includes a few references which will hopefully serve to present an overview of the subject and provide an entrance into the literature. This aspect of the bibliography is, of necessity, very sketchy since an adequate background would entail thousands of references of peripheral relevance. For example, Selye (1975) states that between 1936 and 1975, there were 110,000 articles and books written about stress. I have therefore included only two of Selye's general works (441, 442) as introductions to the General Adaptation Syndrome and the stress concept. Likewise, the physiological literature dealing with the endrocrinological, developmental, reproductive, and pathological aspects of stress is vast. Several of the more relevant articles are included in the bibliography with many more cited in Hudson and Stelfox (227).

It was not until the early 1970's and the development of environmental concerns about snowmobiles and northern development that explicit disturbance research was undertaken. Much of this research has been undertaken by private companies and special government task forces with reports often appearing in manuscript form. Previously, the only related work dealt with "flight distances" while most disturbance observations were included as asides in works of broader scope. As a result of these factors, the disturbance literature is characterized by a high degree of dispersion. Without doubt, this bibliography fails to include a significant amount of information which lies tucked away in unrelated works, company documents and government reports.

Annotations and Keywords

The annotations provided are short and, in most cases, refer only to those aspects of the reference which deal with behavioural disturbance. The annotations are provided solely to allow the reader to assess the citation's general contents and, on that basis, to decide whether the original should be obtained. The annotations are not abstracts, summaries, or reviews. No judgements were made as to the validity of the presentation. The annotations are my own interpretations of the author's writing and may not coincide with what the author meant or with other readers' interpretations. Workers are urged to obtain originals and not use this bibliography as a primary source.

Because of the extensive interconnectedness of diverse subject matters within single references, grouping of references by subject categories was not appropriate. Instead, references were ordered alphabetically by author with keyword designations which are listed by category in an appended set of four indices. The keyword designations are comprised of three parts each separated by a slash. The first part (from left to right) refers to the animal's response to disturbance. The second part refers to the type of disturbing stimulus experienced by the animal. The third part states the genus or taxonomic group of the disturbed animal. Hence, the keywords read as follows:

KEYWORDS: Response/Stimulus/Genus

This system works well in defining the contents of most citations but tends to lose definition in works dealing with general principles. Most of the keyword designations are self-explanatory with the exception of several catch-all categories (i.e., Disturbance, Generalized Stimuli, Various Species) which may refer to subjects not otherwise covered by keywords, to undefined or general subjects, or to subjects too numerous to warrant extensive keywording.

Classic and Important Entries

The importance and usefulness of the bibliographic entries vary widely. While most citations will be found to be useful in referencing certain topics, other less "solid" inclusions were made for the sake of completeness. The validity and importance of the entries is not discussed in the annotations. To assist the reader in concentrating on the more significant contributions, I have labelled those entries which I consider to be classics with an asterisk (*) and those that I feel are important with a dagger (†). This designation is based on how often an article is quoted, the originality of the contents, and the importance of the topic considered. These are purely personal and arbitrary designations and do not imply that other articles are necessarily less worthy.

Sources of Materials

Almost all of the references cited herein were obtained from the University of Calgary library, the Arctic Institute[1] of North America, the library[2] of Foothills Pipe Lines (Yukon) Ltd., or the Canadian Wildlife Service[3] library in Edmonton.

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1 The Arctic Institute of North America, University of Calgary Library Tower, 2920 - 24th Avenue N.W., Calgary, Alberta T2N 1N4.

2 Foothills Pipe Lines (Yukon) Ltd., Library, 1600 Bow Valley Square Two, 205 - 5th Avenue S.W., Calgary, Alberta.

3 Canadian Wildlife Service Regional Library, Environment Canada, Room 1000, 9942 - 108th Street, Edmonton, Alberta T2K 2J5.

1. Adams, D.B., G. Baccelli, G. Mancia, and A. Zanchetti. 1971. Relation of cardiovascular changes in fighting to emotion and exercise. J. Physiol. 212:321-335.

A comparison of cardiovascular responses to emotion (preparation to fight) and exercise in the cat. Responses to the two situations vary in several aspects.

KEYWORDS: Physiology/Laboratory/Other Mammals

2. Alberta Environment Conservation Authority. 1974. Land use and resource development in the eastern slopes; report and recommendations. Env. Cons. Auth., Edmonton. 224 pp.

Pages 59-60 discusses human disturbance of ungulates. Man and his presence may cause severe damage without his being aware of the effects. Ungulates may be displaced to interim habitat. Exertions in winter can cause abortion or death. The impact of snowmobiles and other vehicles is a cause for concern. Occasional disturbance may be more damaging than continuous exposure to disturbing stimuli.

KEYWORDS: Disturbance, Distribution, Mortality/Ground Vehicles, Civilization/Various Species

3. Allen, C. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 36:3454-3456; Ever since the exploration companies came to the Delta, it has been difficult to obtain game.

KEYWORDS: Presence/Industry/Various Species

4. Allen, E.D., J.V. Basile, R. G. Janson, T.N. Lonner, L.J. Lyon, C.L. Marcum, F. Pond, R. Ream, and D. Sall. 1976. Montana Cooperative Elk-Logging study: Progress report for the period January 1 - December 31, 1975. 81 pp.

An annual report on the multi-faceted study of the effects of logging on elk in Montana. Contains information on elk activity in the hunting season, reaction to cattle, reaction to road construction, forage and habitat use, and seasonal range sizes. Describes a computer simulation model of elk use of clear-cut areas in which one of the four independent variables, the most important, was ease of access by vehicles. Below 7180 ft elevation, elk used areas of low vegetation height where no vehicle access was allowed. Where vehicle access was allowed, elk utilized taller vegetation.

KEYWORDS: Distribution/Hunting, Roads, Ground Vehicles/ Cervus

5. Altmann, M. 1956. Patterns of herd behavior in free-ranging elk of Wyoming, (Cervus canadensis nelsoni). Zoologica 41:65-71.

   At the opening of hunting season, elk undertook "evasive migration" with flights of 3-8 miles. Bulls were less eager to move. Rutting activity was depressed. Bulls, however, maintained some rutting activities; they kept spike bulls at a distance and "kept restless vigilance against other bull elk."

   KEYWORDS: Behaviour, Distribution/Hunting/Cervus

6. Altmann, M. 1958. The flight distance in free-ranging big game. J. Wildl. Manage. 22(2):207-209.

   Factors affecting flight distance in moose and elk include seasonality, habitat, sex, and specific experiences. Cows with calves tend to hide and dodge rather than run. Bull moose in velvet are quite wary. This vigilence is lost during the rut. The opening of hunting season dramatically increases flight distance. Moose feeding in the water have shorter flight distances than ones feeding on land. A quiet approach to moose which are habituated to noisy tourists increases wariness. In open country, flight distance is greater. At dusk and dawn wariness decreases. "A keener reaction in the moose was caused by olfactory and by auditory cues than vision alone." Groups show less of a flight tendency than single individuals in elk, moose, and mule deer. Elk unused to humans are quite unwary.

   KEYWORDS: Behaviour/Hunting, Human Presence/Cervus, Alces, Odocoileus

7. Amourous, Fr. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

   Vol. 74:8300-8303; Past developments (mining, roads, creation of air routes) have pushed caribou, moose and other animals away from Rae Lakes. Hunters now have to travel much farther.

   KEYWORDS: Distribution/Industry, Aircraft/Rangifer, Alces, Various Species

8. Anderson, E.W. and R. T. Scherzinger. 1975. Improving quality of † winter forage for elk by cattle grazing. J. Range Manage. 28(2):120-125.

Report of a management plan designed to improve elk winter range by range improvements and careful cattle-grazing in northeastern Oregon. "In 1967, snowmobilers discovered these wintering elk herds. For three winters their enthusiastic pursuit of this exciting sight in a wintery outdoor setting increasingly harassed the elk. Benefits derived from the planned grazing system and range improvement were nullified. The value of the area as an elk sanctuary was affected seriously. Census counts dropped sharply...". A contributing factor in the eventual success of the project was the ban on snowmobiles.

KEYWORDS: Distribution, Population Dynamics/Ground Vehicles/ Cervus

9. Andersen, R. 1971. Effect of human disturbance on Dall sheep. † Alaska Coop. Wildl. Unit Quart. Rpt. 22(3):23-27.

A study of population parameters, range use patterns, seasonal groupings, and reactions to human disturbance in Dall sheep of the Atigun River, Brooks Range. Reactions to aircraft varied. The most severe reactions were to helicopters. Reactions are determined by wind direction, closeness, sheep location, duration of noise and the intensity of the noise. Helicopters fly closer, slower and are more noisy (rotor popping). Specific incidents are described.

KEYWORDS: Behaviour/Aircraft/Ovis

10. Andre, J. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 47:4533; Ever since seismic lines came through, there have been no moose, no caribou, no fish and no beaver.

KEYWORDS: Presence/Industry/Alces, Rangifer, Various Species

11. Andreev, V.N. 1972. Personal communication to D. R. Klein cited † in Klein, (1973). p. 114.

"Attempts to develop ramps and underpasses to allow the passage of wild reindeer across large-diameter, above-ground pipelines have met with failure or only partial success in Siberia...".

KEYWORDS: Movement/Pipelines/Rangifer

12. Andreev, V.N. n.d. Personal communication to D. R. Klein cited in Klein (1974).

Helicopters and airplanes were used in the Soviet Union to herd reindeer. After a number of years, this was discontinued due to its detrimental effects to the reindeer.

KEYWORDS: Disturbance/Aircraft/Rangifer

12a.* Andreev, V. N. n.d. Personal communication to D. R. Klein cited in Klein 1979.

In the Taimyr Region of the Soviet Union, reindeer experienced great difficulties in crossing elevated gas pipelines. Wooden ramps over the pipeline were unsuccessful. After three years, the pipe was elevated 3 - 6 in. in sections of 75 - 100 m. Lead fences were constructed to channel reindeer movements. These structures allowed about 25% of the reindeer to cross the pipeline. Finally, after several years, 54 km of lead fences were constructed in conjunction with large lakes to guide the reindeer to the east and away from the obstructions. The herd continues to expand although previously used winter ranges are no longer available. The greatest detrimental effect of pipelines is felt to be local concentrations with consequent over-grazing and range trampling.

KEYWORDS: Movements, Population Dynamics/Pipelines/Rangifer

13. Appleton, G.R. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner, Allwest Reporting Ltd., Burnaby, B.C.

Vol. 117:17771-17772; Gulf's Parsons Lake operations do not disturb local reindeer.

KEYWORDS: Disturbance/Industry/Rangifer

14. Appley, M.H. and R. Trumbull. 1967. Psychological stress: Issues in research. Appleton-Century-Crafts, New York. 471 pp.

A collection of papers given at a conference on psychological stress in 1965. The introductory article by the editors is an excellent introduction to the stress concept. Other papers deal with military stress, captivity stress, cultural stress, the endrocrinology and physiology of stress, and adaptive stress behaviour.

KEYWORDS: Stress/Generalized Stimuli/Humans

15. Archer, J. 1970. Effects of population density on behaviour in rodents. Pages 169-210 in: J.H. Crook (ed.), Social behaviour in birds and mammals. Academic Pr., London.

Increase in rodent density results in increased aggression which in turn leads to physiological and behavioural changes. Physiological effects include adrenal hyperactivity, changes in sympathetico-adrenal medullary catechol amine levels, changes in the ratio of cortical to subcortical cholinesterase in the brain, reduced thyroid activity and reduced reproductive activity. These changes result from nonspecific arousal from environmental stimulation. A good literature review.

KEYWORDS: Stress, Physiology, Behaviour/Generalized Stimuli/Various Species

16. Archer, J.E. and D.E. Blackman. 1971. Prenatal psychological stress and offspring behaviour in rats and mice. Develop. Psychobiol. 4:173-248.

An extensive literature review of the effect on offspring of stress applied to the mother.

KEYWORDS: Reproduction, Stress/Generalized Stimuli/Other Mammals

17. Arima, E.Y. 1975. A contextual study of the Caribou Eskimo kayak. Natl. Mus. of Man, Mercury Ser., Can. Ethn. Serv., Pap. No. 25. Natl. Mus. Can., Ottawa. 262 pp.

A study of the use and construction of the inland Inuit kayak and the cultural aspects of the kayak complex. Pages 147 - 153 discuss the lancing of caribou at river crossings. Tents at crossing sites did not frighten caribou. In driving caribou, much use was made of wolf mimics; primarily short, sharp, whispery whistles and light-coloured, flapping objects such as gull skins, scapulae and hides. Eskimos considered caribou to have keen senses but very variable reactions to disturbance.

KEYWORDS: Behaviour/Hunting, Predators/Rangifer

18. Baldwin, M.F. 1968. The snowmobile and environmental quality. Living Wilderness 32(104):14-17.

An article outlining environmental detriments of snowmobile use including wildlife harassment.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

19. Baldwin, M.F. 1970. The off-road vehicle and environmental quality; a report on the social and environmental effects of off-road vehicles, particularly snowmobiles, with suggested policies for their control. The Conservation Foundation, Washington. 52 pp.

Superseded by Baldwin & Stoddard (1973).

KEYWORDS: Disturbance/Ground Vehicles/Various Species

20. Baldwin, M.F. & D.H. Stoddard, Jr. 1973. The off-road vehicle † and environmental quality. The Conservation Foundation, Wash., D.C. 61 pp.

An analysis and literature review of off-road vehicle use, their effects, their safety, and relevant legislation. Often strident in tone. The section on wildlife effects relies heavily on secondary sources which are inadequately referenced.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

21. Ballard, W.B. 1975. Mountain goat survey technique. Alaska Fed. Aid. Wildl. Rest. Rpt., Proj. W-17-7, 12.2 R. Alaska Dept. Fish and Game, Juneau. 21 pp.

Mountain goats react adversely to helicopters. Cited in Ballard 1977.

KEYWORDS: Behaviour/Aircraft/Oreamnos

22. Ballard, W. 1977. Status and management of the mountain goat † in Alaska. Pages 15 - 23 in W. Samuel and W.G. MacGregor (eds.), Proc. First Int. Mountain Goat Symp., Kalispell, Montana. Spons. by N.W. Sect. Wildl. Soc., B.C. Fish and Wildl. Br. 243 pp.

Appendix I discusses censusing of mountain goats with helicopters and fixed-wing aircraft. The lowest count ever recorded was two days following a helicopter survey. Firm data are not available indicating that helicopter disturbance was the cause of the low presence but it was a possibility.

KEYWORDS: Distribution/Aircraft/Oreamnos

23. Banfield, A.W.F. 1954. Preliminary investigation of the barren-ground caribou. Part I Former and present distribution, migrations and status. Wildl. Manage. Bull., Ser. I, No. 10A. Can. Dept. North. Aff. and Nat. Dev.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli/Rangifer

24. Banfield, A.W.F. 1972. Northern ecology, pipelines, and highways. Nature Can. 1(2):14-16.

A popular article on wildlife research done by pipeline companies and the expected impacts of development on wildlife. Of greatest concern to the author is the Dempster Highway. In October 1971, the caribou migrated unusually far southward and crossed the highway in a wide band near Dawson City. The herds were greatly disturbed by highway traffic.

KEYWORDS: Disturbance, Movements/Roads, Pipelines/Rangifer, Various Species

25. Banfield, A.W.F. 1973. Effects of a railway to the arctic on † northern wildlife. Unpubl. MS, Can. Wildl. Serv., Ottawa. 30 pp.

An assessment of the probable effects of a proposed railway to the arctic. The most serious impact is likely to be on the Porcupine caribou herd during the fawning and summer periods. Contains observations by the author of deflection of migrating caribou by the Hudson Bay Railroad from Churchill to the South. From 1947-1955, the number of caribou crossing the tracks declined. After 1957 or 1958, caribou remained entirely west of the railway.

KEYWORDS: Disturbance, Movements, Distribution/Railways/ Rangifer

26. Banfield, A.W.F. 1974. The relationship of caribou migration behaviour to pipeline construction. Pages 797-804 in: V. Geist and F. Walther (eds.), Behaviour of ungulates and its relation to management. IUCN Publ. New Ser. 24, Vol. 2, Morges.

A discussion of research in progress (ca. 1971) to discover the impact of pipelines on the Porcupine caribou herd. Speculates on the impact of the caribou being delayed in reaching, or deflected from, traditional calving grounds. Gravel berms will resemble eskers and should be extensively used for travel. The sounds of compressor stations are expected to have little effect. Aircraft flying over 1000 ft have little effect on caribou activity. Helicopter traffic over calving grounds could result in neonate mortality.

KEYWORDS: Disturbance, Movements, Behaviour, Population Dynamics/Noise, Pipelines/Rangifer

27. Banfield, A.W.F. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 95:14476-14495; The sensitivity of caribou in the nursery area and during aggregation were overemphasized by Geist.

Vol. 97:14710-14713; Heavy hunting from the Steese Highway may be one reason why the caribou withdraw eastward.

KEYWORDS: Distribution, Disturbance/Hunting, Pipelines, Roads/
Rangifer

28. Bannikov, A.G., L.V. Zhirnov, L.S. Lebedev and A.A. Fandeev. 1961. Biology of the saiga. Transl. from Russian by the Israel Program for Sci. Transl., U.S. Dept. Int. and Nat. Sci. Found., Wash., D.C. 252 pp.

A general treatment of the taxonomy, distribution, ecology, behaviour, reproduction, growth and utilization of the saiga in the U.S.S.R. Page 230 mentions that saigas often develop pulmonary oedema from hunting drives and from being chased by automobiles.

KEYWORDS: Pathology/Hunting, Ground Vehicles/Other Mammals

29. Barnicoat, C.R., A.G. Logan, A.I. Grant. 1949. Milk secretion studies with New Zealand Romney ewes. Parts I and II. J. Agric. Sci. 39:44-45.

Page 45 states "Observations made in the field indicate that lambs of 4 - 6 weeks of age suckle only about six times daily unless disturbed, ...". It is not stated whether disturbance increases or decreases frequency of suckling.

KEYWORDS: Behaviour/Generalized Stimuli/Ovis

30. Barry, T.W. and R. Spencer. 1976. Wildlife response to oil well drilling. Can. Wildl. Serv. Prog. Note No. 67. 15 pp.

A study completed in the summer following the installation of an oil-rig on the Mackenzie River delta. Numbers and species of birds found in eight selected plots within 2.5 km of the site were compared with eight plots in comparable habitat in a control area 8 km distant. In all, 43 percent of bird species were found to be less abundant near the rig. During the moult, geese and swans moved away completely. Helicopters were the most disturbing factor. Mammals showed no significant reaction to the rig.

KEYWORDS: Distribution/Industry/Birds, Various Species

31. Bartonek, J.C. 1969. Arctic Slope and Trans-Alaska Pipeline Task Force report: The bird resources of Alaska's Arctic Slope and petroleum development. Mimeo Rpt. on file, Northern Prairie Wildl. Resour. Center, Jamestown, N.D. 33 pp.

Refers to the possibility that compressor stations in the Atigun Valley might disrupt Dall sheep populations. Cited in Gollop, M.A., J.R. Goldsberry and R.A. Davis. 1974. Effects of compressor noise simulator disturbance to terrestrial breeding birds, Babbage River, Yukon Territory, June, 1972. Chapter II in W.W.H. Gunn and J.A. Livingston (eds.), Disturbance to birds by gas compressor noise simulators, aircraft, and human activity in the Mackenzie Valley and the North Slope, 1972. L.G.L. Environmental Research Ass., Can. Arctic Gas Study Ltd. Biol. Rpt. Series No. 14.

KEYWORDS: Disturbance/Pipelines, Noise/Ovis

32. Baskin, L.M. 1970. Reindeer ecology and behaviour. Nauka, Moscow. Transl. by Can. Wildl. Serv., Ottawa.

Herding keeps reindeer in a state of chronic, low intensity alarm. Cited in Geist 1975.

KEYWORDS: Behaviour/Husbandry/Rangifer

33. Baskin, L.M. 1974. Management of ungulate herds in relation to domestication. Pages 530-541. In: V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management, Vol. 2. IUCN Publ. New Series 24, Morges.

By reference to native livestock herding practices, the author attempts to identify the biological principles of herd control. Stimuli having great meaning to an animal under natural conditions are called "biological signals." For example, reindeer and sheep react with fright to a barking dog while yaks are most sensitive to the sound of falling rock suggesting these stimuli are biological signals. If humans produce stimuli which are incidentally biological signals for a certain species, the animals will react as if the situation were dangerous. Cites urials in Turkmenia remaining close to villages where there are few predators. In the tundra of Kamchatka and the Taimyr Peninsula, wild reindeer remain at least one km from people. Free ranging reindeer grow and fatten faster than herded ones.

KEYWORDS: Behaviour, Distribution/Husbandry, General Stimuli/ Rangifer, Ovis, Various Species

34. Basner, V. 1976. Mountain goat-human interactions in the Sperry-Gunsight Pass area, Glacier National Park. M.S. Thesis, Univ. of Montana. 46 pp.

Mountain goats in the study area are attracted to salt and habituated to humans. They cautiously approach humans to beg salt. Goats are more frightened by people appearing suddenly than those standing in full view.

KEYWORDS: Behaviour/Human Presence/Oreamnos

35. Basson, P.A. and J.M. Hofmeyr. 1975. Mortalities associated with
† wildlife capture operations. Pages 151 - 160 in E. Young (ed.), Capture and Care of Wild Animals. Ralph Curtis Books, Hollywood, Fla.

Descriptions of white muscle disease and shock in captured African animals. Since myopathy occurs even when overexertion has been eliminated, it is thought that fear, anxiety, and/or shock is the major trigger mechanism.

KEYWORDS: Pathology, Mortality/Capture and Handling/Various Species

36. Batcheler, C.L. 1968. Compensatory responses of artificially
* controlled mammal populations. Proc. N.Z. Ecol. Soc. 15:25-30.

Presents evidence for the following management hypothesis: "When the control technique disrupts the ability of survivors to use favoured habitat, the effects of reduction of numbers are reinforced by suppression of compensating response mechanisms." When red deer and chamois were heavily hunted in their favoured habitats over a period of years, populations were significantly reduced, ratio of young to adult did not rise, and physical condition as represented by a kidney fat index decreased. These results are explained by the more secretive habits adopted by the animals and the shift to suboptimal habitats where food resources are poor and where, in the case of chamois, confinement to bluffs increased juvenile mortality by accidental death.

KEYWORDS: Population Dynamics, Physical Condition, Behaviour, Distribution, Mortality/Hunting/Cervus, Other Mammals

37. Beak Consultants. 1975. Seismic activities and muskoxen and caribou on Banks Island, N.W.T. Unpubl. Rpt. Prep. for Panarctic Oils Ltd. 15 pp.

There was no noticeable effect of seismic activity on muskox group size on Banks Island. No statistically significant differences in distribution arose as a result of seismic activity although the muskoxen did make way for the work crews. There was no noticeable change in muskox or caribou activity if they were one km or more from seismic crews. Caribou seemed extremely tolerant of snowmobiles and human activity. Muskoxen reacted more strongly to snowmobiles than to Nodwells perhaps because snowmobiles bear more resemblance to wolves. Common knowledge amongst seismic workers is that the best way to get muskox photographs is to approach slowly in a Nodwell.

KEYWORDS: Distribution, Behaviour/Industry, Ground Vehicles/ Rangifer, Ovibos

38. Beak Consultants. 1976. A study of the influence of seismic † exploration on muskoxen and caribou on Banks Island, N.W.T. Prep. for Panarctic Oils Ltd. 67 pp.

Seismic activity did not influence distribution of muskoxen on Banks Island nor did it affect population or herd sizes. The time spent reacting to seismic activity was small. In flat terrain, it is possible to approach muskoxen in a Nodwell to within 250 m without disturbing the animals. In hilly terrain, this distance increases to 1.5 km. Similar reactions were noted in caribou but the sample sizes were small. Aircraft and snowmobiles are more disturbing than Nodwells.

KEYWORDS: Behaviour, Distribution/Industry, Ground Vehicles/ Ovibos, Rangifer

39. Beak Consultants Ltd. 1979. Summary of impacts of linear facil- * ities on northern ecosystems: A literature review. Prep. for the Env. Prot. Service and Dept. Supply and Services. 138 pp.

An excellent review of literature available concerning the effects of pipelines, railways and roads on terrain, hydrology, vegetation, aquatic systems, birds and mammals in the North. Among other topics, it discusses disturbance during construction and maintenance, interference with seasonal movements and attraction of nuisance animals to facilities.

KEYWORDS: Disturbance/Pipelines, Roads, Railways, Generalized Stimuli/Various Species

40. Beer, P. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

    Vol. 63:9004; Caribou are reluctant to approach within 1/8 mile of a continuous noise source.

    KEYWORDS: Distribution/Noise/Rangifer

41. Behrend, D.F. and R. A. Lubeck. 1968. Summer flight behavior of * white-tailed deer in two Adirondack forests. J. Wildl. Manage. 32(3):615-618.

    The summer flight distance of white-tailed deer was studied in two areas in northern New York. One was hunted and the other was not. Mean flight distance for antlered deer (exclusive of spikes) was greater on the hunted area. Deer fled more often with their tails up on the hunted area than on the unhunted one. Behaviour of fawns on the two areas was similar to that of adults. Spikehorns appear to be the least wary class.

    KEYWORDS: Behaviour/Hunting, Human Presence/Odocoileus

42. Bellis, E.D. and H.B. Graves. 1971. Deer mortality on a † Pennsylvania interstate highway. J. Wildl. Manage. 35(2):232-237.

    Highway mortality was greatest in forested regions where highway rights-of-way provide pastures not otherwise found in the area. Most deer do not cross highways at right angles; most move along the highway being channeled by local topography or the continual attraction of food.

    KEYWORDS: Movements/Roads/Odocoileus

43. Berger, T.R. 1977. Northern frontier, northern homeland. The report of the Mackenzie Valley Pipeline Inquiry, volume One. Min. Supply and Serv., Ottawa. 213 pp.

Pages 38-43 present a thoughtful assessment of expert opinion regarding the effects of northern pipeline and road development on caribou. Most experts considered disturbance on calving grounds to be the most critical factor. The view of the caribou as an obligate wilderness species is accepted. Most caribou herds have declined in numbers since contact with industrialized man. The evidence of man's role in these declines is circumstantial but compelling. Berger considers overly optimistic the opinions of wildlife biologists who maintain that the coastal pipeline route would not seriously affect caribou. Berger emphasizes that the influence of the gas pipeline along the Dempster Highway cannot be considered in isolation from the highway itself. Since the highway will be completed prior to construction of the pipeline, the caribou will already be under stress as the pipeline is being constructed. Therefore, extrapolation from present conditions is unwarranted.

KEYWORDS: Population Dynamics, Disturbance/Pipelines, Roads, Civilization/Rangifer

44. Berger, T.R. 1977. Northern frontier, northern homeland: The report of the Mackenzie Valley Pipeline Inquiry, Volume Two, terms and conditions. Min. Supply and Serv., Ottawa. 268 pp.

Sets out the terms and conditions that should be imposed if a pipeline or other energy corrider is constructed in the Mackenzie Valley. Pages 95 - 111 deal with wildlife. The Dempster Highway was built without adequate environmental assessment and now poses a real threat to the Porcupine caribou herd. It is recommended that hunting be banned within 2 miles of the highway and that restrictions on travel and construction be imposed during caribou migration. Roads and other obstacles may cause diversions in lines of travel, increased exposure to hunters or predators and range abandonment. Uncontrolled aircraft flights are probably the most serious form of disturbance to caribou. If bears are disturbed during winter and forced to abandon their dens, mortality would probably result. A major problem is easier access to previously remote areas. Improved access will result in increased stress on many species through direct hunter kill, by increased disturbance, and by habitat loss. Recommendations are made to mitigate these and other hazards. A strong case is made for more research on wildlife and institution of a monitoring program. Recommendation 54 (p. 109) calls specifically for more research on disturbance caused by aircraft,

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fixed facility noise, blasting, ground transport and watercraft. With respect to caribou, it is recommended that both behavioural and physiological responses be investigated.

Page 203 states that insufficient data are available concerning wildlife response to different aircraft types. More information must be gathered regarding sensitivities of various species under different conditions and at different stages in the life cycle so that the short and long term effects can be evaluated. It is recommended that the government establish such research.

Page 194 states that it is difficult to judge how much noise abatement at compressor stations will be necessary to protect wildlife. The problem is site-specific and depends upon the nature of the installation and local environmental sensitivities.

Page 150 expresses concern that blasting will disturb wildlife during sensitive periods in their life cycles. At the community hearings, the inquiry heard many complaints about the adverse effects on wildlife of seismic blasting. Blasting is considered to be disturbing to migrating, calving or nursing caribou and Dall sheep when it occurs within 5 miles. (p. 152)

KEYWORDS: Disturbance/Pipelines, Roads, Civilization/ Rangifer, Ursus, Various Species

45. Bergerud, A.T. 1963. Aerial winter census of caribou. J. Wildl. † Manage. 27(3):430-449.

Four hundred hours were spent censusing Newfoundland caribou during the winters of 1957-1961. Caribou ceased moving soon after the airplane passed overhead and rarely moved into an adjacent 1/2 km-wide strip-plot. Areas devoid of caribou were either unsuitable habitat or near settlements.

KEYWORDS: Behaviour, Distribution/Aircraft, Civilization/ Rangifer

45a. Bergerud, A.T. 1971. The population dynamics of Newfoundland
† caribou. Wildl. Manage.

For several years, caribou continued to migrate across a railroad transecting Newfoundland. Associated with a population crash (40,000 to 2,000) in 1915-1925, the caribou ceased to cross the railway. The author equates the crash to over-hunting and lynx predation. By 1966, the herd had increased to about 6,000 aminals but there was no reestablishment of railway crossings.

KEYWORDS: Population Dynamics, Movements/Railways/Rangifer

46. Bergerud, A.T. 1974. The role of the environment in the aggre-
* gation, movement, and disturbance of caribou. Pages 552-584 in: V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management. IUCN Publ. New Series No. 24, Vol. 2, Morges.

"The aggregation, movement, and disturbance behaviour of caribou (Rangifer tarandus) is discussed in relationship to the interaction of the extrinsic environmental factors: (1) other animals (wolves, insects, and caribou); (2) a-place-in-which-to-live (open habitats); (3) food (slow growing plants); and (4) weather (snow and wind)." Groups of cows with calves alert and flush at greater distances than lone cows or lone cow-calf units. "The calving season was the only time of year when caribou consistently took flight at long distances when alerted by sight stimuli, without verification by scent." In summer, caribou seek shade to escape flies, not heat. "Important factors that have influenced perceptive and escape behaviour have been open habitat, gregarious herd structure, and predation by wolves. Animals that respond inappropriately to wolves were selected against and thus these disturbance mannerisms appear due to phylogenetic contingencies." "The seriousness of human disturbance should be considered in light of the perceptive and escape adaptations which caribou have evolved in association with wolves. For example, a road or a building are not factors which have been prior phylogenetic contingencies." "Female caribou are considerably more wary than males. Females with young are especially wary. For a female to contribute to future generations, it is necessary that she successfully rear her young; adequate escape behaviour for herself and her calf is essential. The Darwinian fitness of males depends on his successfully siring which depends on dominance in the rut. Size and physical condition are important as well as perser-verance and attentiveness to females in courtship. These characteristics may be at odds or override interspecific wariness." Scent is the most discerning sense leading to flight behaviour. Noise alone has little impact. Sounds of

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trains, cars, chain saws, and dynamite produced no visible reactions. When an intruder is sighted, caribou often approach and circle and when they run, it is usually into open terrain. Caribou will walk on and across roads. Car and aircraft noise creates only temporary alertness. Movement in cars or aircraft, however, often elicits response. Helicopters are more disturbing than fixed-wing aircraft. The management premise the caribou are wilderness animals is a substitute for a lack of specific biological knowledge.

KEYWORDS: Behaviour/Civilization, Aircraft, Noise, Ground Vehicles, Generalized Stimuli/Rangifer

47. Bergerud, A.T. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 110:16754-16758; The most vulnerable times in the caribou life cycle are during calving and summer insect harassment. Both of these occur along the coast therefore the interior route is preferred. Harassment during the calving and post-calving periods must be avoided.

Vol. 110:16862-16863; The Renewable Resources argument for the coastal route is strained in its documentation.

Vol. 110:16823-16827; Caribou hesitate at road crossings in proportion to the volume of traffic.

Vol. 110:16860-16861; A minimum flight altitude of 1000 ft is adequate except during the calving period. The EPB recommendation of 2000 ft is better.

Vol. 110:16837-16838; Caribou can co-exist with man if the right environmental mix exists.

Vol. 110:16750-16751, 16874-16880; The differentiation between caribou types has no operational meaning. Environment alters behaviour. Woodland caribou are more wary of man and less gregarious. These sorts of characteristics will govern reactions to pipelines.

Vol. 110:16749-16750; Caribou are wilderness animals in that they need large areas to roam and are unwary of man. The problem is whether people can live with caribou; not the converse.

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Vol. 110:16745-16749; The Arctic Gas work is not ecosystemic or a long-term in approach. The Porcupine caribou can withstand the short-term effects of a pipeline but not the long-term effects.

Vol. 110:16796-16816; Discussion of research needs. The quantification of animal responses to roads, etc. should be pursued so as to allow assessment of additive effects.

KEYWORDS: Disturbance, Behaviour/Pipelines, Aircraft, Ground Vehicles, Civilization/Rangifer

48. Bergerud, A.T. 1975. Impact on the living environment: Caribou.
* Exhibit No. 403 entered before the Mackenzie Valley Pipeline Inquiry, Yellowknife. 20 pp.

An important discussion of human-caribou interactions. The author disagrees that the caribou is a "wilderness species." Caribou have no inherent aversion to man - they "... can occupy ranges with men, the question is whether people can live with caribou." (p.5). Caribou are very adaptable to different environments. Reindeer, however, have been bred for certain characteristics and it is misleading to study these animals for an understanding of disturbance behaviour in caribou. The weakest link in caribou biology is not migration but the calving and fly seasons. Females require a period of sedentariness after calving to learn to recognize their calves; they are therefore very susceptible to disturbance at this time. Females and young often are separated when disturbed. Herd structure also has an anti-predator function during the post-calving period and splintering of groups through disturbance would be detrimental. Herds bothered by flies are least likely to cross pipelines. Groups would meet a coastal pipeline at angles of less than 45^{o} and would be deflected. Pipelines in the forest would blend better with the landscape and would therefore be more easily crossed. Where there is deep snow, caribou could be led to crossing areas by snowmobile trails. It should be investigated whether (a) caribou are more likely to first cross pipelines on spring migration rather than fall, (b) light-coloured lines are preferable to dark ones, and (c) the importance of blending in with the landscape and ability to see over the line. Caribou in winter and during migration habituate to aircraft. This is evidenced by the constant birth rates in many herds that have experienced intensive aerial censusing. "The aerial surveys conducted by the Renewable Resources Consulting Services have likely disturbed the animals more than will flights connected with construction and maintenance of the pipeline." (p.14). Range abandonment is a normal part of caribou biology. The author discusses the necessity and sufficiency of cause as it relates to human influence on caribou decline.

KEYWORDS: Movements, Population Dynamics, Behaviour/Pipelines, Aircraft, Civilization/Rangifer

49. Bergerud, A.T. 1978. Caribou. Pages 83-101 in: J.L. Schmidt and † D.L. Gilbert (eds.), Big game of North America: Ecology and Management. Wildlife Management Inst., Stackpole Books, Harrisburg, Pa.

An overview of biological knowledge about the caribou. Suggests that the negative influences of roads and pipelines are more imagined than real. There is no evidence to suggest caribou abandon ranges as a result of disturbance; with the possible exception of calving areas. Thinks the adverse effects of human harassment have been overstated. Caribou biologists are among the worst offenders. The effects of natural environmental stresses and human harassment are not additive. Harassment of groups with young calves is serious; calves are often trampled or abandoned.

KEYWORDS: Disturbance, Distribution, Behaviour/Roads, Pipe lines, Civilization, Aircraft/Rangifer

50. Betsina, F. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. C-77:8387; A pipeline will change the pattern of caribou travel.

KEYWORDS: Movements/Pipelines/Rangifer

51. Bigalke, R.C. 1974. Ungulate behaviour and management, with specific reference to husbandry of ungulates on South African ranches. Pages 830 - 852 in V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management. IUCN Publ. New Series No. 24, Vol. 2, Morges.

Contains a section dealing with the reactions of wild and semi-tame African ungulates to fences. "The effectiveness of these barriers in holding wild ungulates is related to size, behaviour and locomotory abilities of the animals." Barriers which normally restrict movements may fail to hold excited animals or ones strongly motivated by hunger and thirst. Animals which have become accustomed to a fence tend to accept it as an insuperable barrier. Even when a fence has been removed, it is difficult to drive some species across the line of a known fence.

KEYWORDS: Behaviour, Movements/Fences/Various Species

49a. Berner, L.M. 1955. A study of deer pellet groups as an index to population trend, true population and range use. 1953 - 1954. P-R project 12-R-12. Rpt., South Dakota Game, Fish ad Parks. 41 pp. mimeo.

Deer fecal pellet densities were comparatively low in portions of transects within 300 ft of roads. Cited in Rost 1975.

52. Bjorvall, A. 1974. North American studies on the effects of snowmobiles on fauna. Fauna Flora 69:47-52.

Not seen.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

53. Black, P. 1970. Physiological correlates of emotion. Academic Pr., N.Y. and London.

Contains 13 papers dealing with genetic, developmental, endocrinal, neurophysiological and psychophysiological correlates of emotion.

KEYWORDS: Physiology/Generalized Stimuli/Various Species

54. Blancho, P., J. Hardy and J. Gully. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 75:8312, 8339, 8347; Description of the impact of seismic lines and other exploration activities on wildlife. There are now fewer animals. "If just the seismic trail can cause trouble like this, just think what would happen if the pipeline goes through."

KEYWORDS: Disturbance/Industry, Pipelines/Various Species

55. Bliss, R.L. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 112:17116-17119; There are no quantitative data to assess the impact of drilling, roads and seismic activity on reindeer. The impact of aircraft on cow-calf bonding is unknown.

KEYWORDS: Disturbance/Industry, Aircraft/Rangifer

56. Bliss, L.C. and E. B. Peterson. 1973. Ecological impact of northern petroleum development. Pages 505-537 in: Arctic oil and gas: problems and possibilities. Le Ve Congres International de la Fondation Francaise d'etudes Nordiques, Ecole Pratique des Hautes Etudes, Contributions du Centre d'Etudes Arctiques No. 12.

A good review of ecological impacts of northern oil development. Contains a section on wildlife resources.

KEYWORDS: Disturbance/Generalized Stimuli, Industry, Pipelines/Various Species

57. Blong, B. 1967. Desert bighorn and people in the Santa Rosa Mountains. Trans. Calif.-Nevada Section meeting, The Wildlife Society. Page 66.

Human disturbance and loss of habitat to urban development are the greatest threats to the survival of desert bighorns in the Santa Rosa Mountains of southern California. Cited in Dunaway, 1971.

KEYWORDS: Disturbance/Human Presence/Ovis

58. Bollinger, J.G., O.J. Rongstad, A. Soom, and R.G. Eckstein. 1973.
* Snowmobile noise effects on wildlife, 1972-1973 report. Univ. Wisc. Engineering. Exp. Sta., Madison. 85 pp.

Ten radio-collared white-tailed deer (does and female fawns) were subjected to peak sound levels of 46-64 dbA during test snowmobile runs. The deer did not significantly increase their home range size nor their rate of travel. Patterns of activity/inactivity were not affected. An initial disturbance of deer was noted; 20-25 individuals were often seen on the first snowmobile run and only 6-7 thereafter. Deer change home range locations spontaneously and caution is advised in studies of home range shift in response to disturbance. Deer remained close to areas where pulp timber was being cut and were therefore assured of a constant food supply. They would remain near men operating chain saws or heavy machinery but would move away if approached. Cited in Bury 1978 and Heath 1974.

KEYWORDS: Behaviour, Distribution, Movements/Ground Vehicles, Noise/Odocoileus

59. Bowden, D.M. 1971. Nonesterified fatty acids and ketone bodies in blood as indicators of nutritional status in ruminants: A review. Can. J. Anim. Sci. 51(1):1-13.

A literature review indicating that nonesterified fatty acid (NEFA) levels increase in sheep and cattle with the excitement caused by handling. This effect is reduced by repeated handling with the consequent reduction in excitement.

KEYWORDS: Physiology/Capture and Handling/Ovis, Bos

60. Broadbent, D.E. 1957. Effects of noise on behaviour. Chapter 10 in: C.M. Harris (ed.), Handbook of noise control. McGraw, N.Y.

A literature review of the effects of noise disturbance in man grouped into three categories: annoyance, physiological measurements and efficiency.

KEYWORDS: Physiology/Noise/Humans

61. Brooks, J.W., J.C. Bartonek, D.R. Klein, D.C. Spencer and A.S. Thayer. 1971. Environmental influences of oil and gas development in the arctic slope and Beaufort Sea. Bur. Sport Fisheries and Wildl., Fish and Wildl. Serv., U.S. Dept. Interior Resour. Bull. 96.

    A description of the environment of the North Slope and the Beaufort Sea and the expected results of oil and gas development there. It is felt that caribou will not be affected significantly due to the enormous area available to them and their ability to adjust to fairly conspicuous habitat changes (road, buildings, etc.). Land disturbances are unlikely to have much effect on moose. Unless obstacles to movements are set up, development should have no effect on Dall sheep. If preferred muskox areas are avoided, oil development should have little effect on populations. Wolf denning areas are in foothills and mountain areas and are therefore safe from human disturbance.

    KEYWORDS: Disturbance, Movements/Industry, Pipelines/Rangifer, Alces, Ovis, Lupus, Ovibos

62. Brown, R.G.B. 1974. Bird damage to fruit crops in the Niagara Peninsula. C.W.S. Rpt. Series No. 27, Information Canada, Ottawa.

    A review of bird damage to fruit crops and methods to minimize it. Points out the fallacy of the anthropomorphic view that what scares us, scares birds too. For example, loud noises have no effect on robins. What frightens one species does not frighten another. Scarecrows basically exploit fear of predators. If the scarecrow is not constantly reinforced by actual attack, birds quickly learn to ignore it. "Any efficient scarecrow must allow for this habituation by being so frightening that the birds' initial reaction is slow to wane or by being so complex and unpredictable that the birds never learn that the threat is never carried out."

    KEYWORDS: Disturbance/Generalized Stimuli/Birds

63. Bubenik, A.B. 1962. Geweihmorphogenese im Lichte der neurohumoralen † Forschung. Symp. Theriol. 1:59-66.

    Describes inhibition of antler growth in a red deer buck as a result of prolonged fear. Cited in Topinski, 1975.

    KEYWORDS: Physiology/Generalized Stimuli/Cervus

64. Bubenik, A.B. 1966. Das Geweih. Paul Parey Pr., Hamburg. 182 pp.

Discusses the negative effects of military operations on antler growth in free-living deer during World War II. Cited in Topinski, 1975.

KEYWORDS: Physiology/Generalized Stimuli/Various Species

65. Bubenik, A.B. and J.M. Bubenikova. 1965. Twenty-four hour periodicity in red deer. Pages 343 - 349 in Seventh Congress of the International Union of Game Biologists, Beograd, Yugoslavia.

In response to disturbance, cervids exhibit abnormal patterning of activity. In activity graphs, the number of peaks may increase and the saddles between the peaks may be "beretted" or obliterated. When stress is severe, the secondary maximum may disappear with the main peak culminating at midnight.

KEYWORDS: Behaviour/Generalized Stimuli/Cervus

66. Burbridge, W.R. and D.J. Neff. Coconino National Forest - Arizona Game and Fish Department co-operative roads-wildlife study. Pages 44-57 in: S.R. Hicks (ed.), Proc. Elk-logging-roads Symp., Moscow, Idaho.

Report of a study in progress wherein 2 areas in Arizona (11,200 and 12,160 acres) were closed to vehicular traffic. As indicated by fecal pellet group counts, there was no distributional or refuge effect created in deer or elk by road closure.

KEYWORDS: Distribution/Roads, Ground Vehicles/Cervus, Odocoileus

67. Burkholder, B.L. 1959. Movements and behaviour of a wolf pack in Alaska. J. Wildl. Manage. 17:10-13.

Wolves were initially frightened by the aircraft used in the study but later came to accept it.

KEYWORDS: Disturbance/Aircraft/Lupus

68. Bury, R.L. 1978. Impacts of snowmobiles on wildlife. Trans. N. Amer. Wildl. and Nat. Resour. Conf. 43:149-156.

A critical review of research on the effects of snowmobiles on wild animals. "In general, snowmobiles created little effect on larger animals; moderate effects were observed on medium-sized animals, and small animals overwintering in subsnow environments were drastically affected."

KEYWORDS: Disturbance/Ground Vehicles/Various Species

69. Bury, R.L., R.C. Wendling, S.F. McCool. 1976. Off-road recreation vehicles, A research summary, 1969 - 1975. Texas Agr. Exp. Sta., College St., Texas. 84 pp.

Not seen.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

70. Calef, G.W. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 106:16188-16194; The effects of a pipeline on caribou cannot be predicted with certainty.

Vol. 106:16194-16203; The history of caribou/human interaction in the Forty-Mile, Kaminuriak and Churchill Falls herds is described. In each case there was insufficient information to make cause/effect evaluations of population changes. Among the general conclusions are: 1) calf survival declines when the herd is driven from traditional calving grounds, 2) disturbance influences are felt over very long time spans, 3) the effect of disturbance is dependent upon its intensity, and 4) disturbance effects are additive.

Vol. 106:16203-16233; The analysis by Arctic Gas' consultants is misleading. Calef then goes on to utilize the same data to show that the interior route rather than the coastal route is preferable.

Vol. 106:16233-16238; The significance of Arctic Gas' field studies is over-rated. For example, the compressor station simulators reproduce only one of many associated stimuli.

Vol. 106:16238-16240; The Porcupine caribou could decline by 90% in 5 - 10 years because of development. The impact will not be attributable directly to the pipeline.

Vol. 110:16806-16807; Discussion of DeBock's studies on caribou disturbance.

Vol. 110:16816-16821; One of the major problems is cow-calf separation due to harassment.

Vol. 110:16848; Caribou are more easily disturbed as they approach the Porcupine River.

Vol. 110:16864-16871; Explanation of the effects of the Steese Highway on the Forty-Mile herd. Discussion of the difficulties in ascribing causes to population changes.

Vol. 110:16823-16827; Caribou hesitate at road crossings in proportion to the volume of traffic on the road.

No. 70 - Con't.
Calef, G.W. - 1975

Vol. 111:16928-16931; The human activity associated with compressor stations would compound the effects of noise.

Vol. 111:16937 - 16943; The pipeline will throw the Bluenose herd into contact with the reindeer causing the reindeer to be absorbed. This would result in several problems.

Vol. 111:16954; Harassment by snowmobiles and airplanes is discussed.

KEYWORDS: Disturbance, Population Dynamics, Movements, Behaviour, Distribution/Hunting, Pipelines, Roads, Aircraft, Ground Vehicles/Rangifer

71. Calef, G.W. 1975. Impact on the living environment: Caribou.
* Exhibit No. 390 entered before the Mackenzie Valley Pipeline Inquiry, Yellowknife. 33 pp.

An extremely well-reasoned essay on the probable effects of pipeline construction on caribou populations. Discusses the ability of biologists to predict the effects of northern construction on caribou populations. Concludes that due to the inaccuracies of the censuses, the lack of knowledge about movement and distribution patterns, and the unknown demographic characteristics of the herd, no accurate predictions are possible. Discusses at some length what is known of caribou population biology. Reviews the cases of several caribou declines in parallel with construction activities and suggests that, although no strong case for casualty can be maintained, several general lessons can be learned. These are: 1) when caribou are driven from traditional calving grounds, reproduction drops, 2) a disturbance or barrier exerts its influence over a period of time, 3) the effect of a disturbance is dependent on its intensity, 4) various disturbance factors are additive in their effects, and 5) since caribou populations may run in cycles of 20 - 50 years duration, disturbances at different points in the cycle might have very different effects. The author then analyses the applicant's evidence that a coastal pipeline would have less impact than an interior one. He suggests that this evidence is misleading. Utilizing the same data, he presents arguments for the interior route. The point is stressed that "data" themselves do not provide answers; they must be interpreted and extrapolated. It is suggested that little caribou mortality will not be "attributable" to the pipeline but that mortality will occur in a much more diffuse manner.

KEYWORDS: Disturbance, Population Dynamics/Pipelines, Industry/Rangifer

72. Calef, G.W. 1974. The predicted effect of the Canadian Arctic Gas
* Pipeline Project on the Porcupine caribou herd. Pages 101 - 120 in Environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta: Volume IV, research reports. Env. Prot. Board, Winnipeg.

A description of the Porcupine caribou herd and the possible effects on it of the Mackenzie Valley Pipeline. The author suggests that if precautions are not taken, the herd can be expected to decline by 90 percent in 5 - 10 years. Impacts are of four major categories: direct mortality, disturbance, physical barriers and habitat destruction. Caribou tolerate human presence if they do not associate man with harm. Several examples are given of differences in sensitivity of hunted and unhunted caribou. Blasting is not expected to stress animals in winter although it may do so during the fly season. Compressor stations are expected to have little effect. The calving and fly periods are the times that disturbance will be most critical. The construction crews being spread out over 10 miles might be a very detrimental factor in migration. Repeated disturbances can be expected to cause range abandonment such has recently occurred in the Fortymile herd. Since the pipeline is to be buried under a low mound with gradually sloping sides, the pipeline is not expected to represent a physical barrier. Heavy traffic on the roads might present a barrier as would an elevated oil pipeline.

KEYWORDS: Population Dynamics, Disturbance, Distribution/ Pipelines, Human Presence, Ground Vehicles/ Rangifer

73. Calef, G.W. 1976. Numbers beyond counting, miles beyond measure.
+ Audobon 78(4):42-61.

An excellent popular article on caribou ending with a summary of threats to the species' survival. Suggest pipelines may retard migration enough to cause calving in improper locations. "The Russians have considerable information about the reaction of caribou to gas pipelines, but very little is reaching biologists in North America. Reports that have been received indicate considerable alteration of traditional migration routes has resulted, the ultimate consequences of which are still unknown." Alaskans heavily hunted the Fortymile herd as it crossed the Steese Highway. The herd no longer crosses this road. In 1972, the herd stopped and reversed its migration when it encountered hunters on snowmobiles at the Taylor Highway. Caribou must be prevented from reaching a range for several years before they abandon it.

KEYWORDS: Movements, Disturbance, Distribution/Roads, Hunting, Pipelines/Rangifer

74. Calef, G.W., E.A. DeBock and G.M. Lortie. 1976. The reaction of * barren-ground caribou to aircraft. Arctic 29(4):201-212.

During spring and fall migrations, aircraft above 200 ft caused response in less than 20% of caribou groups. There was no response observed in flights over 500 ft. In the winter or on the calving grounds, 62% showed panic at elevations of 300-500 ft; there was no altitude effect on response. On the calving grounds, helicopters caused less response than fixed wing aircraft. There was no observable effect due to terrain, vegetation type, or travelling and feeding behaviour. Animals at river crossings were very responsive while bedded animals were very unresponsive. The authors suggest that flying above 150 m in the spring and fall and above 300 m at other times would prevent caribou from reacting in ways most immediately injurious to themselves.

KEYWORDS: Behaviour/Aircraft/Rangifer

75. Calef, G.W. and G.M. Lortie. 1971. Toward an environmental impact assessment of a gas pipeline from Prudhoe Bay, Alaska to Alberta. Interim Rpt. No. 1, Appendix I, Env. Protection Board, Winnipeg.

A report of studies carried out in summer 1971 on the movements, distribution, numbers, and population structure of the Porcupine caribou herd. Contains a section on the possible effects of gas pipeline construction. It is considered essential to avoid human disturbance on the calving grounds. A bermed pipeline is unlikely to create a physical barrier but may present a psychological one. Caribou have an aversion to objects on the skyline. Therefore, attempts should be made to keep prominent objects from ridge tops.

KEYWORDS: Disturbance, Movements/Pipelines/Rangifer

76. Calef, G.W. and G.M. Lortie. 1973. Observations of the Porcupine
* caribou herd, 1972. Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Interim Rpt. No. 3, Appendix I, Env. Protection Board, Winnipeg.

Report of a study done in 1972 on the distribution, movements, numbers, population structure and behaviour of the Porcupine caribou herd. The closer, both vertically and horizontally, an airplane flies to caribou, the greater the response. An altitude of 200 ft seems a threshold below which a panic response often results. Between the elevations of 100 and 500 ft, decrease in response is roughly linear to altitude. Observed seasonal differences were difficult to interpret due to the different observers and aircraft used. Small and large groups responded more than groups of intermediate size while groups in timber were more reactive than ones in the open. Actively calving cows paid little attention to the aircraft. Cows showed little inclination to leave their calves. Calves were the most reactive group while cows with calves were no more so than other age-sex types. Helicopters which slowly followed caribou were particularly disturbing. Caribou usually stop running within 1/4 mile. A useful discussion of the predicted impacts of pipeline construction follows.

KEYWORDS: Behaviour, Disturbance/Aircraft, Pipelines/Rangifer

77. Cameron, R.D. and K.P. Whitten. 1976. First interim report of the
† effects of the Trans-Alaska Pipeline on caribou movements. Spec. Rpt. No. 2, Joint State/Fed. Fish and Wildl. Advisory Team, Anchorage, Alaska. 53 pp.

Systematic aerial and ground reconnaissances showed there to be significant pipeline related delay in northern movement of caribou and/or an avoidance of pipeline activities by nursing pairs. Caribou select road crossings with lower berm heights. Disturbance behaviour was associated with both deflections from the pipeline and successful crossings.

KEYWORDS: Movements, Distribution, Behaviour/Pipelines/
Rangifer

78. Cameron, R.D. and K.R. Whitten. 1977. Second interim report on
† the effects of the Trans-Alaska pipeline on caribou movements. Spec. Rpt. No. 8, Joint State/Fed. Fish and Wildl. Advisory Team, Anchorage.

Report on the second year (1976) of studies on the effects of the TransAlaska pipeline on caribou movements. Caribou avoidance of the corridor increased over 1975 findings. Calf percentages along the haul road continued to be lower than in adjacent areas. The caribou continued to avoid the Prudhoe Bay area. Frequency of crossing the haul road decreased in 1976. Contact with the pipeline itself was infrequent. Results indicate that the herd is undergoing a separation into eastern and western components.

KEYWORDS: Movement, Distribution, Behaviour/Pipelines/ Rangifer

79. Cameron, R.D. and K.R. Whitten. 1978. Third interim report on the
† effects of the Trans-Alaska Pipeline or caribou movements. Spec. Rpt. No. 22, Joint State/Fed. Fish and Wildl. Advisory Team, Anchorage.

Report of the third year (1977) of studies of the Trans-Alaska pipeline on caribou movements. As in the previous two years, little if any calving took place in the Prudhoe Bay oilfield. The percentage of calves observed along the haul road was lower in comparison to adjacent areas than in previous years. Avoidance of pipeline structures and/or activities was again noted. Corridor crossings declined during spring 1977 but frequencies increased in the fall. This, together with a more nearby representative age-sex structure along the corridor, suggests a slight reversal in the downward trend in local occupancy and crossing success. Caribou in groups with calves were progressively more numerous as distance from the corridor increased. Groups without calves may be attracted to the corridor. Infrequent contact of caribou with the pipeline makes it impossible to assess the effectiveness of crossing structures. High winter calf survival suggests steady herd growth.

KEYWORDS: Movements, Distribution, Behaviour, Population Dynamics/Pipelines/Rangifer

80. Cameron, R.D., K.R. Whitten, W.T. Smith and D.D. Roby. 1979.
* Caribou distribution and group composition associated with construction of the Trans-Alaska Pipeline. Can. Field-Natur. 93(2):155-162.

Caribou were road-censused along the pipeline haul road and aerial-censused in a large area centring on the haul road. In summer there was a lower percentage of cow-calf groups along the highway than away from it. Caribou along the corridor were retarded in their northward movements. Group size along the road was smaller suggesting avoidance of corridor by large groups, group fragmentation, or decreased tendency for group coalescence. Prudhoe Bay has been essentially abandoned as a calving area.

KEYWORDS: Movements, Distribution/Pipelines/Rangifer

81. Canadian Arctic Gas Pipeline Limited. 1974. Environmental statement (Canada-north of the 60th parallel). Section 14. Submitted to Dept. Indian Affairs and North. Dev. and Natl. Energy Board.

A presentation of Canadian Arctic Gas' environmental programme along the Mackenzie corridor. Contains a description of the environmental setting (climate, vegetation, animals, etc.), the field studies done, the measures to be taken to protect the environment, and predicted environmental impacts.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

82. Carbaugh, B., J.P. Vaughan, E.D. Bellis, and H.B.Graves. 1975.
+ Distribution and activity of white-tailed deer along an interstate highway. J. Wildl. Manage. 39(3):570-581.

Distribution and activity of white-tailed deer were studied along sections of I-80 and a rural highway in Pennsylvania. Deer crossed rights-of-way more readily when they could see across. Abundance and distribution of deer close to roads are functions of highway location relative to deer requisites such as feeding and resting locations and to the availability of these in areas other than rights-of-way.

KEYWORDS: Distribution, Behaviour/Roads/Odocoileus

83. Carbyn, L.N. 1974. Wolf population fluctuations in Jasper National Park, Alberta, Canada. Biol. Conserv. 6(2):94-101.

Increased human visitation of Jasper National Park is resulting in new pressures on wolves. Wolves are vulnerable to human disturbance at the den-site.

KEYWORDS: Disturbance/Human Presence/Lupus

84. Casaday, R.B. and R.P. Lehmann. 1967. Studies at Edwards Air Force Base, June 6-20, 1966. Interim Report, Sec. H., National Sonic Boom Evaluation Office, Arlington, Va. Contr., AF(638)-1758.

Sonic booms have little effect on animal behaviour. Cited in Espmark et al. 1974.

KEYWORDS: Disturbance/Noise, Aircraft/Various Species

85. Chadwick, D.H. 1973. Mountain goat ecology-logging relationships in Bunker Creek drainage of western Montana. Montana Fed. Aid. Wildl. Rest., Proj. Rpt., Proj. W-120-R-3. 4. Montana Fish and Game Dept., Bozeman. 262 pp.

Mountain Goats are terrified of helicopters and move out of areas which receive frequent helicopter useage. Cited in Ballard 1977.

KEYWORDS: Distribution, Behaviour/Aircraft/Oreamnos

86. Chalmers, G.A. and M.W. Barrett. 1977. Capture myopathy in pronghorns in Alberta, Canada. J. Am. Vet. Med. Assoc. 171:918923.

Approximately 4.2% of 594 captured pronghorns died of capture myopathy. The effects of various capture methods and clinical signs, clinico-pathological findings, and pathological findings are discussed. It is suggested that capture myopathy may be a natural event associated with intraspecific combat and harassment by predators including man. Warm ambient temperatures during trapping increase myopathy incidence. Includes an extensive bibliography.

KEYWORDS: Pathology/Capture and Handling/Other Mammals

87. Chanaud, J. 1974. The effects of noise on wildlife: A bibliographical survey. Engineering Dynamics, Inc., Littleton, Colo., Copy on file with Can. Wildl. Serv., Edmonton. 20 pp.

A literature review of recent research into the effects of noise on wildlife. Contains an historical review of such research and discusses the effects of noise on laboratory animals, farm animals and the demonstrated and suspected effects on wildlife. Contains 147 references. It is clear that very little research has been directed towards the effects of noise on wildlife.

KEYWORDS: Disturbance/Noise/Various Species

88. Chapman, R.C. 1977. The effects of human disturbance on wolves
* (Canis lupus L.). M.S. Thesis, Univ. of Alaska, Fairbanks. 209 pp.

A study of the effect of disturbance on the denning behaviour of wolves. Dens were observed for 1800 hours. Three packs in northern Alaska were experimentally disturbed. An extremely thorough review of the literature yielded over 100 published and unpublished articles. Appendices A-F present quotes from articles concerning wolf disturbance. Wolves react in several ways upon detecting humans near their pups. They may bark and howl, leave the area, abandon the den or abandon the pups. The latter was only observed once in 51 recorded cases. Following human disturbance, wolves may move pups to a new den which averages 3 km distant. Den sites are probably selected relative to prey availability and movements to new den sites may therefore reduce ease of hunting. Dens within 1 km of human activity are usually abandoned but ones 2.4 km or more from roads and campgrounds are usually viable. Human presence does in some cases affect hunting and prey utilization. The presence of artificial food sources, such as dumps, attracts wolves. Human activity should be restricted within a 2.4 km radius of wolf homesites.

KEYWORDS: Behaviour, Distribution/Human Presence/Lupus

89. Chester, J.M. 1976. Human wildlife interactions in the Gallatin
† Range, Yellowstone National Park, 1973 - 1974. M.S. Thesis, Montana St. Univ., Bozeman. 114 pp.

In Yellowstone National Park there was an inverse relationship between the intensity of back-country recreational usage and the number of animals seen by users. In any given area, though, there appeared to be no relationship. Faecal transects indicated a shift in elk distribution away from heavily used areas. Parties utilizing an anti-bear strategy of producing continuous, repetitive sounds saw no fewer animals than parties not producing such noises.

KEYWORDS: Distribution/Human Presence, Noise/Various Species, Cervus, Ursus

90. Chicksi, B. 1975. Testimony in Proceedings at Inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 43:4139-4140; If a pipeline were built there would be work for the 18 local people for three years but all the animals would be chased away. What benefit would a pipeline be to local people then?

KEYWORDS: Distribution/Pipelines/Various Species

91. Child, K.H. 1973. The reaction of reindeer to a simulated pipeline. Quart. Rpt. Alaska Coop Wildl. Unit 24(1):11-14.

The reaction of reindeer to a simulated pipeline was tested by herding reindeer against the simulation and recording their responses. A group of 196 animals approached the simulation diagonally and then moved parallel along its complete length. Another group of 150 animals paralleled the simulation to a gap near a river and attempted to cross there. When prevented from doing so, they continued parallel to the structure and finally, after a period of milling about, several reindeer, led by a bull, crossed under an elevated portion. Insect harassment was very pronounced during this observation.

KEYWORDS: Movements, Behaviour/Pipelines/Rangifer

92. Child, K.N. 1973. The reactions of barren-ground caribou (Rangifer tarandus granti) to simulated pipeline and pipeline crossing * structures at Prudhoe Bay, Alaska. Compl. Rpt., Alaska Coop. Wildl. Res. Unit, Univ. of Alaska, Fairbanks. (Also Exhibit 393 entered before the Mackenzie Valley Pipeline Inquiry.)

The final report of a project to assess the reaction of caribou to simulated pipelines. Most caribou paralleled the obstruction and moved around the ends. Smaller groups were better at crossing than larger ones. Adult bulls or mixed herds usually went around the simulation while nursery bands would investigate and more readily use crossing facilities. The simulation often split groups or did not allow them to coalesce. Groups under female leadership made greater use of crossing facilities. Successful use of crossing facilities is highly correlated with the level of insect harassment. Ramp structures were used more than underpasses. Of 42 crossings by cow-calf units, 19 resulted in separation of the mother and young for periods of up to 2 hours. In 13 of these cases, the cow crawled beneath the pipeline to rejoin the calf and then moved away from the pipeline. Use of ramps increased through the season.

KEYWORDS: Movements, Behaviour/Pipelines/Rangifer

93. Child, K.N. 1973. Impact of north slope oil developments and
† Trans-Alaska Pipeline on caribou movements, migrations and habitat utilization. Alaska Coop. Wildl. Unit. Quart. Rpt. 25(1):1-5.

Summary of the final report. Two pipeline simulations were constructed at Prudhoe Bay with various experimental methods of passage for caribou. Most caribou avoided the structure. At Alyeska's simulated 48-inch pipeline, 17.6% of 5,599 animals used ramps, 4.9% used underpasses, 0.7% passed beneath the pipe, 34.4% reversed their direction and 42.4% moved around the structure. At BP Alaska's mock-up, 6.8% of 1,362 animals passed beneath the pipe, 8.3% used low profile ramps, 9.5% reversed their movements, and 75.4% moved around the structure. There are significant effects of group size and composition with singletons crossing more successfully than groups. Density of biting insects was the factor most influential in determining crossing success. Cows and calves were often temporarily separated by the simulated pipelines. Validity of these conclusions outside of summer is questionable. A set of 10 recommendations is appended.

KEYWORDS: Movements, Behaviour/Pipelines/Rangifer

94. Child, K.N. 1974. Reaction of caribou to various types of
† simulated pipelines at Prudhoe Bay, Alaska. Pages 805-812 in: V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management. Vol. 2. IUCN Publ. New Series, No. 24, Morges.

A report of preliminary tests during 1971 of the reaction of caribou to two simulated pipelines acting as barriers to their movements. A total of 1707 caribou encounters were recorded. At one site 12.4% used ramps, 5.4% underpasses, 0.6% crawled under, and 81.6% were diverted. At the other site, 1.5% crawled under, 16.7% returned the way they came, and 81.8% walked around the simulation. Smaller groups crossed more successfully. Although the number of bulls was small, they seemed to cross more successfully than cows and calves. Cows and calves preferred ramps to underpasses.

KEYWORDS: Behaviour, Movements/Pipelines/Rangifer

95. Child, K.N. 1975. A specific problem: the reaction of reindeer and caribou to pipelines. Pages 14-19 in: Proc. 1st Intl. Reindeer/Caribou Symp., Univ. of Alaska, Fairbanks.

A description of the study of caribou reactions to pipelines using two simulations on the oilfield at Prudhoe Bay. No results are given.

KEYWORDS: Movements, Behaviour/Pipelines/Rangifer

96. Child, K.N. and P.C. Lent. 1973. The reactions of reindeer to a * pipeline simulation at Penny River, Alaska. Interim Rpt., Alaska Coop. Wildl. Unit, Univ. of Alaska, Fairbanks. 30 pp.

A 7,500 foot elevated pipeline, 32 inches in diameter was constructed of dredge pipe across the Penny River Valley. Two crossing facilities, a gravel ramp and an underpass, were built as experimental passage provisions. Six experimental runs against the pipeline were attempted. During all seasons, reindeer showed a general avoidance of the structure. Distance of approach was a constant 50 m except in an elevated portion where it increased to about 125 m. Animals most frequently moved parallel to the structure until they reached the terminus or were deflected away from the simulation. Reindeer crossed the pipeline only when snow covered the pipe or when insect harassment was intense. Cow-calf separation was observed twice. There was no evidence of habituation to the structure. The reactions of groups were very dependent on those of the leader. Generally speaking, reindeer responded to the pipeline simulation much as did the caribou at Prudhoe Bay.

KEYWORDS: Movements, Behaviour/Pipelines/Rangifer

97. Church, D.C. 1972. Effect of stress on nutritional physiology. Pages in D.C. Church (ed.), Digestive physiology and nutrition of ruminants. O.S.V. Bookstore, Corvallis, Oregon.

Not seen.

KEYWORDS: Stress, Physiology/Generalized Stimuli/Various Species

98. Clarke, C.H.D. 1972. Terrestrial wildlife and northern development. Pages 195-234 in: D.H. Pimlott, K.M. Vincent, and C.E. McKnight (eds.), Arctic alternatives. Can. Arctic Resour. Comm., Ottawa. 391 pp.

Contains a review of past human impacts on northern wildlife, a species by species account of status and susceptibility to development, and a treatment of the possible effects of wells, mines, impoundments, oil spills, and pollution. Artificial structures such as highways and railroads are sometimes crossed freely by caribou; at other times caribou are diverted by them. They are most likely to be crossed in winter. Muskoxen and other animals flee in panic after an aircraft has left the vicinity. When the Banff-Jasper Highway was constructed, grizzly bears retreated and only later were drawn in to Lake Louise. Bears seem to initially react to roads and then get used to them. Moose have a history of coexistence with man. They are not deterred by transportation corridors.

KEYWORDS: Disturbance, Movements, Distribution/Industry, Roads, Aircraft/Rangifer, Ovibos, Ursus, Alces

99. Corbett, R.L., R.L. Marchinton, and C.E. Hill. 1971. Preliminary study of the effects of dogs on radio-equipped deer in mountainous habitat. Proc. S.E. Assoc. Game and Fish Comm. Conf. 25:69-77.

Eight radio-instrumented white-tailed deer in North Carolina were subjected to 20 chases by hunting hounds. Chases averaged 54 minutes and 2.4 miles. Chases were usually downhill and streams were crossed repeatedly. Chased deer left their home ranges but returned soon after the chase. Compared to coastal plain habitats, in mountainous terrain escape routes were more predictable, deer suffered injury from running in rugged terrain and the return to the home range was slower. Cited in Neil et al. 1975.

Chased deer died of pneumonia and cold water shock. Cited in Sealander et al. n.d.

KEYWORDS: Movement, Distribution, Mortality/Chasing, Predators/Odocoileus

100. Couey, F.M. 1950. Rocky Mountain bighorn sheep of Montana. Fed. Aid Wildl. Rest. Proj. 1-R, Bull. No. 2, Montana Fish and Game Comm. 90 pp.

Bighorns are readily alarmed when an observer is at a great distance but apparently disregard a person who is quite near. If approached from above, sheep quickly stampede. Cited in Smith 1954.

KEYWORDS: Behaviour/Human Presence/Ovis

101. Council, E.R., C.E. Law and R.W. Lake. 1973. The arctic railway, environmental aspects. Eng. J. 56(3):23-27.

Environmental aspects of the construction of an arctic railway to the Mackenzie Delta and Prudhoe Bay. "The rail system cannot avoid some conflict with the wildlife. Our concern is not that the noise and movement of heavy trails will scare wildlife out of the country surrounding the line, but that wildlife will in fact be caught on the rail line by a fast moving train. To minimize this danger, we have proposed very long, heavy trains, therey reducing the number of train movements per day."

KEYWORDS: Disturbance, Mortality/Railways/Various Species

102. Cowan, I. McT. 1956. Life and times of the coast black-tailed deer. Pages 523-618 In: W.P. Taylor (ed.), The deer of North America. The Stackpole Co., Harrisburg, Pa., and the Wildlife Management Inst., Wash., D.C. 668 pp.

"Generally, the less deer are disturbed by man, the more they feed in the daytime." (p. 556).

KEYWORDS: Behaviour/Human Presence/Odocoileus

103. Cowan, I. McT. 1972. Some environmental considerations in † northern road planning, construction and maintenance. Unpubl. MS., Env. Prot. Serv. 63 pp.

An excellent review of the major environmental issues arising from the construction of highways in northern Canada. Discusses the principles of road planning, biological inventory, the susceptibility of vegetation, fishes, birds and mammals to road construction, maintenance and use, and contains an extensive set of recommendations for sensitive road planning and construction. The section on "Biological Factors" discusses the expected effects of road construction on certain sensitive and/or rare organisms. With respect to barren-ground caribou, the author concludes that, to the best of his knowledge, "... no major herd has long survived after a highway has transversed its main routes of movement."

KEYWORDS: Disturbance, Population Dynamics/Roads/Rangifer, Various Species

104. Cowan, I. McT. 1974. Management implications of behaviour in the † large herbiverous mammals. Pages 921-934 in: V. Geist and F. Walther (eds.). The behaviour of ungulates and its relation to management. IUCN Publ. New Ser. No. 24, Vol. 2, Morges.

Comments on the need for privacy at parturition to allow the mother-young bond to form. If this opportunity is denied through harassment by predators, tourists, air or ground traffic, there will be an increased incidence of desertion, inadequate mother-young recognition, inappropriate nursing, inhibited milk flow, and subsequent loss of young. Few ungulates respond appropriately to features altered to acquire new and dangerous characteristics. Care should be taken to include recognizable features of hazard. Some species may be genetically wild and therefore cannot learn to accept man. Most ungulates can accept man as a harmless associate if they learn they are allowed to remain in his presence without alarm.

KEYWORDS: Reproduction, Disturbance/Human Presence, Aircraft, Ground Vehicles, Generalized Stimuli/Various Species

105. Cowan, I. McT. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 47:6195-6225; The impacts of a pipeline on northern terrestrial mammals would consist of 3 major types: 1) direct killing due to increased access, 2) disturbance and harassments by people, ground vehicles and aircraft, particularly the latter, and 3) habitat alteration. The impacts of these categories are discussed with reference to moose, grizzly bears, Dall sheep, caribou, polar bears, wolverines and wolves. A set of 17 recommendations is presented.

Vol. 107:16293-16294; Caribou are more sensitive to disturbance during the calving period and during heavy insect attack rather than during migration.

Vol. 107:16335-16334; The Arctic Gas approach to examining the effects of aircraft on wildlife have resulted in "rough-cut tests".

Vol. 107:16290-16291; Dall sheep adapt to noise provided there is no harassment due to hunting.

Vol. 107:16391-16394; Discussion of disturbance tests, physiological effects of disturbance and energy budgets.

Vol. 107:16407-16414; The real issue in controlling impact on caribou is avoiding disturbance. The EPB overflight restriction of 2000 feet is preferable to the 1000 feet proposed by Arctic Gas. A discussion follows about whether disturbances are more serious on wintering or calving ranges.

Vol. 108:16455-16456, 16520-16511; Overflight altitude minimums are discussed. It should be prohibited to fly over caribou during periods of aggregation.

Vol. 108:16539; Impact of continuous disturbance on caribou.

KEYWORDS: Disturbance/Aircraft, Pipelines, Hunting, Generalized Stimuli/Rangifer, Ovis

106. Cowan, I. McT. 1977. Cumulative impact of development of the Mackenzie Estuary/Delta, N.W.T. Pages 71 - 82 in Mackenzie Delta: Priorities and alternatives. Proc. of a conf., Can. Arctic Resour. Comm., Ottawa. 193 pp.

Pages 79 - 80 discuss disturbance in the Mackenzie Delta area. In theory, most damaging aircraft disturbance can be reduced to tolerable levels by appropriate regulations. There are insidious consequences to the penetration of people into the wild, undisturbed retreats required by some species. The Dall sheep on Sheep Mountain in Kluane National Park are declining apparently as a result of people invading the lambing grounds. Only by invoking a no-hunting zone along the Dempster Highway can the interaction of the disturbances due to hunting and moving vehicles be removed for the Porcupine caribou.

KEYWORDS: Population Dynamics, Disturbance/Hunting, Aircraft, Human Presence, Roads/Rangifer, Ovis

107. Craighead, F.C., Jr. and J.J. Craighead. 1972. Grizzly bear † prehibernation and denning activities as determined by radio tracking. Wildl. Manage. 32. 35 pp.

Grizzly bears can easily be awakened from their winter sleep. "Even our muffled activity close to a den has awakened sleeping bears ...". Dens are located far from developed areas or human activity. Isolated den-sites would be a survival factor favoured by natural selection since American Indians and primitive man undoubtedly found bears easy to kill in winter. The amount of disturbance needed to cause den abandonment varies from bear to bear. Several instances of abandonment were recorded despite few approaches to dens of closer than 100 ft. Abandonment seems most likely in the fall.

KEYWORDS: Behaviour/Human Presence/Ursus

108. Craighead, J. J. and F.C. Craighead, Jr. 1972. Grizzly bear-man † relationships in Yellowstone National Park. Pages 304-332 in: S. Hererro (ed.), Bears - their biology and management. IUCN Publ. New Ser. No. 23, Morges.

"Many of the grizzlies that feed at the isolated, open-pit, garbage dumps exhibit less fear, and greater tolerance of man at these areas than at other areas. The same animals that ignore human scent at the dumps are quickly alerted by it in the backcountry." "Tolerance of man while feeding on artificial food at the dumps is definitely linked with specific sites. It is not a general toleration of humans or human scent ...".

KEYWORDS: Behaviour/Human Presence/Ursus

109. Curatolo, J.A. 1975. Factors influencing local movements and
† behaviour of barren-ground caribou (Rangifer tarandus granti). M.S. Thesis, Univ. of Alaska, Fairbanks. 146 pp.

An investigation into how caribou movements are influenced by time, weather, insects, predators, group size, and group composition. Pages 75-76 discuss the influence of hunting in the passage of the Fortymile herd's crossing of the Taylor Highway in fall 1972. When the herd reached the highway it was met by hunters on foot and on snowmobiles. The caribou moved 30 miles south and tried to cross the highway along a ten-mile stretch of heavily wooded ridges. In total, 1400 animals were killed.

KEYWORDS: Movements/Hunting, Roads/Rangifer

109a. Dalton, L. B., J.A. Roberson, J. W. Bates. 1978. Capture myopathy
† in desert bighorns - a literature review and treatment. Trans. Desert Bighorn Couns. 22: 31-35.

A literature review illustrating the history, clinical signs, and pathological abnormalities of capture myopathy in bighorn sheep.

KEYWORDS: Pathology/Capture and Handling/Ovis

110. Dasmann, R.F. and R.D. Taber. 1956. Behaviour of Columbian black-tailed deer with reference to population ecology. J. Mammal. 37(2):243-164.

There was no evidence that hunting or other disturbances drove California black-tailed deer from their home ranges. Hunting seems to decrease mobility. Attempts to drive deer from their home ranges with dogs were unsuccessful. This may be a function of dense cover.

KEYWORDS: Movements, Distribution/Hunting, Chasing, Predators/ Odocoileus

111. Dauphiné, T.C., Jr. and R.L. McClure. 1974. Synchronous mating in
† Canadian barren-ground caribou. J. Wildl. Manage. 38(1):54-66.

Analysis of synchrony of reproduction in the Kaminuriak caribou herd. It is suggested that the increasing presence of human technology in areas inhabited by caribou could disrupt this synchrony with disastrous consequences.

KEYWORDS: Reproduction/Industry/Rangifer

112. Deane, N.N. and J.M. Feely. 1974. The development of a South African game ranch. Pages 882-887 in: V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management Vol. 2. IUCN Publ. New Ser., No. 24, Morges.

In game ranching, fear of man is an important limitation. Human predation increases flight distance. "It is essential, therefore, that hunting be compensated by constant harmless activity by day and night; be restricted to short, well-spaced periods, and be practised in the most innocuous manner possible."

KEYWORDS: Behaviour, Habituation/Hunting/Various Species

113. DeBock, E. and D. Surrendi. 1974. Some aspects of the ecology of the Porcupine Caribou herd. Prelim. Rpt. prep. for the Task Force on North. Oil Dev., Ottawa.

An earlier draft of Surrendi and DeBock (1976).

KEYWORDS: Behaviour/Aircraft, Roads, Ground Vehicles/Rangifer

114. DeForge, J.R. 1972. Man's invasion into the bighorn's habitat. † Trans. Desert Bighorn Counc. 16:112-116.

Increased use of a restricted road through bighorn range, caused abandonment of the area until well after the high level of disturbance had ceased,

KEYWORDS: Distribution/Human Presence, Civilization/Ovis

115. DeForge, J.R. 1976. Stress: Is it limiting bighorns? Trans. Desert Bighorn Counc. 20:30-31.

Bighorn sheep lack the capacity to colonize new ranges. When human disturbance leads to range abandonment in sheep, overcrowding occurs on the remainder of the range. This leads to stress and abnormal social relations. Bighorn habitat requirements include solitude.

KEYWORDS: Stress, Population Dynamics/Generalized Stimuli/ Ovis

116. DeLeonardis, S. 1970. Industrialization of the north and its effects on wildlife resources. Trans. Federal-Provincial Wildlife Conference. 34:46-49.

Among the potential problems to wildlife posed by exploitation of northern hydrocarbons is harassment and interruption of caribou movements. No one can accurately predict or assess the actual effects. It must be recognized that some loss of wildlife is not too high a price to pay for oil.

KEYWORDS: Disturbance/Industry/Rangifer

117. Denenberg, V.H. and K.M. Rosenberg. 1967. Nongenetic transmission of information. Nature 216:549-550.

Stress through handling of infant female rats results in that individual's offspring being deficient in weight and open field performance. Under certain conditions, this effect may even be visited upon the individual's grandpups. The nature of the underlying mechanism is unknown.

KEYWORDS: Behaviour, Physical Condition, Reproduction, Stress/Laboratory/Other Mammals

118. Denniston, R.H. 1956. Ecology, behaviour and population dynamics of the Wyoming or Rocky Mountain moose. Zoologica 41:105-118.

"One reason for the success of moose in the Rocky Mountain area may well be their ability to adapt to human influences." Moose abandoned an area in 1949 when U.S. Highway 287 was being constructed. Where moose are unused to humans, their flight distance is between 90 and 140 yards compared with 20 to 50 yards where they are habituated. Moose use plowed roads during winter. "... when the observer's efforts at a quiet stalking fail, they seem to disturb the moose more than much stronger, but less stealthy stimuli." Moose may be provoked into aggression or threats by humans, particularly in the winter.

KEYWORDS: Distribution, Disturbance/Roads, Human Presence/ Alces

119. Department of Public Works, Canada, and the U.S. Department of Transportation. 1977. Environmental impact statement: Shakwak Highway improvement; British Columbia and Yukon, Canada. DPW Proj. No. 010417 and FHWA Rpt. No. FHWA-BC/YT-EIS-77-01-D. Volume 2.

A discussion of probable wildlife impacts by the Shakwak Project. Includes discussions of impacts resulting from the creation of movement barriers and the noise and disturbance of construction. Depends entirely on literature review.

KEYWORDS: Disturbance/Roads/Various Species

120. de Vos, A. 1958. Summer observations on moose behaviour in † Ontario. J. Mammal. 39(1):128-139.

A paper dealing with the vocal and social behaviour of moose, their reaction to disturbance, their food habits, and their movements. "Although moose at times may leave the impression that they are not very alert, because they can be approached closely without visible alarm reactions, this is actually not true." Often moose will not show any alarm at all when initially disturbed. They will move slowly to cover, occasionally looking back and, once covered by brush, break into a run indicating the true level of alarm.

KEYWORDS: Behaviour/Human Presence/Alces

121. de Vos, A. 1960. Behaviour of barren-ground caribou on their calving grounds. J. Wildl. Manage. 24:250-258.

A study of the behaviour of cows and calves. Flushing distance varied greatly with environmental conditions and band size. Cows with calves were more alarmed than calfless individuals.

KEYWORDS: Disturbance/General Stimuli/Rangifer

122. Dixon, J.S. 1936. The status of the Sierra bighorn sheep. Proc. N.A. Wildl. Conf. 1:631-643.

Recreational camping is considered as limiting to bighorns in the Sierra Nevada mountains. Cited in Dunaway 1971.

KEYWORDS: Presence/Human Presence/Ovis

123. Dixon, J.S. 1938. Birds and mammals of Mount McKinley National Park, Alaska. U.S. Natl. Park Serv., Fauna Ser. No. 3, U.S. Govt. Print. Off., Wash., D.C. 236 pp.

The latter half of the book gives a species by species account of mammals found in the Mt. McKinley area. Moose grow accustomed to automobiles but are shy of people on foot. Moose may attack men when they feel themselves to be cornered. Caribou have weak sight but a very acute sense of smell; this is illustrated by several anecdotes. Cow caribou are more alert than bulls. The sense of smell in Dall sheep is not well developed but they are quick to see movement. Sheep tend to bunch together when disturbed. Thunder is very disturbing to them. Sheep are basically shy and timid but, at the same time, also curious and will occasionally approach unidentified objects. Older rams are less fearful and more independent than younger ones.

KEYWORDS: Behaviour/Human Presence/Alces, Rangifer, Ovis

124. Doan, K.H. 1970. Effects of snowmobiles on fish and wildlife resources. Pages 97 - 103 in Proc. 60th Internation Ass. Game, Fish and Conserv. Comm. Convention, N.Y.

"A general complaint against snowmobiles is that they have the capability to flush wintering animals and birds from limited and essential winter cover, and may contribute to overexposure of wildlife at a critical time of the year. The liability, if such is so, needs more research on the effect of casual and heavy vehicle use upon deer survival and reproduction." (p. 100).

KEYWORDS: Distribution/Ground Vehicles/Various Species

125. Doll, D., W.P. McCrory, and J.D. Feist. 1974. Observations of
† moose, wolf and grizzly bear in the northern Yukon Territory. Chapter III in: K.H. McCourt and L.P. Horstman (eds.), Studies of large mammal populations in northern Alaska, Yukon and Northwest Territories, 1973. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. No. 22.

The appendices contain remarks on reactions of moose, wolves and grizzly bears to aircraft. Includes reaction description and aircraft altitude.

KEYWORDS: Behaviour/Aircraft/Alces, Lupus, Ursus

126. Dorrance, M.J., P.J. Savage, and D.F. Huff. 1975. Effects of
* snowmobiles on white-tailed deer. J. Wildl. Manage. 39(3):563-569.

The effects of snowmobiles on home range size, movement and distance to the nearest trail of radio-collared white-tailed deer were studied at two areas in Minnesota. One area was hunted; the other was not. In the hunted population, home range size, movement and distance to the nearest trail increased with snowmobile activity. The only effect on the unhunted population was that deer moved away from trails during periods of peak activity. The authors hypothesize that hunted deer will never become as habituated to snowmobile traffic as unhunted ones.

KEYWORDS: Movement, Habituation, Distribution/Ground Vehicles, Hunting/Odocoileus

127. Douglas, M.J.W. 1971. Behavioural responses of red deer and
† chamois to cessation of hunting. N.Z.J. Sci. 14:507-518.

Eleven months after an intensive hunting campaign, red deer and chamois were very wary, stayed close to cover, and fed in the open mainly at night. Two years after the cessation of hunting, the animals were becoming less wary and began to revert to preferred habitats. This reversion process was still noticeable after six years.

KEYWORDS: Behaviour, Distribution/Hunting/Cervus, Other Mammals

128. Dunaway, D.J. 1970. Status of bighorn sheep populations and
† habitat studies on the Inyo National Forest. Trans. Desert Bighorn Counc. 14:127-146.

Preliminary analysis indicates that there may be a real relationship between increased human use of the Sierra Nevada and decrease in sheep populations. Of five herds defined in 1948, only two have not been subjected to huge increases in recreational use and these are now the most important bighorn ranges remaining in the Sierras. The increased popularity of backpacking has recently placed people in areas that were previously seldom visited.

KEYWORDS: Presence/Human Presence/Ovis

129. Dunaway, D.J. 1971. Human disturbance as a limiting factor of
† Sierra Nevada bighorn sheep. Trans. N. Amer. Wild Sheep Conf. 1:165-172.

It is doubtful whether poaching, competition, disease, or parasites are limiting to bighorns in the Sierra Nevada. The decrease in sheep numbers is correlated with the increase in recreational users. People once travelled by horse and were therefore restricted to good trails. Now people backpack and can intrude on alpine ranges. The evidence is considered to be circumstantial but adequate to warrant action.

KEYWORDS: Presence/Human Presence/Ovis

130. Eckstein, R.G. and O.J. Rongstad. 1973. Effects of snowmobiles on the movements of white-tailed deer in northern Wisonsin. Proc. Midwest Fish and Wildlife Conf. 35:39.

Not seen.

KEYWORDS: Movements/Ground Vehicles/Odocoileus

131. Elder, J.M. 1977. Human interactions with Sierra Nevada bighorn sheep: The Mount Baxter herd. M.S. Thesis, Univ. of Mich., Ann Arbor. 102 pp.

Not seen.

KEYWORDS: Disturbance/Human Presence/Ovis

132. Environmental Assessment Review Panel. 1977. Alaska Highway Pipeline: Report of the Environmental Assessment Panel. Dept. Fisheries and Environment, Ottawa. 55 pp.

An environmental assessment of the Alaska Highway Pipeline route. Pages 23-30 discuss effects on wildlife very briefly. The major effects are expected to be displacement during construction and continued disturbance to caribou, Dall sheep and raptors.

KEYWORDS: Disturbance, Distribution/Pipelines/Rangifer, Ovis

133. Ericson, C.A. 1972. Some preliminary observations on the acoustic † behaviour of semi-domestic reindeer (Rangifer tarandus tarandus) with emphasis on intraspecific communication and the mother-calf relationship. M.S. Thesis, Univ. of Alaska, Fairbanks. 121 pp.

A study of the overt acoustically related behaviour of confined reindeer during the calving season. Contains a section entitled "Response to environmental and interspecific acoustic stimuli". The reindeer were habituated to commonplace sounds such as shouting, motor noises and train whistles. They were habituated to the sounds of aircraft at altitudes of more than 100 m but overflights at 30 m caused nervousness and crowding. Helicopters were more disturbing than fixed-wing aircraft. When acoustic stimuli were reinforced by unfamiliar visual stimuli, more overt responses were produced. After four snowmobile arrivals and departures associated with chasing and capture for physiological tests, the reindeer began to show alarm to the sound of snowmobiles. Cows with calves were always the first to move away from a disturbance. They also moved farthest and remained alarmed the longest. The degree of response was inversely related to the age of the calf.

KEYWORDS: Habituation, Behaviour/Civilization, Aircraft, Capture and Handling, Ground Vehicles/Rangifer

134. Espmark, Y. 1964. Studies in dominance-subordination relationship in a group of semi-domestic reindeer. Anim. Behav. 12(4):420-426.

A castrated bull reindeer was found to be at the top of the dominance hierachy. Since no sex hormonal basis can be given for this, the author speculates that the advantage may have arisen as a result of the high degree of habituation to man shown by this individual.

KEYWORDS: Behaviour/Human Presence/Rangifer

135. Espmark, Y. 1970. Abnormal migratory behaviour in Swedish reindeer. * Arctic 23:199-200.

Starving reindeer were trucked 150-300 km to wintering ranges. Many did not return to traditional summer ranges. Disrupted migratory traditions may be partly or wholly lost.

KEYWORDS: Movements/Husbandry/Rangifer

136. Espmark, Y. 1971. Mother-young relationships and ontogeny of behaviour in reindeer (Rangifer tarandus L.) Z. Tierpsychol. 29:42-81.

Contains a section entitled "Reaction to Disturbances". After the birth of a calf, the mother becomes much more alert. While licking the calf, mothers are less alarmed than while not doing so. If disturbed while lying down, the mother immediately gets up, intensifies the contact with the calf, and grunts repeatedly. Primiparous mothers are particularly sensitive to disturbance. The reindeer studied were more responsive to the bark of unfamiliar dogs than to dogs kept at the station. "No matter what the disturbance, the interaction between the mother and her calf was the same. One of the first reactions of both animals involved was to make contact with the other. Mutual identification followed and suckling attempts were usually made by the calf." (p. 71).

KEYWORDS: Reproduction/Generalized Stimuli/Rangifer

137. Espmark, Y. 1972. Behaviour reactions of reindeer exposed to sonic booms. Deer: J. Brit. Deer Soc. 2(7):800-802.

Not seen.

KEYWORDS: Behaviour/Noise, Aircraft/Rangifer

138. Espmark, Y., L. Falt and B. Falt. 1974. Behavioural responses in cattle and sheep exposed to sonic booms and low altitude subsonic flight noise. Vet. Rec. 94:106-113.

Observations were made of the behavioural responses of sheep and cattle exposed to 28 sonic booms and 10 low-altitude subsonic flights over a period of four days. In both species, the responses were considered as within the range of reactions to disturbances from daily human activity. Although it was difficult to compare sheep and cattle, it seemed as if sheep were more responsive. Any thorough study must take adaptation to the sounds into account.

KEYWORDS: Behaviour, Habituation/Aircraft, Noise/Bos, Ovis

139. Falconer, I.R. 1976. Interrelationships between the thyroid gland and adrenal cortex during fear, cold and restraint in the sheep. Austr. J. Biol. Sci. 29:117-124.

An examination of the functional relationship between the adrenal and thyroid glands in stressed sheep. Stress was induced by pistol shots, barking dogs, cooling and wetting, and by restraint. Increased plasma cortisol concentration was observed as a response to all stresses but decreased with habituation. Only stress associated with cooling and wetting showed parallel activation of the adrenal cortex and the thyroid gland.

KEYWORDS: Physiology, Stress/Capture and Handling, Noise, Predators/Ovis

140. Falk, N.W., H.B. Graves, and E.D. Bellis. 1978. Highway right-of-way fences as deer deterrents. J. Wildl. Manage. 42(3):646-650.

Deer will crawl under fences with openings less than 23 cm high. It is suggested that high traffic volume itself is sufficient to keep deer from venturing onto highways.

KEYWORDS: Movements/Fences, Roads/Odocoileus

141. Faro, J. and S. Eide. 1974. Management of McNeil River State Game Sanctuary for nonconsumptive use of Alaska brown bears. Pages 113 - 118 in Proc. Fifty-fourth Ann. Conf. West Ass. State Game and Fish Comm., Albequerque, N.M., July 16 - 19, 1974.

Alaska brown bears modified the time and location of their fishing activities to reduce contact with photographers. Some fishing areas were abandoned completely. Cited in Tracy 1976.

KEYWORDS: Distribution, Behaviour/Human Presence/Ursus

142. Fedatov, U.S. 1972. Hoof-rot of the reindeer and the fight against it. (Summary transl. from Russian.) Pages 19 - 20 in Proceedings of Reindeer Symposium, Rovaniemi, Finland, May 1971. 212 pp. Transl. for Can. Wildl. Serv. by Translation Bureau, Secr. of State, Canada.

Hoof-rot is spread through disturbed, closely packed, restless animals which move about rather than eating or resting quietly. To prevent hoof-rot, "half-free" (i.e., semi-controlled) summer grazing is recommended. This ensures normal behaviour.

KEYWORDS: Pathology/Human Presence/Rangifer

143. Feist, J.D., W.P. McCrory, H.J. Russell. 1974. Distribution of
† Dall sheep in the Mount Goodenough area, Northwest Territories. Chapter II in: K.H. McCourt and L.P. Horstman (eds.), Studies of large mammal populations in northern Alaska, Yukon, and Northwest Territories, 1973. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. No. 22.

Appendix A contains remarks on the reactions to helicopters exhibited by four groups of Dall sheep seen in April 1973. All showed very strong reaction to the helicopter at elevations up to 1,500 feet and horizontal distances of one mile. In one case, the sheep ran for 1-1/2 miles.

KEYWORDS: Behaviour/Aircraft/Ovis

144. Ferris, C.R. 1977. Effects of Interstate 95 on songbirds and white-tailed deer in northern Maine. Ph.D. Thesis, Univ. of Maine, Orono. 48 pp.

A study of the effects of two and four-lane highways on distributions of birds and deer in Maine. Distribution and abundance of deer were estimated by pellet-group counts, winter track counts, and spotlight-counts. Deer used areas within 100 m of the highway less than areas farther away. Whether this was due to traffic disturbance or avoidance of the exposed edge is unknown. Deer fed on the right-of-way at night. Deer preferred to feed on vegetatively similar "waste areas" rather than on rights-of-way.

KEYWORDS: Distribution/Roads/Odocoileus

145. Fielder, D.E. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vo. 41:5341; The Soviets build pipelines with little concern for environmental matters yet damage seems to be minimal. Their main concern is not to interfere with caribou (sic) movements. In certain areas, they increased pipeline height to "something like" two meters instead of one so that caribou could pass underneath. Occasionally the line was buried so caribou could pass over it. A film was seen of reindeer passing under and over the pipeline.

KEYWORDS: Movements/Pipelines/Rangifer

146. Fischer, C.A., D.C. Thompson, R.L. Wooley and P.S. Thompson. 1977.
* Ecological studies of caribou on the Boothia Peninsula and in the District of Keewatin, N.W.T., 1976 with observations on the reaction of caribou and muskoxen to aircraft disturbance, 1974 - 1976. Renewable Resources Consulting Services Ltd., prep. for Polargas Environmental Programs.

A very careful aircraft harassment study with excellent statistics. Distances of aircraft from animals were combined into separate horizontal and vertical "distance cell" categories. Animal responses were classified as nil, moderate and strong based on several criteria. Fixed-wing aircraft of various types were used. For caribou, 2,866 data points were collected. Larger groups of caribou reacted more strongly than smaller ones, groups with calves reacted more strongly than groups without calves, caribou reacted more strongly in late winter than during the pre-calving, calving and post-calving periods, the proportion of strong response classes decreased as distance from the aircraft increased. The most important factor was distance of the aircraft. From 21 - 37% of caribou reacted strongly to flights above 122 m. A total of 334 observations were made on muskoxen. Small sample sizes in some distance cells made statistical analysis difficult. There were no statistical differences in proportion of strong reactions in various horizontal distance classes and prior activity exerted no influence on reaction.

KEYWORDS: Behaviour/Aircraft/Ovibos, Rangifer

147. Fletcher, J.L. and R.G. Busnel (eds.). 1978. Effects of noise on wildlife. Academic Pr., 320 pp.

Not seen.

KEYWORDS: Disturbance/Noise/Various Species

148. Foothills Oil Pipe Line Ltd. 1979. Volume 3, Part E - Environment. Application to the National Energy Board and the Dept. of Ind. Aff. and North. Dev. 397 pp.

Pages 291 - 292 discuss possible disturbances to mammals resulting from an oil pipeline. These include withdrawal from construction activity, strings of pipe causing barriers to movements, and aircraft and ground vehicle harassment. Page 316 suggests that elevated road profiles and pipeline berms can act as visual barriers to migrating ungulates.

KEYWORDS: Disturbance, Movements/Aircraft, Pipelines, Ground Vehicles/Various Species

149. Foothills Pipe Lines (South Yukon) Ltd. 1979. Environmental impact statement for the Alaska Highway Gas Pipeline Project, Calgary.

Section 6.7 deals with the biology, location, and abundance of major mammal species. Section 8.2.2 (Page 8 - 30 and ff.) deals with impact concerns related to wildlife. Dall sheep are characterized as being very susceptible to disturbance. Sheep could, in the worst possible case, be restricted by construction activity to one side or another of the Ibex Pass during the summers of 1982 and 1983. Dall sheep in Kluane National Park have accommodated to a high level of activity suggesting that range abandonment need not result from the pipeline. Direct evidence regarding the degree to which mountain caribou are susceptible to construction-related disturbance is not available. Impacts on caribou are expected to be minimal.

KEYWORDS: Disturbance/Pipelines/Ovis, Rangifer

150. Foothills Pipe Lines (South Yukon) Ltd. 1979. Overview summary of the environment impact statement for the Alaska Highway Gas Pipeline Project, Calgary. 256 pp.

A summary of the 1979 Foothills environmental impact statement designed to allow a quick overview of the argument. Pages 2 - 37 to 2 - 40 discuss concerns related to wildlife. Dall sheep are one cause of concern since they have been observed to react to simulated compressor noises at one mile and to aircraft at one km. In the worst possible case, the pipeline through the Ibex Pass could restrict sheep to one side of the River. Mountain caribou are also a concern since there is no information on their susceptibility to disturbance. Caribou are characterized only as being less susceptible to aircraft sounds than are Dall sheep.

KEYWORDS: Disturbance/Pipelines/Rangifer, Ovis

151. Foothills Pipe Lines (Yukon) Ltd. 1976. Public interest. Volume 5B-1: Environmental Statement. Application to the National Energy Board and the Dept. of Ind. Aff. and North. Dev. 537 pp.

Pages 228 - 240 describe the biology of those mammals found along the pipeline route. Habitat preservation is seen as the key to minimizing impact since animals will return to an area after disturbance only if their habitat is intact. Mountain sheep are viewed as the species most susceptible to disturbance.

Pages 451 - 471 deals with concerns about mammals and proposed measures to limit impacts. Sheep habituate to men on foot and vehicles after prolonged exposure. Their reaction to short-term construction activity has, however, not been documented. Construction activity would have minimal impact since it is scheduled for summer. Interference with summer movements in the Ibex Creek area is likely to be serious while the disturbance to sheep due to the compressor station at Haeckel Hill is an unknown factor. The effect of aircraft disturbance is discussed. Sheep are very sensitive to aircraft disturbance while moose are quite tolerant of it. Seven aspects of construction activity are identified as being disturbing to animals. These are (1) presence and activity of humans, (2) blasting, (3) presence of foreign objects, (4) machinery noise, (5) machinery smell, (6) motion of machinery, and (7) lights. Carnivores and ungulates are expected to withdraw from construction areas. The length of ditch left open during pipe-laying can adversely affect animal movements. Such permanent features as compressor stations, elevated roads and pipeline berms are all potentially disturbing. Grizzly bear dens are primarily in alpine areas and are unlikely to be disturbed.

KEYWORDS: Disturbance/Pipelines, Aircraft/Ovis, Rangifer, Ursus

152. Foothills Pipe Lines (Yukon) Ltd. 1979. The Dempster Lateral Gas Pipeline Project. Volume 4. Environmental impact statement. Applications for Certificates of Public Convenience and Necessity, Calgary. 631 pp.

Pages 523 - 558 deal with concerns about impact on wildlife species and means with which to mitigate this impact. Among the subjects treated are the pipeline as a barrier to movements, blasting, aircraft, ground vehicles, compressor stations noise and human presence. The literature review is extensive.

KEYWORDS: Disturbance, Movements, Population Dynamics, Distribution/Pipelines, Noise, Human Presence, Ground Vehicles, Aircraft/Ursus, Rangifer, Ovis, Alces, Lupus

153. Franzmann, A.W. 1972. Environmental sources of variation in † physiologic values of bighorn sheep. J. Wildl. Manage. 36:924-932.

Captive and wild bighorn sheep were tested for a spectrum of physiologic values. Excitability was the primary source of variability. It was found to significantly influence rectal temperature, blood glucose, blood cholesterol, hemoglobin, blood calcium, blood protein and packed cell volume of the blood. "The demonstrated effect of excitement on bighorn sheep physiology necessitates minimizing this effect as much as possible in management procedures."

KEYWORDS: Physiology/Generalized Stimuli/Ovis

154. Franzmann, A.W. and E.T. Thorne. 1970. Physiologic values in wild † bighorn sheep (Ovis canadensis canadensis) at capture, after handling and after captivity. J. Amer. Vet. Med. Assoc. 157: 647-650.

Various physiological measures were made on four bighorn sheep at capture (an immobilizing drug was used), after handling two days later and after two weeks of captivity. Rectal temperature and blood glucose content reflect short-term excitability and struggle. Increased values of serum cholesterol after handling can be ascribed to output of epinephrin and corticosteriods. High levels of serum glutamic oxalacetic transaminase (SGOT) is related to cell necrosis and "white muscle" myopathy.

KEYWORDS: Physiology/Capture and Handling/Ovis

155. Fraser, D., J.S.D. Ritchie, and A.F. Fraser. 1975. The term "stress" in a veterinary context. Br. Vet. J. 131:653-662.

The imprecise use of the term "stress" in a veterinary context has led to much confusion. The author gives a brief account of how the concept developed and how it has been applied to veterinary problems. Clarifying definitions are proposed. "Stress" should not be regarded as an explanatory term.

KEYWORDS: Stress/Generalized Stimuli/Various Species

156. Freddy, D.J. 1974. Status and management of the Selkirk caribou herd, 1973. M.S. Thesis, Univ. of Idaho, Moscow. 132 pp.

Not seen.

KEYWORDS: Movements/Roads/Rangifer

157. Freddy, D.J. 1977. Harassment investigations. Page 7 in: O.D. Cope (ed.), Colorado game research review: 1975-1976. Colo. Div. Wildl., State Publ. Code DOW-R-R-G75-76.

A 3-year study of harassment will commence in January 1977. Semi-tame mule deer will be instrumented with implanted heart-rate transmitters. The first year's work will monitor heart rates during normal activities while in a 4-ha pasture. Using published equations, energy expenditure will be calculated. Later, the deer will be harassed by a snowmobile.

KEYWORDS: Energetic, Physiology/Ground Vehicles/Odocoileus

158. Freddy, D.J., L. Carpenters, T. Spraker, L. Strong, P. Neil, B. McCloskey, J. Sweeting, L. Ward, and J. Cuporl. 1977. Snowmobile harassment of mule deer on cold winter ranges. Colo. Div. Wildl., Fed. Aid W-38-R-32, Work Plan 14, Job 10, Job Progr. Rpt., P. 89-104.

Two semi-tame, castrated mule-deer, aged 2-1/2 years, were equipped with implanted heart-rate monitoring transmitters. They were allowed to freely range in 10 acres of native pasture and were harassed by snowmobiles, people, and dogs in a prescribed manner. Several severe technical problems were encountered. Heart-rate may accelerate in response to harassment even when no overt behavioural change occurs.

KEYWORDS: Physiology, Behaviour/Ground Vehicles, Human Presence, Predators/Odocoileus

159. Freddy, D.J. and A.W. Erickson. 1975. Status of the Selkirk † mountain caribou. Pages 221-227 in: Trans. 1st Intl. Reindeer/Caribou Symp., Univ. of Alaska, Fairbanks.

Mountain caribou in southern British Columbia exhibit habitual movement routes between feeding areas which include crossings of the Trans Canada Highway.

KEYWORDS: Movements/Roads/Rangifer

160. Gaare, E., T. Skogland and B.R. Thomson. 1970. Wild reindeer food habits and behaviour. Report from the grazing project of the Norwegian IBP committee. Statens viltundersokelser, Trondheim. (English summary). 97 pp.

The energy cost to reindeer from a short, intensive hunting period was 10% of the annual energy budget. Cited in Roby 1978.

KEYWORDS: Energetics/Hunting/Rangifer

161. Gaare, E., B.R. Thomson and O. Kjos-Hanssen. 1975. Reindeer activity on Hardangerridda. Pages 206 - 215 in Fennoscandian tundra ecosystems. Springer-Verlag, Berlin.

The energetic effect of hunting on reindeer in Norway is to raise the total annual energy requirement by 8 - 9%. Cited in Thomson 1977.

KEYWORDS: Energetics/Hunting/Rangifer

162. Gartner, R.J.W., L.L. Callow, C.K. Grazien and P. Pepper. 1969. Variations in the concentration of blood constituents in relation to the handling of cattle. Res. Vet. Sci. 10:7-12.

Not seen.

KEYWORDS: Physiology/Capture and Handling/Bos

163. Gauthier-Pilters, H. 1974. The behaviour and ecology of camels in the Sahara, with special reference to nomadism and water management. Pages 542-551 in: V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management. IUCN Publ. New Ser. 24, Vol. 2, Morges.

Camels that have escaped from man remain in better physical condition than herded ones.

KEYWORDS: Physical Condition/Husbandry/Other Mammals

164. Gavin, A. 1972. 1971 wildlife survey, Prudhoe Bay area of Alaska. Report to Atlantic Richfield Company. 16 pp.

Not seen.

KEYWORDS: Disturbance/Industry/Rangifer, Various Species

165. Gavin, A. 1974. Wildlife of the North Slope: A five year study, 1969 - 1973. Atlantic Richfield Co. 61 pp.

A slick promotional book with beautiful photographs. Wind plays a large role in reactions to helicopters. Operation of a helicopter in a normal manner at an elevation of a "few hundred feet" causes little or no disturbance to wildlife.

KEYWORDS: Disturbance/Aircraft/Various Species

166. Gavin, A. 1978(?). Caribou migrations and patterns, Prudhoe Bay † region, Alaska's North Slope, 1969 - 1977. Prep. for Atlantic Richfield Co.

A review of caribou surveys done in the Prudhoe Bay region from 1969 - 1977. The reactions of caribou to the pipeline and associated facilities are mixed. Some are blase while others show suspicion and wariness. Single animals are more wary. During the fly season, caribou will move onto drilling pads, airfields and beneath buildings with no signs of apprehension. Within the oil field there has been no change in use made of the area. "The number of animals using the development zone during the calving period varies with the fluctuations in the overall populations of caribou utilizing the areas adjoining the field" (p. 56). During the insect season, hundreds and sometimes thousands of animals move through the field. So far there has been no disruption in the movements or well-being of caribou in the Prudhoe Bay region.

KEYWORDS: Movements, Distribution, Behaviour/Pipelines, Industry/Rangifer

167. Gavitt, J.D. 1973. Disturbance effects of free-running dogs on deer reproduction. M.S. Thesis, Virginia Poly. Inst., Blacksburg, Va. 53 pp.

Dogs were used to run white-tailed deer at the Dublin Arsenal of the Radford Army Ammunition plant during late April to early June of 1972 and late May to late October of 1972. As a control, one half of the study area was not subjected to chasing. Chases were usually less than 30 minutes in duration. The dogs switched trails and did not pursue single individuals for long. Deer returned to their home ranges within a few days. No significant difference was noted in number of fawns/doe surviving until late summer between dog-run deer and by those not subjected to chasing. Cited in Neil et al. 1975.

KEYWORDS: Distribution, Reproduction/Chasing, Predators/ Odocoileus

168. Geist, V. 1960. Feral goats in British Columbia. Murrelet 41(3):1-7.

Disturbance often elicits suckling behaviour in feral goat kids.

KEYWORDS: Behaviour/Generalized Stimuli/Other Mammals

169. Geist, V. 1963. On the behavior of North American moose (Alces alces andersoni, Peterson 1950) in: British Columbia. Behaviour 20(3-4):377-416.

When cow-calf groups are disturbed, calves seem indifferent. Yearlings also act surprisingly tame. The first reaction to disturbance in adults is the "attentive pose" which is illustrated. Sometimes they will urinate on their hocks. Invariably moose will stop to look before going out of sight. Moose do not run far; they usually stop to watch their back trail. Following a disturbance, moose often feed intensely. There is great individual variation in sensitivity to disturbance. One bull reacted to the sound of an axe at 500-600 yards while another did not mind a trail crew working 100 yards away. The sound of a power saw had no disturbing effect.

KEYWORDS: Behaviour/Generalized Stimuli, Noise, Human Presence/ Alces

170. Geist, V. 1970. Sheep management dilemmas. Pages 46 - 49 in Trans. North. Wild Sheep Counc.

Hunted rams will withdraw from their accustomed areas and occupy rugged, secluded terrain. They begin to act ecologically atypical and derive sustenance from inferior quality range. Psychic stress occurs resulting in physiological malfunction. Very little stress is required.

KEYWORDS: Stress, Distribution, Physiology/Hunting/ Ovis

171. Geist, V. 1971. A behavioural approach to the management of
* ungulates. In: Duffey, E. and A.S. Watt (eds.), The scientific movement of animal and plant communities for conservation. Brit. Ecol. Soc. Symp. 11:413-424.

The author believes the idea of "shy, wilderness species" to be a myth; animals can get along with man if allowed. "Free living ungulates can be expected to treat humans at first as any strange object, and thereafter adjust their response on the basis of the behaviour of humans. If hunted, stalked, or repeatedly frightened they will flee. This response is likely to continue for a long time even if all hunting stops ...". If rewarded, animals will seek out humans; if punished they will avoid humans. The author gives a conceptual model of a ruminant's "Umwelt" wherein the animal strives to maintain a predictable social and physical environment. It is able to generalize from one stimulus to classes of stimuli thereby reducing indecision in ambiguous or novel situations. "It (1) becomes excited if the unpleasant object or any evidence associated with it is sensed, and remains excited even after the object disappears; (2) avoids the locality where the disturbance was experienced, and (3) generalizes to all objects and localities and avoids them or becomes disturbed upon sensing them." Unpredictability causes neurosis, loss of weight, loss of appetite, malfunctioning of horn growth, susceptibility to predation, reduced reproduction, or death. Excitation increases the cost of living. Unfamiliar environments may cause pregnancy toxemia in domestic ewes. Disturbance may cause loss in body weight, increased susceptibility to disease, absorption of embryos, abortion, desertion or trampling of neonates, and fetal displacement and hence distocia. "The most damaging effect of frequent disturbance could be decreases in birth weight of the reindeer calves and hence their viability ...". Persistent disturbance may result in voluntary withdrawal from preferred habitat. Once certain species leave an area, it is very difficult for them to return.

KEYWORDS: Distribution, Reproduction, Physical Condition, Behaviour, Pathology/Generalized Stimuli, Hunting, Human Presence/Various Species

172. Geist, V. 1971. Bighorn sheep biology. Wildl. Soc. News. 136:61.

"Mammals learn to minimize encounters with humans if harassed enough, by reducing activity to areas, habitats and times of day where encounters with humans are minimal. That this can lead to a change in ecology, and decline in population size by habituating the animals to life in secondary habitat, has been shown for red deer in New Zealand. From work on the memory and learning mechanisms of mammals to which a whole branch of science, psychology, is dedicated, we know that it could not be otherwise. The worst combination of harassment is hunting combined with hiking, particularly camera-happy hiking, for the second reinforces what the first teaches - flight from humans. There is every reason to suspect that such a combination can be most damaging and finally fatal."

KEYWORDS: Disturbance, Distribution, Stress, Habituation/ Hunting, Human Presence, Generalized Stimuli/ Ovis

173. Geist, V. 1971. Is big game harassment harmful? Oil Week 22(17): 12-13.
*

An early and influential discussion of the deleterious effects of increasing the energetic cost of living in wildlife through harassment. The author calculates and compares the energy needs of stressed and unstressed animals. A caribou which runs for 10 minutes, walks for another hour, and remains excited for a further hour requires 21% more calories for maintenance. This means catabolizing 74 g of fat the synthesis of which requires the ingestion of 2 pounds of good forage.

KEYWORDS: Energetics/Generalized Stimuli/Rangifer, Various Species

174. Geist, V. 1971. Mountain sheep: a study in behaviour and evolution. Univ. of Chicago Pr., Chicago. 383 pp.

A primary source for information on mountain sheep behaviour and evolution. Hunting can lead to range abandonment. Sheep vision appears to be different than ours; they are better at spotting moving objects in obscure terrain but not so good at resolution. Sheep react to loud rumbles, such as rock falls or avalanches, but only run as far as necessary. In response to low-flying aircraft, Stone's sheep were seen to run into the cliffs. Mountain goats crouch against the rock in response to loud noises.

KEYWORDS: Behaviour, Distribution/Hunting, Aircraft/Ovis

175. Geist, V. 1975. Harassment of large mammals and birds. Exhibit * 359 entered before the Mackenzie Valley Pipeline Inquiry, Yellowknife, N.W.T. 62 pp.

A thoughtful discussion of the effects of disturbance on animals. Discusses the following three results of harassment: (a) elevation of the energetic cost of living, (b) illness, death, or reduced reproduction, and (c) avoidance of preferred areas. The causes of harassment are discussed from a somewhat theoretical standpoint. Disturbing stimuli are of three basic types: (a) those that are unpredicted or unfamiliar, (b) those based on "stimulus contrast," i.e., rapid movement, quick change, etc., and (c) those to which the animal innately responds. Animals react to harassment either by avoiding the stimulus, by habituating to it, or by exhausting themselves by maintaining a classical stress adaptation response. A large section of the paper is devoted to a critical, and generally unfavourable, review of the scientific acceptability of research done on harassment. The effects of roads on wildlife is summarized. Several recommendations, primarily for further research, are appended.

KEYWORDS: Stress, Habituation, Disturbance/Generalized Stimuli, Roads/Various Species

176. Geist, V. 1975. On the management of mountain sheep; theoretical considerations. Pages 77 - 105 in J.B. Trefethen (ed.), The wild sheep of modern North America. Boone and Crockett Club, The Winchester Pr., New York. 302 pp.

A discussion of the management implications raised by the biology of mountain sheep. Sheep are typical Ice Age mammals in having a highly developed social order and excellent learning abilities. They therefore readily alter their ecology in response to experience. Where protected from hunting, they exploit man-made habitats and food and readily accept people. When hunted however, they are easily pushed to extinction through confinement to safer but sub-optimal habitat. Sheep do not disperse readily and should be taught to accept better available ranges. Management of the same area for both hunting and nonconsumptive uses is not feasible. Such a combination leads inevitably to high levels of harassment. Sheep that are to be maintained for nonconsumptive uses must be habituated to human presence.

KEYWORDS: Habituation, Distribution, Movements/Generalized Stimuli/Ovis

177. Geist, V. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 53A:7410; Caribou could be susceptible to harassment when in a positive energy budget on their summer range.

Vol. 53A:7383; It would now be impossible to reconstitute a massive migration on the scale of the Fortymile herd's movements from 1920 - 1940.

Vol. 53A:7391; Mountain sheep can withstand large-scale disturbance. If there were no roads, impact would be less. Mountain sheep are resilient if there is no hunting. Regular overflights at altitudes of at least 1000 ft should not disturb sheep although irregular flights might stimulate anxiety.

Vol. 54:7419; Sheep have already been disturbed along the Fairbanks Corridor.

Vol. 57:7433; Mountain caribou have been disturbed along the Fairbanks Corridor - Alaska Highway.

KEYWORDS: Disturbance, Movements, Energetics/Aircraft, Civilization, Hunting, Generalized Stimuli/ Rangifer, Ovis

178. Geist, V. 1976. Letter to I. Scott, Q.C., dated May 25, 1976. Exhibit No. 836 entered before the Mackenzie Valley Pipeline Inquiry, Yellowknife.

A reply to Jakimchuk's (1976) rebuttal of Geist's (1975) original criticism of the disturbance studies done by Renewable Resources Consulting Services Ltd. Together with the two above-mentioned documents, this letter makes for interesting reading on the scientific adequacy of disturbance research.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

179. Geist, V. 1978. Behavior. Pages 283-296 in: J.L. Schmidt and † D.L. Gilbert (eds.), Big game of North America: Ecology and management. Wildlife Management Inst., Washington, D.C. and Stackpole Books, Harrisburg, Pa. 494 pp.

Deals with the question: "What should game managers know about animal behaviour in order to accomplish management objectives?" Contains an excellent discussion of harassment. Harassment of wildlife has three primary results it: (1) elevates metabolism (2) causes death, illness, or reduced reproduction through secondary effects (3) leads to abandonment of preferred habitat. There are three types of harassment stimuli: (1) unpredictable, unexpected or strange stimuli, (2) sudden changes in the animal's surroundings, (3) innately alarming stimuli. A priori prediction of what might constitute a harassing stimulus is impossible. Species differ in learning ability, innate responses and stimulus thresholds. Harassment can be precipitated by stimuli too subtle for understanding by an observer. Much of the conflicting descriptions of reactions to motor noises can be explained by learning theory. Most animals will habituate to humans and apparently noxious stimuli. Many of the harassment studies done are unimportant and cannot be generalized because previous experiences have not been taken into account.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

180. Geist, V. 1978. Life strategies, human evolution, environmental design: Toward a biological theory of health. Springer-Verlag, New York. 495 pp.

Pages 5-6 discuss the energetic costs of harassment and the results of stress. Energy is "... difficult to obtain, costly to store, and very easy to lose, and ... organisms must indeed conserve it as much as possible or not have a sufficient amount for reproduction."

KEYWORDS: Energetics/Generalized Disturbance/Various Species

181. Gericke, M.D. and J.M. Hofmeyer. 1976. Aetiology and treatment of capture stress and myopathy in springbok Antidorcas marsupialis. S. Afr. J. Sci. 72:28.

Captured springbok showed increases in rectal temperature, heart rate and respiration rate which were much higher than expected simply from exercise. There were also dramatic increases in plasma levels of glucose, creatine kinase, lactate dehydrogenase, and lactate with a reduction in blood pH.

KEYWORDS: Physiology/Capture and Handling/Other Mammals

182. Gilbert, P.F., D.F. Reed and T.M. Pojar. 1971. Migratory deer and Interstate 70 in western Colorado. Proc. 51st Annual Conf., West. Assoc. State Game and Fish Comm.

Discusses the wariness with which mule deer pass through highway underpasses.

KEYWORDS: Behaviour/Roads/Odocoileus

183. Glasrud, R.D. 1971. Personal communication to D.R. Klein cited in Klein (1973), p. 114.

"Even such temporary influences to the land as trails plowed in the snow in winter to assist in the movement of equipment or for seismic exploration have been known to disrupt the normal movements of caribou in Canada causing deflection of migrating herds 15 to 25 km from their normal routes."

KEYWORDS: Movements/Industry/Rangifer

184. Glenn, L.P. 1971. Report of 1970 brown bear studies. Proj. † Progr. Rpt., Fed. Aid in Wildl. Rest., Proj. W-17 -2, Vol XII, Alaska Dept. Fish and Game, Juneau.

The McNeil River Falls are fished by brown bears in mid-summer. In 1969, 45 man-days were spent in the area by photographers. In 1970, this increased to 174 man-days. In 1969, bears were present at all hours of the day; in 1970 they were concentrated in late afternoon and evening. It is suggested that increased human useage is causing an abandonment of the area by bears.

KEYWORDS: Distribution, Behaviour/Human Presence/Ursus

185. Goodwin, G.A. and A.L. Ward. 1976. Mule deer mortality on Interstate 80 in Wyoming: Causes, patterns and recommendations. USDA For. Serv. Res. Note RM-332. 4 pp.

Elk and mule deer readily adapt to traffic and related disturbances. Cited in Mutch 1977.

KEYWORDS: Behaviour, Habituation/Roads, Ground Vehicles/ Cervus, Odocoileus

186. Grace, E.S. 1976. Interactions between men and wolves at an arctic outpost on Ellesmere Island. Can. Field-Natur. 90:149-156.

Observations on wolf responses to human activity at a weather station on Ellesmere Island, N.W.T. Wolves frequently used the camp garbage dump and human activity had no significant effect on the timing of these visits.

KEYWORDS: Behaviour/Human Presence/Lupus

187. Graham, H. 1971. The impact of modern man. In L. Summer and G. Momson (eds.), The desert bighorn: Its life history, ecology and management. Desert Bighorn Counc., Las Vegas, Nev.

Cites N. Simmons stating that sheep become more nervous in the presence of aircraft. Repeated low-level flying causes sheep to become "spooky". Cited in Mackenzie 1976.

KEYWORDS: Behaviour/Aircraft/Ovis

188. Graham, N. McC. 1958. Energy metabolism studies with sheep. Ph.D. Thesis, Univ. of Glasgow.

Individual sheep untrained to a metabolic measurement apparatus had a fasting heat production 20% higher than the same individuals after 3 weeks of habituation. Cited in Blaxter, K.L. 1962. Brit. J. Nutr. 16:615.

KEYWORDS: Energetics, Habituation/Capture and Handling/ Ovis

189. Graham, N. McC. 1962. Measurement of the heat production of sheep: The influence of training and a tranquilizing drug. Proc. Aust. Sci. Anim. Prod. 4:138-144.

Sheep unaccustomed to confinement in a calorimetric apparatus have higher fasting metabolisms than animals trained by several months of experimental usage. In 5 months of training, the fasting heat production decreased by 18%.

KEYWORDS: Energetics, Habituation/Capture and Restraint/ Ovis

190. Gray, D.R. 1971. Winter research on the muskox (Ovibos moschatus wardi) on Bathurst Island, 1970-71. Arct. Circ. 21(3): 158-163.

Muskoxen on Bathurst Island were frightened very easily. The sound of plywood being sawn caused a stampede in a herd one mile away. Seismic blasts four miles from a herd caused no reaction, however. Muskoxen, often stand in a tight group when an aircraft is overhead but may run after the aircraft has departed. This may involve alternate running and walking for several miles.

KEYWORDS: Behaviour/Aircraft, Noise, Industry/Ovibos

191. Gray, D.R. 1972. Winter research on the muskox (Ovibos moschatus wardi) on Bathurst Island, 1970 - 1971. Can. Wildl. Serv. Rpt. 74 pp.

Many observations were made of muskox disturbance by human activity. A herd feeding one mile from the camp was stampeded several miles by the sound of plywood being sawn. Seismic blasts at 4 miles caused no noticeable response. Approaching a herd on foot or ski-doo caused them to gallop off in a tight group. Buzzing or circling by aircraft seems to be the most harmful disturbance. In many cases the herd ran causing the group to split and individuals to fall or flounder in deep snow. This may have a deleterious effect on old bulls, pregnant cows and animals in poor condition. Muskoxen often stampede after the aircraft has departed. This may involve alternate running and walking for several miles.

KEYWORDS: Behaviour/Human Presence, Noise, Aircraft, Industry/ Ovibos

192. Gray, D.R. 1974. The defense formation of the muskox. The Muskox 14:2529.

Muskoxen often react to aircraft by forming their typical defensive huddle. Numerous ground observations show that these herds often stampede from the area after the aircraft has passed. In early spring, this can lead to abandonment of young calves. It can also result in displacement from favoured range.

KEYWORDS: Behaviour, Distribution/Aircraft/Ovibos

193. Greg, D. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 23:2302-2303; The extension of the Skagway - Carcross road is driving away game animals.

KEYWORDS: Distribution/Roads/Various Species

194. Grise Fiord Community Council. 1973. Minutes of Grise Fiord Community Council Meeting with Panarctic Oils Ltd., March 19, 1973. 6 pp.

Stories from oil-men about muskoxen thriving around oil camps. Cited in Riewe 1973.

KEYWORDS: Distribution/Industry/Ovibos

195. Grubb, C.A., J.E. Van Zandt, and J.L. Bockholt. 1967. Report on data retrieval and analysis of USAF sonic boom claim files. Stanford Res. Inst. TR 4. Contract AF 49(638)-1696.

Reports of behavioural responses to sonic booms in mink, horses, cattle, sheep, and poultry. Cited in Espmark et al. 1974.

KEYWORDS: Behaviour/Noise, Aircraft/Various Species

196. Grubb, P. and P.A. Jewell. 1966. Social grouping and home range in feral Soay sheep. Symp. Zool. Soc. London. 18:179-210.

The Soay sheep are a particularly primitive form of domestic sheep which have persisted on the St. Kilda Islands off Scotland for centuries. Their adherence to home range is strong.. Attempts to capture them leads to their being chased far from their home ranges yet they return within hours.

KEYWORDS: Distribution/Chasing/Ovis

197. Gruell, G.E. and G. Roby. 1976. Elk habitat relationships before logging on Bridger-Teton National Forest, Wyoming. Pages 110-121 in: S.R. Heib (ed.), Proc. Elk-logging road Symp., Moscow, Idaho. 143 pp.

Report of an on-going study evaluating the influence of timber-cutting on an elk population. Although data have not been completely analyzed, they show that elk are not significantly influenced by 4-wheel drive trails when they are not used. During hunting season, when they are travelled frequently, they do have an effect on elk distribution.

KEYWORDS: Distribution/Roads, Ground Vehicles/Cervus

198. Gunn, A. and F.L. Miller. 1977. A preliminary bibliography of harassment of mammals especially cervids. Unpubl. Rpt., Prep. for Arctic Pipeline Program by Can. Wildl. Serv., Edmonton. 15 pp.

Presently being revised. Should be available from the Canadian Wildlife Service in autumn, 1979.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

199. Hamilton, D.R. 1974. Immunosuppressive effects of predator induced stress in mice with acquired immunity to Hymenolepsis nana. J. Psychosomat. Res. 18:143-153.

Mice were immunized with parasite eggs then given brief exposures to a cat. A challenge infection was then given. Predator stressed groups showed a high level of reinfection, high plasma corticosterone levels, increased adrenal weights and decreased body weight gains all in direct proportion to increasing predator exposure.

KEYWORDS: Pathology, Stress/Predators, Laboratory/Other Mammals

200. Hamilton, H. 1962. Kanon mot vilkskador. Svensk Jakt 100:304-305.

A carbide cannon producing loud "cracks" at certain intervals was "rather effective" in scaring moose away. Cited in a letter from G. Markgren to V. Geist included as an appendix to Geist 1975.

KEYWORDS: Behaviour/Noise/Alces

201. Hansen, C.G. 1970. Tongue color in desert bighorn. Desert † Bighorn Counc. Trans. 14:14-22.

In desert bighorns there are two distinct varieties. One has a pink tongue, wide, flaring horns, a deep chest and thin flanks. The other has a black tongue, tight horns and a blocky shape. Pink tongued animals stay together while black tongued ones move more independently. Black tongued sheep are relatively serene while pink tongued ones are very wary sometimes running from people at a distance of one mile. Only one of 17 hunter-killed rams was pink tongued.

KEYWORDS: Behaviour/Genetics, Hunting, Human Presence/Ovis

202. Hansen, C.G. 1971. Overpopulation as a factor in reducing desert bighorn populations. Trans. Desert Bighorn Counc. 15:46-52.

In many areas, bighorn populations are declining although habitat conditions appear favourable. Local range abandonment due to disturbance leads to overcrowding on certain areas. This leads to population reduction through a complex of factors.

KEYWORDS: Population Dynamics/Human Presence/Ovis

203. Harding, L.E. 1975. Our mountain caribou . . . . endangered species? B.C. Outdoors 31(2):24-31.

A discussion of the biology, status and conservation of mountain caribou in British Columbia. South of Fort Nelson, there is a population which annually migrates across the Alaska Highway where many are shot by hunters.

KEYWORDS: Movements/Roads, Hunting/Rangifer

204. Harding, L.E. 1976. Den-site characteristics of arctic coastal † grizzly bears (Ursus arctos L.) on Richards Island, Northwest Territories, Canada. Can. J. Zool. 54:1357-1363.

On Richards Island, N.W.T., coastal grizzly bears were observed to retreat into their dens in response to aircraft disturbance. Disturbance of denning areas by industrial developments can be expected to have severe consequences for the population.

KEYWORDS: Behaviour/Industry, Aircraft/Ursus

205. Harding, L.E. and J.A. Nagy. 1976. Responses of grizzly bears to * hydrocarbon exploration on Richards Island, Northwest Territories, Canada. Paper presented at Bear Symp., Kalispell, Mont.

The responses of grizzly bears to industrial disturbances on Richards Island, N.W.T. were noted. In 4 years of the study, 13-23 bears coexisted with industrial activity on the study area. Hydrocarbon related activities caused the abandonment of two dens. Bears almost never ventured within 1 km of camps. Only twice did bears persist in remaining near camps. Of 36 bear responses to fixed-wing aircraft, 22 (61%) were either running or hiding. Of 17 bears observed from helicopters, 15 (88%) responses were overt. Bears which had been previously captured were particularly sensitive. The authors feel that the cumulative impact of proposed hydrocarbon development facilities will be a reduction in the grizzly population to the point that continued existence will depend on immigration.

KEYWORDS: Population Dynamics, Behaviour, Distribution/ Industry, Aircraft/Ursus

206. Harper, F. 1955. The barren-ground caribou of the Keewatin. Univ. of Kansas, Allen Pr., Lawrence. 163 pp.

There is general agreement on the caribou's keen sense of smell, good hearing and less well-developed vision. The author suggests perhaps the latter is lack of perception or recognition rather than acuity. Gives a list of references on caribou senses. "The Barren-ground Caribou comes close to holding the palm for unwariness among larger land mammals of North America." "It is scarcely conceivable that it could survive, as the white-tailed deer does, in some of our most thickly settled areas." They are less wary in large aggregations. They pay no attention to airplanes at a height of 6,000 ft but become frightened at a height of 200 ft.

KEYWORDS: Behaviour/Aircraft/Rangifer

207. Harthoorn, A.M. and J.H.M. Van Zyl. 1972. Physiological aspects of forced exercise in wild ungulates with special reference to overstraining disease. Mamm. Res. Inst., 4th Ann. Meet., Pretoria. Mimeo.

Not seen.

KEYWORDS: Physiology/Chasing, Capture and Handling/Various Species

208. Heath, R. 1974. The environmental consequences of the off-road vehicle: With profiles of the industry and the enthusiast. Defenders of Wildlife and Friends of the Earth, Wash., D.C. 36 pp.

An excellent literature review on off-road vehicles and their environmental effects.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

209. Hebert, D. M. and I. McT. Cowan. 1971. White muscle disease in † the mountain goat. J. Wildl. Manage. 35(4):752-756.

Six of 11 trapped mountain goats developed paralytic symptoms in the hindquarters suggesting white muscle disease. In domestic animals the disease is known to accompany selenium deficiency. Local forage was shown to have selenium values known to accompany the pathology in livestock.

KEYWORDS: Pathology/Capture and Handling/Oreamnos

209a. Helvie, J. B. 1971. Bighorns and fences. Trans. Desert Bighorn + Counc. 15:53-62.

Testing of several fence types for attributes allowing free-passage of desert bighorns. Sheep will go under fences 20 inches above the ground. Sheep were never observed to jump over a fence.

KEYWORDS: Movements/Fences/Ovis

210. Hemstock, R.A. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 53:7067; As pipeline construction goes through, wildlife will move away some distance. Wildlife will abandon areas around compressor stations.

KEYWORDS: Distribution/Pipelines/Various Species

211. Hickie, P. 1937. Four deer produce 160 in six seasons. Michigan Conserv. 7(3):6-7, 11.

A description of the flight and panic behaviour of white-tailed deer during a census drive. Cited in Tester and Heegen, 1965.

KEYWORDS: Behaviour/Chasing/Odocoileus

212. Hicks, L.L. 1977. Human disturbance of the Mount Baxter herd of Sierra Nevada bighorn sheep. M.S. Thesis, Univ., of Michigan, Ann Arbor. 57 pp.

Not seen.

KEYWORDS: Distribution/Human Presence/Ovis

213. Hill, R.M. 1971. The arctic environment and petroleum pipelines. The Muskox 9:35-41.

Since caribou move long distances and the pipeline is unlikely to be above ground for long distances, caribou are unlikely to be adversely affected. "Caribou are generally aggressive and are not affected by passive industrial activity such as roads, buildings and oil rigs." (p.39). "There is little evidence that man-made barriers adversely affect caribou movements. However, as small piles of rock and trees are known to deflect caribou into hunting traps it is important that more be known on the effect of a pipeline on caribou." (p.41). Even where the pipeline is above ground, there will be natural depressions in creek valleys where the pipeline will be several feet above the ground and where caribou should be able to pass beneath.

KEYWORDS: Movements/Pipelines, Industry/Rangifer

214. Hinde, R.A. 1970. Behavioural habituation. Pages 3-40 in: G. Horn and R.A. Hinde (eds.), Short-term changes in neural activity and behaviour. Camb. Univ. Pr., Cambridge.

A useful discussion of the psychological concept of habituation and a review of the literature.

KEYWORDS: Habituation/Generalized Stimuli/Various Species

215. Hinman, R. 1974. The impact of oil development on wildlife populations in northern Alaska. Ann. Conf. W. Ass. St. Game and Fish Comm. 54:156-164.

A comment on observed and expected impact on wildlife of oil exploration and development in northern Alaska. Harassment may constitute a major impact but it is difficult to quantify. All hydocarbon related activities are heavily dependent on aircraft. Helicopters produce greater adverse effects in wildlife than do fixed-wing aircraft. The potential for the blocking of animal movements has received widespread attention. Leases contain a Technical Stipulation that "free passage and movement" of big game animals will be assured. Allowing this "free passage" is a complex issue and it is doubtful whether any facility can fully comply with the stipulation. Research shows that caribou tend to avoid pipelines. Movements of moose may be adversely affect particularly where pipelines cross valleys. Moose tend to parallel the 40 - 45 inch pipe of the Davidson Ditch near Fairbanks. Cows and calves are most affected. Some crossings do occur since the Ditch was completed in 1928 and ample time has elapsed for habituation to occur.

KEYWORDS: Movements, Behaviour/Pipelines, Aircraft/Alces, Rangifer

216. Hoffman, ?. n.d. No reference.

A report on the effects of snowmobiles and seismic activity on caribou. Mentioned in Monaghan (1976) but is apparently unavailable.

KEYWORDS: Disturbance/Industry, Ground Vehicles/Rangifer

217. Hood, R.E. and J.M. Inglis. 1974. Behavioural responses of white-
† tailed deer to intensive ranching operations. J. Wildl. Manage. 38(3):488-498.

Description of the effects on 9 radio-collared white-tailed deer of cattle round-ups in Texas. Round-ups were held every second or third week for a year. Bucks reacted by flight far away from the home range. Does usually took a circuitous escape route and returned within hours. The tendency to leave home ranges turned into a chronic pattern with excursions finally taking place with no round-up disturbance; something that had never happened prior to the initiation of round-ups. Bucks tended to increase their home range size. Bucks and does therefore respond to disturbance differently with does showing more home range fidelity. Southern deer seem more likely to remain in their home range under disturbance than northern deer. Deer seem to fear horses.

KEYWORDS: Distribution, Movements/Husbandry, Human Presence/ Odocoileus

218. Horejsi, B. 1975. Wildlife studies. Section III in: Baseline
† studies of the biology of streams and wildlife populations in the Sheep Creek drainage, Alberta. Aquatic Environments Ltd., Crossfield, Alberta.

A study of wildlife in the Sheep Creek area near Grand Cache, Alberta. Pages 16-22 describe the reactions of various species to a Bell 47G-81 helicopter. Bighorn sheep were the most sensitive species observed. Sheep were almost always already moving when first seen. They rarely allowed the helicopter to approach closer than 1/2 mile before running. Rams were less excitable than ewes and yearlings both of which often ran more than a mile and continued to run after they were apparently exhausted. The degree of reaction shown by caribou was dependent on elevation flown. Caribou approached the helicopter after it landed. Bull elk showed little reaction to the helicopter whereas cows and calves showed a greater flight distance. For all elk, the flight distance was greater when they were in the open. Mule deer were more disturbed than were elk. Mountain goats showed quick flight in response to helicopters. They chose the most rugged terrain available and remained there unless flushed out by additional passes. Moose were the least responsive of the ungulates. Bulls with antlers showed less fear than cows however there was no noticeable behavioural differences after the antlers were dropped. Wolves seemed reluctant to leave kills when approached by helicopter.

KEYWORDS: Behaviour/Aircraft/Ovis, Alces, Lupus, Odocoileus, Cervus, Rangifer

219. Horejsi, B.L. 1976. Some thoughts and observations on harassment
† and bighorn sheep. Pages 149-155 in: Northern Wild Sheep Conf., Jackson, Wyo.

Differentiates between "active" and "passive" harassment depending upon whether flight is precipitated. Disturbance is associated with certain stimuli and certain sites. Man is not inherently a disturbing influence but can become one primarily through hunting. The behavioural differences between hunted and unhunted populations is very striking. Ewes may pass their fear of man onto their offspring. Since sheep cannot differentiate hunters from more innocent men, sheep are becoming increasingly harassed by the influx of recreationists and development crews. Ewes in the Sheep River react more strongly to humans on their summer range than their winter one because on the summer range, humans are rare therefore disturbing and because hunting occurs there. Sheep will abandon their preferred range when harassed and move to areas where they are more susceptible to predation and less familiar with the area thereby imposing extra energy demands. Helicopters can be particularly disturbing to sheep. Suggests that in heavily used areas, hunting cannot continue as at present. Lambing and wintering areas should be specifically protected.

KEYWORDS: Behaviour, Distribution, Disturbance/Hunting, Human Presence, Aircraft/Ovis

220. Horejsi, B.L. 1979. Seismic operations and their impact on large
† mammals: Results of a monitoring program. Western Wildlife Environments, prep. for Mobil Oil Canada Ltd., Calgary. 86 pp.

A study on the impact of seismic operations on large mammal behaviour in the Copton Creek-Kakwa River area of Alberta. Wolves were found to use seismic lines extensively for travel. Moose used the lines less during the periods of seismic activity. During such activity, both moose and elk tended to cross the lines only in treed areas. Moose were less likely to be found within 1 km of the lines when there was activity on them. Vehicle activity within 250 m of moose in open terrain often causes them to leave the vicinity. Caribou avoid areas of human activity. It is suggested that these behavioural alterations impose a burden on ungulates.

KEYWORDS: Distribution, Movements/Industry, Ground Vehicles/ Alces, Rangifer, Cervus

221. Horejsi, B.L. 1979. Behavioural response of barren-ground caribou to a moving vehicle. Subm. to Can. J. Zool.

A study of the behavioural responses of caribou to a pick-up truck on the Dempster Highway. Multiple regression analysis was used to differentiate the factors affecting avoidance. Forty-eight percent of animals reacted to the vehicle by running away while another 38% trotted away. Duration of flight was almost twice as long for females as for males. The road itself was treated as a novel object and 29% of animals reversed directions or were involved in group disintegration. Flight distance did not vary between open and treed habitats or between sexes. Mean flight distances for males was 167 m and for females 144 m. The data suggest that fast-moving vehicles are particularly frightening to caribou. The results are discussed in terms of their evolutionary basis and adaptiveness.

KEYWORDS: Behaviour, Movements/Roads, Ground Vehicles/Rangifer

222. Houston, D.B. 1976. The northern Yellowstone elk, Parts III & IV, Vegetation and habitat relations. Yellowstone Natl. Park, Wyoming. 444 pp.

Avoidance of human activity by elk in Yellowstone Park decreased after control hunting was halted in 1969. Cited in Schultz & Bailey, 1978.

KEYWORDS: Behaviour/Hunting, Human Presence/Cervus

223. Howe, C. 1973. Environmental impacts of residential mountain development in Colorado. Ecol. Today 2:6-11, 29-31.

Not seen.

KEYWORDS: Distribution/Civilization/Various Species

224. Hubert, B. Personal communication cited in McCourt and Horstman (1974) p. 28.

Muskoxen residing near the airfield at Eureka, N.W.T. show little or no reaction to aircraft, while others in more isolated areas react stongly.

KEYWORDS: Behaviour, Habituation/Aircraft/Ovibos

225. Hudson, R.J. 1972. Stress and *in vitro* lymphocyte stimulation by † phytohemagglutinin in Rocky Mountain bighorn sheep. Can. J. Zool. 51:479-482.

Bighorn sheep are particularly susceptible to disease when brought into captivity. Lymphocyte stimulation by phytohemagglutin *in vitro* has been used as a correlate of immunologic reactivity. The lymphocyte response of bighorn sheep was tested at capture and during the first few months of captivity. Stress associated with capture, transport, and nutritional changes was accompanied by a depression in lymphocyte responsiveness.

KEYWORDS: Pathology, Physiology/Capture and Handling/Ovis

226. Hudson, R.J., H. Saben, and D.M. Emslic. 1974. Physiological and environmental influences on immunity. Vet. Bull. 44:119-128.

A literature review of the effects of psychological stress on disease resistance.

KEYWORDS: Pathology, Stress/Generalized Stimuli/Various Species

227. Hudson, R.J. and J.G. Stelfox. 1976. Bibliography of stress in † relation to management of wildlife ungulates in Wood Buffalo National Park. Pages 638-659 *in*: Bison research 1972-1976, 1976 Annual report. Can. Wildl. Serv. and Parks Canada, Edmonton.

A bibliography and brief literature review of stress in wildlife. An excellent source for physiologically oriented literature. Treats (a) neurophysiological and psychological pathways from stimulus to response, (b) behavioural manifestations of stress, and (c) physiological results of stress. Emphasis is on stress associated with capture.

KEYWORDS: Physiology, Pathology, Behaviour, Stress/Generalized Stimuli/Various Species

228. Huff, D.E. and P.J. Savage. 1972. A correlation of deer movements with snowmobile activity in Minnesota during winter. Proc. Midwest Fish. Wildl. Conf. 34:42.

Discusses the energetic consequences of snowmobile harassment. Cited in Hudson and Stelfox 1976.

KEYWORDS: Energetics, Movements/Ground Odocoileus

229. Huff, D.E., P.J. Savage, D.L. Urich and R.L. Watlov. 1972. Wildlife-snowmobile interaction project, preliminary report covering November 1971 - April 1972. Univ. of Minnesota and Minn. Dept. Nat. Resour., Minneapolis. 34 pp.

The first year results of a several faceted study of wildlife-snowmobile interactions. In one aspect of the study, white-tailed deer were radio-collared on an area protected from snowmobiles and on another area where snowmobile use was heavy. During the weekends, deer on the snowmobile-use area moved from jackpine dominated areas to a hardwood area where radiation measurements showed heat losses to be much greater. Concurrently with the decrease of snowmobile activity on Monday, deer returned to jackpine areas. Deer counts by snowmobile during the week yielded higher counts than on weekends. A questionnaire sent to 311 field personnel in state conservation agencies indicated that most professionals thought that white-tailed deer was the species most affected by snowmobiles. From 22 - 62% (depending on departmental affiliation) felt that the overall state-wide impact of snowmobiles on wildlife was detrimental. Track counts in Sherburne National Wildlife Refuge showed significantly fewer animals crossed snowmobile tracks as compared to snowshoe trails. Wild mammals tend to avoid snowmobile trails.

KEYWORDS: Energetics, Movements, Distribution/Ground Vehicles/Odocoileus

230. Hume, A. 1977. Dempster Highway: Disaster for wildlife. B.C. Outdoors 33(3):76-83.

A popular account of the effect of the Dempster Highway on the Porcupine caribou and the associated political problems. Quotes M. Hoefs as saying that the Porcupine herd could be reduced by 30 - 40% if they consistently refuse to cross the road and abandon ranges on the eastern side of the highway. There are some early indications that the highway has caused a shift in wintering areas to the west.

KEYWORDS: Movements, Population Dynamics/Hunting, Roads, Ground Vehicles/Rangifer

231. Humphrey, S.R. 1978. Status, winter habitat and management of the endangered Indiana bat, Myotis sodalis. Fla. Sci. 41(2):65-76.

The Indiana bat in Kentucky has decreased by 28% in 15 years. This is largely a result of disturbance by biologists and cavers. Winter disturbance causes arousal, flight and raised heat production with significant loss of fat reserves. Repeated disturbances throughout the winter compound the effect. In spring, emaciated bats disappear presumably dying during migration.

KEYWORDS: Energetics, Physical Condition, Population Dynamics/Generalized Stimuli/Other Mammals

232. Hyvarinen, H., T. Helle, M. Nieminen, P. Vayrynen and R. Vayrynen. † 1976. Some effects of handling reindeer during gatherings on the composition of their blood. Anim. Prod. 22:105-114.

Blood samples were taken from adult female reindeer and their calves at summer and autumn gatherings in N.E. Finland. Blood samples were also taken from less-disturbed animals during winter. Due to stress, there was elevation in blood glucose, blood lactate, serum GOT, serum CPK, and serum urea nitrogen.

KEYWORDS: Stress, Physiology/Generalized Stimuli/Rangifer

233. Interdisciplinary Systems, Ltd. 1977. The transmission of Prudhoe Bay gas to American markets: A preliminary environmental comparison of the Canadian Arctic Gas Pipeline and the Foothills (Yukon) pipeline in the Yukon and Northwest Territories. Alaska Highway Pipeline Panel, Winnipeg. 419 pp.

A comparison of the Mackenzie Valley and Alaska Highway pipeline routes in terms of the expected effects on the physical, biological and human environments. Concludes that the Alaska Highway route is preferable by an overall preference rating ratio of 1.4:1.0. In the section on "Mammals," existing literature is extensively reviewed and assessed on a species by species basis. Disturbance is a major concern.

KEYWORDS: Disturbance/Pipeline, Industry/Various Species

234. Interdisciplinary Systems Ltd. 1978. Effects of exploration and development in the Baker Lake area. 2 vols. Prep. for Dept. Ind. Aff. and North. Dev.

A study of renewable resource harvest in the Baker Lake area and the potential impacts of industrialization on harvested species. It also identifies areas deemed critical for maintenance of traditional resource harvest activities. Pages 157 - 161 present a literature review of human-caribou interactions and a discussion of data gaps.

KEYWORDS: Disturbance/Industry, Generalized Stimuli/Rangifer

235. Irwin, L.L. and J.M. Peck. 1978. Relationships of road closures and elk behaviour in northern Idaho. Symp. Elk Ecology and Management in the Jackson-Yellowstone Region.

Not seen.

KEYWORDS: Distribution/Roads, Ground Vehicles/Cervus

236. Jackson, S. 1905. Annual reports on introduction of domesticated reindeer into Alaska with maps and illustrations. Nos. 1-16. U.S. Office Education, Published as U.S. Congress (Senate) documents, Wash. D.C.

Chasing reindeer by dogs "... results in greater damage than the loss of the few the dogs kill outright ... My men tell me instances of deer running very hard when frightened ... and dropping dead. Others live for several weeks but die from the strain." Cited in Skoog 1968, pp. 563-564.

KEYWORDS: Mortality/Chasing, Predators/Rangifer

237. Jacobsen, N.K. 1979. Alarm bradycardia in white-tailed deer fawns † (Odocoileus virginianus). J. Mamm. 60(2):343-349.

Heart rates of five white-tailed deer fawns were radio-telemetered during prone behavioural responses ("freezing") to alarm stimuli. Decreases in heart rate averaged 38% and lasted from 5 - 111 seconds. Alarm bradycardia was most frequent during the first week of life. Heavier fawns are less likely to freeze and show bradycardia than are lighter fawns of the same age. Fawns became quickly habituated to some stimuli. The researcher could handle the fawns with no bradycardic response while strange humans caused lower heart rates.

KEYWORDS: Physiology/Generalized Stimuli/Odocoileus

238. Jakimchuk, R.D. 1975. Plenary session: Potential impact of accelerated northern development or caribou and reindeer populations and ecology. Canadian caribou and northern development. Pages 9-11 in: Trans. 1st Intl. Reindeer/ Caribou Symp., Univ. Alaska, Fairbanks.

Considers behavioural alteration to be the key issue in limiting the undesirable effects of northern development on caribou.

KEYWORDS: Behaviour/Industry/Various Species

239. Jakimchuk, R.D. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 89:13451-13457; The potential impact of the pipeline on caribou is described.

Vol. 89:13456-13491; Presentation of the paper "An analysis of the impact potential of the Arctic Gas Pipeline on the Porcupine Caribou herd."

No. 239 - Con't.
Jakimchuk, R.D. - 1975

Vol. 94:14282-14290; Minimum flight altitudes of 2000 feet would minimize mammal disturbance. The noise simulator experiments did not provide information on visual, scent or other disturbances.

Vol. 94:14244-14282; In studying the Porcupine caribou, more emphasis was placed on finding methods to avoid caribou rather than on specific response mechanisms. This is because it is so very hard to find cause-effect relationships in population dynamics.

Vol. 94:14300-14318; The compelling concern of turning back the caribou migration is the primary reason for preferring the coastal route.

Vol. 95:14360-14363; Dogs at camps would either attract or repel bears.

Vol. 95:14476-14495; Geist's conclusions based on reindeer are not necessarily transferable to caribou.

Vol. 96:14536-14547; There have been no disturbance studies on Delta muskoxen.

Vol. 96:14559-14571; The effect of the Dempster Highway in splitting the winter range of the Porcupine herd would be critical only if the caribou had nowhere else to go. Heavy use of the highway could lead to range abandonment.

Vol. 96:14575-14577, 14637-14644; The concerns that cleared rights-of-way will divert migrating caribou are unfounded. Studies are cited.

Vol. 97:14710-14715; Rebuttable of complaints expressed in Old Crow about Renewable Resources harassment of caribou during surveys.

Vol. 97:14720-14734; Pipeline construction should not impede moose movements between Wrigley and Fort Good Hope.

Vol. 97:14810-14821; For most mammals, a flight altitude of 300 feet is a threshold. A 1000 ft minimum is recommended but the EPB recommendation of 2000 ft is even better.

Vol. 98:14976-14984; Disagrees with Geist's position that habituation related studies should be undertaken.

No. 239 - Con't.
Jakimchuk, R.D. - 1975

Vol. 133:20147; Grizzly bears are more subject to harassment on the tundra.

Vol. 134:20215; The danger of bear harassment differs between rights-of-way and specific sites such as compressor stations.

KEYWORDS: Habituation, Disturbance, Movements, Distribution/Industry, Roads, Pipelines, Aircraft/Generalized Stimuli/Rangifer, Ovibos, Ursus, Alces

240. Jakimchuk, R.D., E.A. De Bock, H.J. Russell, and G.P. Semenchuk.
† 1974. A study of the Porcupine caribou herd, 1971. Chapter 1 in: R.D. Jakimchuk (ed.), The Porcupine herd - Canada. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Series Vol. 4.

Migrating caribou appeared to be indifferent to humans. Caribou reacted in varying degrees to aircraft. Helicopters elicited strong responses. Several instances are given. Caribou are more tolerant of fixed-wing aircraft and less reactive when snow and wind are restrictive to movement. Large herds react less than large ones. Roads and seismic lines are heavily used in spring migrations. Caribou are reluctant to leave roads or trails in deep snow situations. These are rarely left until their northern or western termination is reached.

The reactions of Dall sheep to aircraft disturbance are much more pronounced than those of caribou. Fixed-wing aircraft, even at high altitudes, elicit responses. Helicopters are particularly disturbing.

Moose do not respond strongly to aircraft. Cows with new calves will run if approached closely and all classes are more susceptible to aircraft disturbance during deep snow periods.

KEYWORDS: Movements, Behaviour/Roads, Aircraft/Rangifer, Ovis, Alces

241. Jakimchuk, R.D. 1976. Letter to J.J. Marshall dated April 6, 1976. Exhibit No. 555 entered before the Mackenzie Valley Pipeline Inquiry. Yellowknife.

A rebuttal to Geist's (1975) critique of the disturbance studies done by Renewable Resources Consulting Services Ltd. Together with Geist (1975 and 1976), this letter represents an interesting viewpoint on the adequacy of disturbance research.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

241a. Jenkins, W. L. and J. M. Kruger. 1975. Modern concepts of the † animals physiological response to stress. Pages 172 - 183 in E. Young (ed.), The capture and care of wild aminals. Ralph Curtis Books, Hollywood, Fla.

A very useful review of the pathogenesis and physiological response to somatic and psychological stressors in wildlife.

242. Johnson, A.S. 1972. Man, grizzly and national parks. Natl. Parks Conserv. Mag. 46(2):10-15.

The grizzly's sense of smell is phenomenal; sight and hearing play a supporting role. Historical records indicate that at the time of the white-man's coming, the grizzly had no real natural enemies and hence was unafraid of man. The Lewis and Clark Expedition shot many "charging" grizzlies which is perhaps suggestive of the bears' lack of fear in the pristine state.

KEYWORDS: Disturbance/Human Presence/Ursus

243. Johnson, D.R. 1976. Mountain caribou: Threats to survival in the † Kootenay Pass region, British Columbia. Northwest Science 50:97-101.

There are 25-30 mountain caribou in the Kootenay Pass region. Upgrading of Highway 3 has increased vehicle-caused mortality. Impedance of movement across the highway is greatest in winter when snow is steeply banked along the roadside. A utility corridor is becoming established in the area. The effects of these developments has not been assessed.

KEYWORDS: Movements/Roads/Rangifer

244. Johnson, D.R. and M.C. Todd. 1977. Summer use of a highway † crossing by mountain caribou. Can. Field-Nat. 91:312-314.

Using time-lapse photography, 11 mountain caribou crossings of B.C. Highway 3 were recorded. The authors conclude that the mountain caribou have become habituated to the highway and continue to use a traditional movement route across the road.

KEYWORDS: Habituation, Movements/Roads/Rangifer

245. Johnson, R.J. 1977. Distribution, abundance and management status of mountain goats in North America. Pages 1 - 7 in W. Samuel and W.G. MacGregor (eds.), Proc. First Int. Mountain Goat Symp., Kalispell, Montana. Spons. by N.W. Section Wildl. Soc., B.C. Fish and Wildl. Br. 243 pp.

Harassment due to logging and mining has tended to cause mountain goats throughout North America to move away from traditional ranges.

KEYWORDS: Distribution/Industry/Oreamnos

246. Johnsson, T., J.F. Lavender, E. Hultin, and A.F. Rasmussen, Jr. 1963. The influence of avoidance-learning stress on resistance to Coxsackie B virus in mice. J. Immunol. 91:569-575.

Coxsackie B virus infections were induced in mice subjected to avoidance-learning stress and in unstressed controls. Infected, stressed mice were more susceptible than infected, unstressed mice as manifested by weight loss and deaths.

KEYWORDS: Pathology, Stress/Laboratory/Other Mammals

247. Jones, F.F., R.F. Batchelor, H.R. Merriam and L.A. Viereck. 1963. † Sheep and goat investigations. Vol. III, Ann. Proj. Rev. Segm. Rpt., Fed. Aid in Wildl. Rest. Act, Project W-6-R-3, Work Plan E. 54 pp.

Pages 30 and 31 discuss wariness of Dall sheep and their reaction to noise. There is great individual variation in the wariness of individual Dall sheep which depends on past experience. On some occasions, ewes with lambs may be approached to within 150 feet. "Adult rams are more wary than are other age classes with the exception of ewes with lambs." All sheep are more wary when visibility is restricted. Sheep exhibit little fear of strange noises. High flying aircraft and tractor noises elicited no more than casual glances. Sounds of falling rock draw attention but no response unless danger is imminent. Sheep run hard from low-flying aircraft but it is suggested that this is not from the sound but from the novelty of a moving object.

KEYWORDS: Behaviour/Aircraft/Ovis

248. Jones, F.L. 1949. A survey of the Sierra Nevada mountain sheep. M.A. Thesis, Univ. of Calif. 154 pp.

Bighorn sheep of the Sierra Nevada are thought to require the solitude provided by the wilderness environment as part of their habitat needs. Cited in Dunaway 1971.

KEYWORDS: Presence/Civilization/Ovis

249. Jonkel, C. n.d. Personal communication cited in Kucera 1974, p. 86.

In a wooded area, a black bear remained in its den within 100 yards of a highway construction project.

KEYWORDS: Disturbance/Industry/Ursus

249a. Jorgensen, P. 1974. Vehicle use at a desert bighorn watering † area. Trans. Desert Bighorn Counc. 18: 18-24.

At an area in California where a dirt road crosses a bighorn sheep watering area, sheep use declined by about 56% on days with vehicle traffic. Yearlings were the most affected; rams the least.

KEYWORDS: Distribution/Human Presence, Ground Vehicles/Ovis

250. Kanwisher, J.W., T.C. Williams, J.M. Teal and K.O. Lawson, Jr. 1978. Radiotelemetry of heart rates from free-ranging gulls. Auk 95:288-293.

Herring gulls were fitted with long-range heart rate transmitters. "At one point we watched the bird sitting on a telephone pole 100 m away. A child moved toward the bird offering a bit of food. The bird watched, seemingly otherwise unconcerned, but its apprehension was signaled by a heart rate that accelerated from 160 to 440 beats/min and then returned to 200 as the child backed off."

KEYWORDS: Physiology/Human Presence/Birds

251. Karns, P.D. and V.F.J. Crichton. 1978. Effects of handling and † physical restraints on blood parameters in woodland caribou. J. Wildl. Manage. 42(4):904-908.

Caribou in northern Manitoba were driven into a lake and captured by boat. Blood samples were collected and analyzed. Significant stress effects occurred in 6 of 22 parameters. These were red blood cells, hematocrit, mean corposcular volume, glucose, phosphorus, and sodium. Serum glutamic-oxalacetic transaminose (SGOT) and several other parameters did not change significantly indicating a lack of trauma in the capture.

KEYWORDS: Physiology/Capture and Handling/Rangifer

252. Kelsall, J.P. 1957. Continued barren-ground caribou studies. Wildl. Manage. Bull., Ser. I, No. 12. Dept. North. Aff. and Nat. Res.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli/Rangifer

253. Kelsall, J.P. 1960. Co-operative studies of barren-ground caribou, 1957 - 1958. Wildl. Manage. Bull., Ser. 1, No. 15. 145 pp.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli/Rangifer

254. Kelsall, J.P. 1968. The migratory barren-ground caribou in Canada. Can. Wildl. Serv. Monogr. No. 3, Queen's Printer, Ottawa.

A broad description of the biology of the barren-ground caribou. The senses of sight, smell, and hearing do not warn caribou when they are in massed groups. Senses are dulled during fly season. Aircraft noises stimulate alarm only at close distances. Flight is rarely triggered by the sense of hearing alone. Caribou have little sensitivity to visual colour or form but are very observant of movement.

KEYWORDS: Disturbance/Aircraft, Generalized Stimuli/Rangifer

255. Kevan, P.G. 1970. The caribou of the northern Yukon Territory: A history of man's interest in them with special reference to wildlife biology. Can. Wildl. Serv. Rpt. 47 pp.

Primarily a tabular presentation of reports done on the biology of caribou in the Yukon. A report by K. Lang dating from 1952 is quoted in its entirety. This report deals with the history of man's interaction with Yukon caribou. In the latter half of the 19th century, white whalers slaughtered prodigious numbers of caribou in the Mackenzie Delta. By about 1890, the caribou had abandoned their range east of the Mackenzie and Indians had to travel 30 - 40 miles west of the river before reaching caribou country. Caribou were apparently driven south and west. After the collapse of the whaling industry, caribou slowly reinvaded the area but it was not until 1926 that caribou were seen near the Delta.

KEYWORDS: Distribution/Hunting/Rangifer

256. Kiger, J.H. 1970. Helicopter observations of bighorn sheep on the San Andres National Wildlife Refuge. Trans. Desert Bighorn Counc. 14:23-27.

Sheep were disturbed by helicopters within a few hundred yards. They were usually on the run when first sighted. They appeared generally less frightened when approached in the midst of escape terrain. None were observed to fall in flight and there was no evidence of detrimental effects.

KEYWORDS: Behaviour/Aircraft/Ovis

257. Kiley, M. 1974. Behavioural problems of some captive and domestic ungulates. Pages 603-617 in: V. Geist and F. Walther (eds.), The behaviour of ungulates and its relation to management. IUCN Publ. New Series No. 24, Vol. 2, Morges.

Herding domestic animals decreases time spent grazing, increases resting time, reduces selectivity, reduces forage intake; and may increase intake of poisonous plants.

KEYWORDS: Behaviour/Husbandry/Various Species

258. Kilgour, R. and DeLarge, H. 1970. Stress in sheep resulting from management practices. Proc. N.Z. Soc. Anim. Prod. 30:65-76.

Not seen.

KEYWORDS: Disturbance/Husbandry/Ovis

259. Klein, D.R. 1970. Nutritive quality of Alaskan range forage and associated growth and welfare of reindeer and caribou. Proj. Compl. Rpt., Alaska Coop. Wildl. Unit, Fairbanks. 29 pp.

Herding of reindeer is low intensity harassment resulting in reduced individual spacing and increased forage competition. Herded reindeer exhibit lower rates of fattening and growth relative to free-living ones. Cited in Roby 1978.

KEYWORDS: Behaviour, Physical Condition/Husbandry/Rangifer

260. Klein, R.D. 1971. Reaction of reindeer to obstructions and disturbances. Science 173:393-398.

A review of reindeer reactions to obstructions and disturbance in Scandinavia viewed as a means of anticipating caribou responses to northern development in the U.S. and Canada. Highways and railroads in Scandinavia have not dramatically interfered with the free movement of reindeer; with several exceptions. In the Dorre-Fjell area south of Trondheim, a highway and railroad bisected a major reindeer range. After construction, reindeer showed increasingly greater reluctance to cross the tracks as rail traffic gradually increased over several years. Finally, they ceased to cross altogether. The population, which was now limited in its distribution, overgrazed the range badly. When animals are in poor physical condition, traditional migrations and seasonal ranges may be abandoned. The reindeer seem habituated to automobile traffic. Railroads and highways kill many reindeer each year. Hydroelectric reservoirs disrupt reindeer movements. Bridges have been used to allow reindeer to cross streams but location is critical; fences are ineffective in leading the animals to the bridges. Herders maintain that reindeer fear power lines and are afraid to go under them. The "hum" of these lines is apparently disturbing. Reindeer are attracted by the sound of chain saws to areas where felled trees provide highly available arboreal lichens. Fences are effective in controlling reindeer movements only when they are built with a clear understanding of the relation between terrain features and reindeer behaviour and movements. Reindeer refuse to be forced into dense herds in unfamiliar terrain. Reindeer fences often disrupt traditional moose movements. Snowmobiles are being used increasingly in reindeer herding. It is recognized that careless use of snowmobiles during the calving period can result in losses of females and calves.

KEYWORDS: Disturbance, Distribution, Movements, Behaviour, Reproduction/Roads, Ground Vehicles, Railways, Industry, Fences/Rangifer

261. Klein, D.R. 1972. Problems in conservation of mammals in the north. Biol. Conserv. 4(2):97-101.

A discussion of the effects of oil development, tourism, and expanding human populations on northern mammals. Harassment by aircraft is perhaps the most widespread disturbance. Helicopters are more disturbing than fixed-wing aircraft because of their low-level flight and rotor sounds. Rare species are in particular jeopardy because these are the animals people want to see which results in repeated attempts at photography and close observation. Snowmobiles allow increased hunter mobility and create disturbing noises both of which place more pressures on animal populations. The obstruction of caribou movement by oil and gas pipelines is a real problem; in Scandinavia traditional movements of reindeer have been disrupted by railroads and highways.

KEYWORDS: Disturbance, Movements/Pipelines, Aircraft, Ground Vehicles/Rangifer, Various Species

262. Klein, D.R. 1973. Reaction of wildlife to aircraft disturbance. Quart. Rpt. Alaska Coop. Wildl. Unit 25(1):18-23.

Identical in essence to Klein (1974).

KEYWORDS: Behaviour/Aircraft/Rangifer, Lupus, Alces, Ursus

263. Klein, D.R. 1973. The impact of oil development in the northern environment. Pages 109 - 121 in Proc. 3rd Interpetrol. Congr., Rome.

The author's abstract: "The ecological and environmental affects (sic) of oil exploration and development in the Arctic and Subarctic are discussed in relation to wildlife and the land. Specific examples of detrimental practices such as harassment of wildlife by aircraft, interruption of migratory movements of animals and destruction of wildlife habitat are discussed. Some methods of minimizing detrimental effects are mentioned. Special attention is given to these wildlife species most vulnerable to disturbances and to the ecological problems unique to oil development in northern regions."

KEYWORDS: Disturbance, Movements/Industry, Aircraft/Various Species

264. Klein, D.R. 1974. The reactions of some northern mammals to
* aircraft disturbances. Pages 377-383 in: Proc. XIth Intl. Cong. Game Biol., Stockholm, Sweden.

Aircraft passing directly overhead produce greater reactions than ones passing to one side. A general consensus exists that helicopters are more disturbing than fixed-wing aircraft. A table of decibel ratings for common aircraft is included. Caribou are particularly insensitive to aircraft in the spring and during the period of insect harassment. There exists a direct correlation between reaction intensity and altitude of overflight. There is rarely any panic elicited by an aircraft over 500 ft. Single caribou and small groups are less alarmed. Caribou cow-calf groups are more sensitive than bulls. Moose are less sensitive to aircraft than are caribou. Again, cows with calves show the most alarm. Grizzlies react very strongly to aircraft while wolves exhibit little alarm.

KEYWORDS: Behaviour/Aircraft/Rangifer, Lupus, Alces, Ursus

265. Klein, D.R. 1975. Opening remarks. Plenary session: Potential impact of accelerated northern development on caribou and reindeer populations and ecology. Remarks of the chairman. Pages 3-4 in: Proc. 1st Intl. Reindeer/Caribou Symp., Univ. Alaska, Fairbanks.

Mention of surface gas pipeline on the Taimyr Peninsula of north-central Siberia resulting in the obstruction of wild reindeer migration.

KEYWORDS: Movements/Pipelines/Rangifer

266. Klein, D.R. 1978. Personal communication cited in Roby 1978, p.7.

"An above-ground gas pipeline constructed in the Taimyr region of the Soviet Arctic in 1969 diverted many wild reindeer from traditional fall migration routes, resulting in large areas of unutilized winter range."

KEYWORDS: Movements/Pipelines/Rangifer

266a. Klein, D. R. 1979. Reaction of caribou and reindeer to obstructions * - a reassessment. Paper presented at the Second Intern. Reindeer/Caribou Symp., Røros, Norway. September 17-21, 1979.

An update of Klein, 1971. Contains many references to the Soviet situation. Man-made linear facilities can delay or deflect caribou movements but the level of the effect is dependent upon the mode of construction, the alteration of existing terrain, and the visual impact. Elevated structures and ditches are obstables. Linear facilities which either are visible for long distance on the tundra or are sharp, unexpected breaks in habitat type, such as forest roads, cause alarm. Strange substrates, such as road surfaces, may be partially associated with predator avoidance. The level and type of traffic or activity on roads and railways influences caribou behaviour. Caribou adapt more readily to infrequent, regularly spaced traffic patterns. Caribou react differentially in relation to seasonality. In spring and summer, cows with calves react more strongly to obstructions than in winter. During summer, caribou are strongly motivated by insect relief and seem less responsive to other disturbances. During migration, movements are less easily influenced than at other times. Adult bulls are more readily adaptable to man-made features. Larger groups are more easily deflected by obstructions. Caribou will habitate better to a man-made obstacle if they are resident in the area rather than being present only seasonally. Variations in response to obstacles exist between Rangifer races.

KEYWORDS: Behaviour, Movement/Pipelines, Roads, Railways, Ground Vehicles/Rangifer

267. Kregosky, B. 1972. 1971 Great Divide Trail impact study. Vol. I. Unpubl. report submitted to Canadian Wildl. Serv., Edmonton. 215 pp.

Pages 110 - 112 deal with the expected effect of the Great Divide Trail on wildlife. As hiker traffic increases, animal-man encounters increase leading to withdrawal of the animal from the area. Shy animals like grizzly bears, mountain goats and wolverine, are most affected. "Most areas which receive heavy traffic use soon become devoid of animal life." Trails provide access to hikers who subsequently leave the trail thereby causing increased disturbance of animals inhabiting areas removed from the trail. Heavy use of trails during migration might disrupt seasonal movement of moose, deer and elk.

KEYWORDS: Distribution, Movements/Human Presence/Ursus, Oreamnos, Various Species

268. Krott, P. and G. Krott. 1963. Zum verhalten des Braunbären (Ursus arctos L. 1758) in den Alpen. (in German, English summary). Z. f. Tierpsychol. 20(2):160-206.

A study of semi-tame young bears in the mountains of the Italian province of Trento. The English summary includes the following statement: "Bears apparently cannot learn to recognize specific sources of danger. Hunger generally overcomes fear, but when not hungry the bear in (sic) extremely timid and fearful and reacts sensitively to unspecific danger situations. The constant readiness to flee is probably internally determined as well, and may be connected with the fact the bears often get into motivational conflicts." (p. 205).

KEYWORDS: Behaviour/Generalized Stimuli/Ursus

269. Kucera, E. 1973. Caribou east of the Mackenzie River, 1972. Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Interim Rpt. No. 3, Appendix I, Env. Protection Board, Winnipeg.

"Aircraft flying below 200 feet almost invariably elicit panic responses in caribou while reindeer are usually much less disturbed." (p.4).

KEYWORDS: Behaviour/Aircraft/Rangifer

270. Kucera, E. 1974. Potential effects of the Canadian Arctic gas pipeline project on the mammals of the western Arctic. Pages 69-100 in: Environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta, Vol. 4, Research Reports. Environmental Protection Board, Manitoba. 307 pp.

For 11 "key species" along the pipeline route, the author presents biological background information, potential effects of the pipeline, and recommends mitigative measures. Wolves can habituate to aircraft but if hunted are extremely sensitive. Low-flying aircraft can herd wolves and chase them to exhaustion resulting in death. The responses of grizzly bears is variable based on previous experience of the individual. Continuous harassment is expected to cause stress which would interfere with feeding and breeding. Bears may overheat in summer if continually "buzzed." Strong flight reactions to a Cessna 185 were seen at altitudes over 1000 ft. Bears often show little sensitivity to disturbance around the den. Moose are very tolerant of human activities and less responsive to aircraft than are caribou. Muskoxen often flee in response to aircraft rather than form defensive circles. Flight distances are roughly the same as those of caribou. Muskoxen that stand their ground when being overflown often run when the aircraft has departed. Dall sheep are frightened by aircraft but not sound simulators. Disturbance may cause range abandonment.

KEYWORDS: Disturbance, Habituation, Distribution, Behaviour/ Aircraft, Generalized Stimuli, Industry, Noise/ Ovis, Rangifer, Ursus, Ovibos, Lupus

271. Lavigne, G.R. 1973. Use of snowmobiles for altering deer yarding and mobility. Univ. Maine Coop. Wildl. Res. Unit, Quart. Rpt. Jan.-Mar., 1973:4-5.

Not seen.

KEYWORDS: Movements, Distribution, Behaviour/Ground Vehicles/ Odocoileus

272. Law, C.E., E.R. Corneil, R.W. Lake, H.O. Helmers, J.A. MacDonald, J.R. Baldwin, R.A. Rice, J.L. Charles, R.E. Olley, F.E.F. Dunford, N.A.M. Makay, E.S. Roszner, and C.N. Kerr. 1972. Railway to the Arctic: A study of the operational and economic feasibility of a railway to more Arctic Slope oil to market. Can. Inst. Guided Ground Transp., Queen's Univ., Kingston, Ontario.

An economic and technical feasibility study for a railroad from the Arctic Slope to the South for the purpose of oil transport. Caribou are not expected to be attracted to the rail line as in Scandinavia because snow is not as deep as in northern Europe and is harder packed. Were the rail line to cross major migration routes, it might cause serious alterations in the migration patterns. About 20 trains per day would travel the route in both directions. This would constitute a disturbance and would cause mortality in young and weakened animals. Moose treat diesel air horns as a threat.

KEYWORDS: Movements, Disturbance, Mortality/Railways/Alces, Rangifer

273. Laycock, R. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. C-21:2146; Caribou would cross the pipeline.

KEYWORDS: Movements/Pipelines/Rangifer

274. Leedy, D.L. 1975. Highway-wildlife relationships. Volume I: A state-of-the-art report. FHWA-RD-76-4, U.S. Dept. Transport, National Inf. Serv., Springfield, Va. 183 pp.

First of a two-volume work assessing, through an extensive literature review, what is known about highway-wildlife relationships.

KEYWORDS: Disturbance/Roads, Ground Vehicles/Various Species

275. Leedy, D.L., T.M. Franklin and E.C. Hekimian. 1975. Highway-wildlife relationships Volume 2: An annotated bibliography. Report No. FHWA-RD-76-5, U.S. Dept. Transport, Nat. Tech. Inf. Serv., Springfield, Va. 417 pp.

Second of a two volume work prepared by the Urban Wildlife Research Center, Inc. for the U.S. Department of Transport. "The primary purpose of the project was to assess what is known about the effects of highways, their construction, maintenance, and operation on fish, wildlife and their habitat." Contains 794 abstracted references.

KEYWORDS: Disturbance/Roads, Ground Vehicles/Various Species

276. Leege, T.A. 1976. Relationship of logging to decline of Pete King † elk herd. Pages 6-10 in: S.R. Hieb (ed.), Proc. Elk-logging-roads Symp., Moscow, Idaho. 143 pp.

Logging began in the Pete King Creek drainage in 1957. Since then there has been a negative correlation between winter elk counts and percentage of summer range logged although carrying capacity is adequate. Hunter harvest in the roaded areas continues to decrease in relation to that of the unroaded areas. Something other than hunter kill is, however, responsible for the population decline.

KEYWORDS: Population Dynamics/Roads, Ground Vehicles, Hunting, Industry/Cervus

277. Lehman, A.G. and R.G. Busnel. 1963. A study of audiogenic seizure, Pages 244-274 in: R.G. Busnel (ed.), Acoustic behaviour of animals. Elsevier, Amsterdam.

Audiogenic seizure is a disturbance in behaviour consisting of a set of psychomotor reactions (very much like epilepsy) which may be induced by acoustic stimulus of high intensity. It is most common in rodents but also seen in several domestic animals including the goat. A bibliography of some 400 references is included.

KEYWORDS: Pathology/Noise/Various Species

278. Lehmann, G. 1964. Man and noise. Chapter 65 in: D.B. Dill (ed.), Handbook of physiology; Section 4: Adaptation to the environment. Am. Phys. Soc., Washington, D.C. 1056 pp.

Differentiates between conscious reactions to noise and unconscious or "primary vegetative reactions." In man, the latter include contraction of blood vessels, change in glandular activity and dilation of the pupil. Intensity of reaction is dependent on sound level, band width, and frequency. Whether the individual is used to the noise makes no difference. Noises of 50-60 db during sleep produces the same reactions as one of 80-90 db during a wakeful state. Conscious perception of noise results in increase in muscle tonus. There is no physiological adaptation to loud, disturbing noise; only psychic habituation.

KEYWORDS: Physiology/Noise/Homo

279. Lemke, T.O. 1975. Movement and seasonal ranges of the Burdette Creek elk herd and an investigation of sport hunting. M.S. Thesis, Univ. of Montana, Missoula. 127 pp.

Elk movement and seasonal home range were determined from 10 elk with radio-transmitters. Hunting activity triggered unusual movements of up to six miles and increased use of dense timber. Cited in Allen et al. 1976.

KEYWORDS: Distribution, Movements/Hunting/Cervus

280. Lenarz, M. 1974. The reaction of Dall sheep to an FH-1100 helicopter. In R.D. Jakimchuk (ed.), The reaction of some mammals to aircraft and compressor station noise disturbance. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Series Vol. 23.

A study of the effects of an FH-1100 helicopter on Dall sheep behaviour during April and August 1973. The aircraft was flown past 691 sheep on 154 occasions at distances of 300-500 diagonal feet. Three reaction classes are defined. Thirty-six percent of groups showed a strong reaction, 49% a moderate one, and 15% exhibited no reaction. Response was independent of aircraft location relative to the sheep (above, same level, below). "Ewe categories" react more strongly than rams. There was no difference in response between April and August. There was no group size effect on reaction. Sheep in this area have been subjected to heavy air traffic for about 2 years.

KEYWORDS: Behaviour/Aircraft/Ovis

281. Lent, P.C. 1964. Calving and related social behaviour in the * barren-ground caribou. Ph.D. Thesis, Univ. of Alaska, Fairbanks. 220 pp.

The number of variables affecting caribou flight is great and much of the variability observed in caribou alarm reactions cannot be explained. The most common reaction to fear is the "alarm pose" described by Pruitt (1960). The "excitation leap" leaves a substance from the pedal grind on the ground which elicits a response in other caribou crossing that spot. The flight distance of caribou varies from a few feet to 1/2 mile. Cows with calves nudge the calf to induce it to follow. Cows with calves often move uphill when frightened. If the calf is unable to follow, the cow will often circle within 10 - 50 yards of the calf even when it is approached by a potential predator. The peculiar, springy gait used by the cow in these circumstances is characteristic. Some cows abandoned their calves when approached by ear-taggers. There was no clear relationship between the age of the cow or the calf and abandonment. Cows were often persistent in locating and reclaiming their lost calves. An undisturbed period of 1/2 hr after birth is considered as necessary to ensure return and seeking behaviour by the cow.

There is great seasonal variation in the wariness of caribou. Cows are most wary during parturition and least so during midsummer. This is most noticeable in relation to visual and auditory stimuli and least so in relation to olfactory stimuli. When a mass of caribou is moving together, alarm reactions to visual stimuli, which will be perceived by only a few individuals, are not very marked. Olfactory stimuli, however, are perceived by many individuals causing simultaneous alarm and group flight. Large groups also show a decline in flight response due to repetitive stimulation from the many individuals surrounding each caribou. Insects also reduce summer reactivity. Stationary objects usually must be smelled to produce a fear response. Caribou apparently differentiate forms very poorly. Flight distances increase during periods of weather change. Caribou often show little regard for sounds. Lone caribou are usually more easily frightened by sounds while groups are more reactive to sounds when visibility is limited by topography. The greatest sensitivity to sound occurs in winter when the temperature is below -20°C.

KEYWORDS: Behaviour, Disturbance/Generalized Stimuli, Human Presence, Noise/Rangifer

282. Lent, P.C. 1966. Calving and related social behaviour in the
† barren-ground caribou. Z.f. Tierpsychol. 23(6):701-756.

Pages 726-733 discuss at some length the reaction of caribou to human disturbance. The "excitation leap" leaves a substance on the ground that can elicit a fright response in a caribou passing the spot some time later. Once several caribou have passed a spot undisturbed, the followers are not so easily frightened. Flight distance is very variable. If a disturbed cow and calf are in a group with a few other cow-calf pairs, the pair may leave the group. In nursery bands, flight is contagious. Cow-calf pairs usually move upslope when disturbed. A disturbed cow induces her calf to follow by an "attraction pose". If the calf is unable to follow, the cow remains 10-50 yards off and dashes wildly about while the disturbing stimulus approaches. Some cows abandoned their calves when disturbed by ear-tagging but most returned to reclaim them later.

KEYWORDS: Behaviour, Disturbance/Generalized Stimuli, Human Presence/Rangifer

283. Lent, P.C. 1971. A study of behaviour and dispersal in introduced muskox populations. Final Rpt. to Arctic Inst. of N. Amer., Proj. No. ONR-419. 41 pp.

In March 1970, 36 muskoxen were released on the Seward Peninsula. In mid-December, an abnormal range shift of 25 miles occurred. This was attributed to harassment by snowmobiles.

KEYWORDS: Distribution/Ground Vehicles/Ovibos

284. Lent, P.C. 1971. Muskox management controversies in North America. Biol. Conserv. 3(4):255-263.

A discussion of the controversy surrounding proposals to permit sport-hunting of muskoxen. On Nunivak Island, cow muskoxen are very sensitive to disturbance which might lead to abandonment of calves.

KEYWORDS: Reproduction, Behaviour/Generalized Stimuli/ Ovibos

285. Lent, P.C. 1975. Impact on the living environment: Caribou.
* Exhibit 389 entered before the Mackenzie Valley Pipeline Inquiry. 22 pp.

A discussion of certain neglected aspects of caribou biology and an assessment of the experience in Alaska relevant to the impact on caribou of Canadian oil and gas developments. Calving grounds generally lie in very remote areas. Therefore, there is little evidence available on human influence on calving. Any pipeline related activity occurring in calving or post-calving areas can be expected to increase caribou mortality. Human disturbance can cause calf abandonment. Barriers to migration may slow movement enough to cause calves to be born too late. Any deflection in migration will decrease optimum utilization of the environment. The implication has been made that since caribou can accommodate to variations in natural conditions, they will have no difficulty in accommodating to man-made charges. This is misleading since human-caused mortality is supplemental to natural mortality. The effects are summative since caribou cannot be assumed to have density-dependent mortality. The author reviews the findings on caribou reactions to mock-up pipelines. Crossing success was greatest when flies were worst. Caribou reacted adversely to the black pipeline against the white snowy background. Where total burial is impossible, ramps are preferable to underpasses as crossing structures. Suggestions are included for construction of crossing structures. The several miles of open ditching present during construction will present a complete barrier to caribou movement. Initial surveillance along the TAPS suggests the greatest avoidance during the calving and post-calving and the least during the fly season. At all seasons, males were more common along the corridor than cows. All caribou populations that are in contact with settled portions of Alaska are presently in decline. This is true even in Mt. McKinley National Park where caribou are protected from hunting. The Steese-Fortymile herd was once the largest herd west of the Mackenzie; today it's numbers are under ten thousand. Since 1950 there has been a gradual shift in the calving grounds to the southeast so that today all animals calve on the same side of the highway as they winter on and only a few cross to summer on the opposite side of the highway. The much reduced Nelchina herd is the only population that regularly crosses a highway; it is doubted whether this will continue. During the 19th century, the Seward Peninsula Delta herd was completely disrupted and wiped out by hunting on the calving grounds. Isolation of causative factors is impossible but the circumstantial evidence is not encouraging. There are only two sub-populations in Alaska which are thriving; these are as yet unaffected by hunting or roads. The Alaskan experience suggests that the caribou is an obligate wilderness species which is not adaptable to human disturbance.

KEYWORDS: Population Dynamics, Reproduction, Mortality, Behaviour, Movements, Distribution/Roads, Industry, Civilization, Pipelines, Hunting/Rangifer

286. Lent, P.C. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 105:16139-16145; Interference into the caribou's attempts to adapt to natural variation will be reflected in reduced productivity. Human-induced mortality is supplemental to natural mortality and the effects are density dependent.

Vol. 105:16145-16152; Description of the pipeline simulation experiments in Alaska. The conclusion is that if complete pipeline burial is not possible, ramps are the preferred method for allowing caribou passage.

Vol. 105:16169-16170; Along the Trans-Alaska corridor there is a disproportionate number of bulls indicating that cows are more sensitive to disturbance.

Vol. 106:16177-16181; Wherever caribou come into contact with settled areas, population declines result. The Steese-Forty-mile and Nelchina herds are cited as examples. The causal factors cannot be isolated but circumstantial evidence is not encouraging.

Vol. 106:16241-16246; Muskoxen are sensitive to disturbance particularly during and after calving. Calves and cows that become separated are less likely to become reunited than in caribou.

Vol. 110:16772-16776; Caribou cannot be sustained in highly altered environments. Calving areas are all "wilderness" areas.

Vol. 110:16776-16779; The differences between reindeer and caribou are not very great and information is interchangeable between the subspecies.

Vol. 110:16780-16781; Human activities, such as road use, which can lead to range abandonment, must be examined more thoroughly so that effective regulations can be developed.

Vol. 110:16816-16821; More information is needed about the causation of cow-calf separation.

Vol. 110:16830-16835; Caribou choose calving grounds on the basis of nutrition and freedom from both wolves and insect harassment. If man's activities force them elsewhere, the second choice may not be good enough for survival.

Vol. 110:16871-16873; There are insufficient data on which to base cause-effect analyses of caribou population changes.

No. 286 - Cont'd.
Lent, P.C. - 1975

Vol. 110:16885-16890; Disturbances caused by an elevated pipeline are likely to differ from those caused by a buried one.

Vol. 110:16892-168931; There have as yet been no declines in caribou around Prudhoe Bay despite the developments there.

Vol. 110:16900-16902; Disagrees with Bergerud about human/caribou coexistence. Man's influence could shift the delicate balance away from survival.

Vol. 111:16934-16940; Discussion of aircraft disturbance and adaptation to disturbance.

KEYWORDS: Disturbance, Population Dynamics, Mortality, Movements, Distribution, Reproduction/Aircraft, Pipelines, Human Presence, Roads, Generalized Stimuli, Ground Vehicles, Civilization/Rangifer, Ovibos

287. Lent, P.C. and R. Summerfield. 1973. Population dynamics and
* movement patterns of Dall sheep in the Atigun River Canyon. Alaska Coop. Wildl. Res. Unit Monthly Rpt. August, 1973.

Dynamite explosions 3-1/2 miles away from Dall sheep produced sound levels of 105 dB near the sheep. Most animals interrupted their activities only briefly and appeared to habituate within the course of a day. Cited in Reynolds 1974.

KEYWORDS: Disturbance, Habituation, Behaviour/Noise, Industry/Ovis

288. Leopold, A.S. 1944. The nature of heritable wildness in turkeys. Condor 46(4):133-197.

Defines wildness in turkeys as "the inherited condition by which turkeys as individuals and collectively as populations, are adapted to live in a natural environment." This includes wariness. Wildness and its opposite, domesticity, are heritable, physiological complexes.

KEYWORDS: Behaviour/Generalized Stimuli/Genetics/Birds

289. LeResche, R.E. 1966. Behaviour and calf survival in Alaskan
† moose. M.S. Thesis, Univ. of Alaska, Fairbanks. 85 pp.

Two calves were found abandoned subsequent to tagging. Immediate reacceptance by the cows was noted, though. It is unclear whether tagging causes calf abandonment. Reaction to disturbance is described. Moose often drifted into the brush with many glances back. Cows showed a reluctance to leave their calves when approached by helicopter.

KEYWORDS: Reproduction Behaviour/Human Presence, Aircraft/ Alces

290. LeResche, R.E. 1972. Migrations and population mixing of moose on
† the Kenai Peninsula (Alaska). Pages 185 - 207 in 8th N. Amer. Moose Workshop, Thunder Bay, Ont., Ont. Min. Nat. Resour., Toronto.

A total of 283 moose were tagged on the Kenai Peninsula in a study of migratory patterns, concentration areas, and population identities. Most groups were seasonally migratory. The author concludes "... construction of barriers along migration routes, could have far wider effects on moose than previously expected." (p. 205).

KEYWORDS: Movements/Roads, Pipelines, Railways/Alces

291. LeResche, R.E. 1974. Moose migrations in North America.
† Naturaliste Can. 101:393-415.

Moose have highly traditional migratory patterns. "Construction of a single highway or pipeline barrier across a major migration route could affect moose over tens of thousands of square kilometers. Misuse of a very small critical seasonal range for only a month each year could result in serious interference in the life cycle of thousands of moose over a vast area. These possibilities are not hypothetical, but very real in some areas ...".

KEYWORDS: Movements, Disturbance/Roads, Pipelines/Alces

292. LeResche, R.E. 1975. The international herds: Present knowledge of the Fortymile and Porcupine caribou herds. Pages 127-139 in: J.R. Luick, P.C. Lent, D.R. Klein, R.G. White (eds.), Proc. 1st Int. Reindeer and Caribou Symp., Biol. Pap. Univ. of Alaska, Spec. Rpt. No. 1, 551 pp.

"Both the Nelchina and Fortymile herds in Alaska have co-existed with lightly-travelled highways for as long as 30 years. In recent years, however, both herds have declined in numbers and shifted in distribution concurrently with increased highway travel. A multitude of factors are involved, and most may have no relation to roads. Nonetheless, the fate of these herds gives cause for somber reflection on the ultimate influence of the Dempster Highway on the Porcupine Herd." (p. 133). The author concludes that any single major pipeline or highway development is unlikely to represent an absolute barrier to caribou movement but that the effects of each succeeding obstruction is cumulative.

KEYWORDS: Population Dynamics, Distribution, Movements/Roads, Ground Vehicles/Rangifer

293. LeResche, R.E., R.H. Bishop and J.W. Coady. 1974. Distribution and habits of moose in Alaska. Naturaliste Can. 101:143-178.

The authors speculate that the Trans-Alaska Pipeline, while only minimally affecting moose habitat, will restrict free passage.

KEYWORDS: Movements/Pipelines/Alces

294. LeResche, R.E. and S.A. Linderman. 1975. Caribou trails systems in northern Alaska. Arctic 23(1):54-61.

Because caribou movement patterns are so changeable and dynamic, short-term studies of distributional responses to man-made structures are doomed to failure. Caribou leave persisting trails through areas most highly favoured for movement. Mapping and analysis of such trails can be used to sensitively plan roads, pipelines, etc. Trails generally follow contours, use ridgelines and parallel obstructions before crossing them.

KEYWORDS: Movements/Other Stimuli/Rangifer

295. LeResche, R.W., U.S. Seal, P.D. Karns, and A.W. Franzmann. 1974.
† A review of blood chemistry of moose and other Cervidae with emphasis on nutritional assessment. Naturaliste Can. 101 (1&2):263-290.

A review of the use of clinical studies of hematology, blood chemistry, protein polymorphisms and endrocrinology as evaluation of herd and range conditions in the Cervidae. Among other things, the effects of handling and the resulting stress must be considered. Reviews the clinical results of stress and proposes manners to overcome this artifact.

KEYWORDS: Stress, Physiology/Capture and Handling/Alces, Other Mammals

296. Levi, L. (ed.). 1967. Stress and distress in response to psychosocial stimuli: Laboratory and real-life studies on sympatheticoadrenomedullary and related reactions. Int. Ser. Monogr. in Exp. Psychol., Vol. 17. Pergamon Pr., Oxford. 165 pp.

The introduction and concluding general discussion are both excellent reviews of the stress concept.

KEYWORDS: Stress, Physiology/Generalized Stimuli/Various Species

297. Levine, S. and D.M. Treiman. 1969. Determinants of individual differences in the steroid response to stress. Pages 171 - 184 in E. Bajusz (ed.), Physiology and pathology of adaptation mechanisms. Pergamon pr., Oxford.

Steriod responses to stress exhibit large differences between individuals. It is argued that genetic and experential differences influence a hypothetical centrally located "hormonostat". The effects of early experience on plasma corticosteroid levels is demonstrated for inbred strains of mice. Genetic differences are demonstrated by showing different steroid levels between species and sexes.

KEYWORDS: Stress, Physiology/Laboratory, Gentics/Other Mammals

298. Lewis, R.J. G.A. Chalmers, M.W. Barret, R. Bhatnagar. 1977.
† Capture myopathy in elk in Alberta, Canada. A report of three cases. J. Amer. Vet. Med. Assoc. 171:927-932.

One hundred and twenty-three elk were captured at Elk Island National Park in Alberta. Four died from capture myopathy. The necropsies of three cases are described. Includes a good literature review of white muscle disease in wild animals. Observations suggest that capture myopathy may be triggered by fear, anxiety, or shock and modified by overexertion and exhaustion.

KEYWORDS: Pathology/Capture and Handling/Cervus

299. Light, J.T. 1971. An ecological view of bighorn habitat on Mt.
† San Antonio. Trans. N. Amer. Wild Sheep Conf. 1:150-157.

Report of an environmental impact analysis arising out of a request to expand the Mt. Baldy Ski Resort. It was found that bighorns do not occupy areas where human use is heavy even if these areas are high-value habitats. The many documented cases of bighorn tolerance to human influence appear where human visitation is relatively infrequent. Continual visitation apparently causes stress which in turn causes avoidance of the area. In historic times, several of the areas investigated maintained sheep, but as human visitation increased, the bighorns disappeared from the area so gradually as to be unnoticeable.

KEYWORDS: Population Dynamics, Distribution/Human Presence/ Ovis

300. Lieb, J.W. 1973. Social behaviour in Roosevelt elk cow groups.
† M.S. Thesis, Humboldt St. Univ., Arcata, California. 82 pp.

A study of social behaviour in two elk groups at Redwoods State Park in northwestern California. During the calving period, the cow group spent less time in the area of high human disturbance. This area was also recognized as the area containing the best forage. Flight distance increased during calving. During disturbance, group leadership was very noticeable. There were also certain cows which consistently moved to the back of the group to act as a rear guard. As human disturbance increased during summer, the level of aggression in the cow groups increased suggesting a decrease in tolerance by elk for their fellows under insecure conditions.

KEYWORDS: Behaviour, Distribution/Human Presence/Cervus

301. Lieb, J.W. 1978. Biotelemetric monitoring of heart rate and activity in elk. Final Progr. Rpt., Research Work Unit FS-INT-1705. 36 pp.

Not seen.

KEYWORDS: Physiology/Generalized Stimuli/Cervus

302. Linderman, S. 1972. A report on the sheep study at the Dietrich * River headwaters. In: L. Nichols and W. Heimer (eds.), Sheep Report Vol. 13. Proj. Progr. Rpt., Fed. Aid in Wildl. Rest. Pro. W-17-3 and W-17-4, Alaska Dept. Fish and Game, Juneau, Alaska.

An average of two fixed-wing aircraft and two helicopters passed over the Dietrich River study area each day. Sheep responded by alarm postures and often crowded close together. They sometimes fled to escape terrain. Extremely variable responses were noted. Helicopters appeared to elicit more overt responses. The author cites an example of a fixed-wing aircraft flying over at 7,000-8,000 ft and 1-2 miles away. The rams fled into the rocks; the ewes continued feeding. Even though sheep may not run, they always appear nervous when aircraft fly over. "Therefore, aerial observations of sheep which appear undisturbed should not be considered to demonstrate sheep tolerance of aircraft." Suggests that the use of summer range and mineral licks on Table Mountain and Lizard Mountain have been disrupted by overflights.

KEYWORDS: Behaviour/Aircraft/Ovis

303. Linderman, S. 1974. Ground tracking of Arctic grizzly bears. † Final Rpt., Fed. Aid in Wildl. Rest. Proj. W-17-6, Job 4.12R, Alaska Dept. Fish and Game, Juneau, Alaska. 24 pp.

A male grizzly bear was fitted with a radio transmitter and followed on the ground and from aircraft for five weeks. Five helicopter and six fixed-wing overflights were recorded. At distances between 500 ft and 1/4 mile, repeated passes were necessary to elicit a strong response even though there was previous negative-conditioning involved in the initial capture. It is suggested that this bear may have been abnormally tolerant of aircraft since other bears seen on aerial surveys usually reacted to distances considerably greater than 500 ft distance. Possible hiding in response to aircraft was seen on one occasion. This is cited as a common problem in relocation of tagged grizzlies. Appendix I presents detailed descriptions of each overflight.

KEYWORDS: Behaviour/Aircraft/Ursus

304. Lodico, N.J. 1973. Environmental effects of off-road vehicles. U.S. Dept. of Interior, Office of Library Serv. Biblio. Series No. 29, Wash., D.C. 109 pp.

A literature review dealing with effects of off-road vehicles (snowmobiles, motorbikes, dune buggies, 4-wheel drive vehicles and ATV's) on vegetation, animals, and soil with reference to noise, recreational conflicts and legislation.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

305. Lord, P. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 16:1642-1648; Renewable Resources Ltd. frightened the caribou around Old Crow by their repeated low altitude over-flights. This pushed the caribou off their normal migration routes and caused them to winter well away from Old Crow.

KEYWORDS: Distribution/Aircraft/Rangifer

306. Lyon, L.J. 1975. Coordinating forestry and elk management in † Montana: Initial recommendations. Trans. N. Amer. Wildl. Conf. 40:193-201.

A summary of information gathered during a four-year study of elk reaction to logging and associated human activities. Elk are disturbed by activities and noise associated with logging and roads and will move considerable distances to avoid this disturbance.

KEYWORDS: Movements, Distribution/Industry, Roads, Noise/ Cervus

307. Lysyk, K.M., E.E. Bohmer and W.L. Phelps. 1977. Alaska Highway pipeline inquiry. Supply and Services, Ottawa. 171 pp.

Report of the Alaska Highway Pipeline Inquiry dealing with expected social and economic impacts of a pipeline through the southern Yukon. Pages 127 - 128 deal with the Porcupine caribou herd and suggest that disturbances along the Dempster would lead to inexorable destruction of the herd.

KEYWORDS: Population Dynamics/Roads/Rangifer

308. MacArthur, R.A., R.H. Johnston and V. Geist. Factors influencing † heart rate in free-living bighorn sheep: A physiological approach to the study of wildlife harassment. Can. J. Zool., in press.

Three unrestrained bighorn sheep ewes were fitted with heart rate transmitters. Responses were recorded under various behavioural and environmental circumstances. There was a positive relation between level of activity and heart rate as well as seasonal and daily effects. Heart rates of animals travelling at night or through stands of timber were higher than those recorded on open slopes during the day. Heart rate was inversely correlated with distance to a gravel road. Appearance of free-ranging canids produced maximal heart rate increases. Vehicles on the road or aircraft produced response only when within 200 m. Most (78%) of the heart rate responses to disturbance were in the absence of overt behavioural responses. Heart rate usually returned to normal within 200 seconds of the cessation of disturbing stimuli but the continued precense of a human within 50 m of a sheep created a stable 20% increase in heart rate.

KEYWORDS: Physiology/Predators, Ground Vehicles, Human Presence, Aircraft, Roads/Ovis

309. MacDonald, B. 1977. Transportation corridor/wild ungulate conflicts and possible solutions: An annotated bibliography. Unpubl. M.S., Habitat Protection Sec., Fish and Wildlife Br., Ministry of Rec. and Comm.

An annotated bibliography of the effects of transportation corridors on big game. Deals with immediate mortality by collisions and more indirect detrimental effects such as migration, obstruction, etc.

KEYWORDS: Behaviour, Movements, Distribution/Roads, Ground Vehicles/Various Species

310. Mackenzie, J.T. 1976. On the impact of petroleum exploration and † development on wildlife in the arctic, subarctic and alpine regions. M.S. Thesis, Univ. of Calgary, Calgary.

A compilation of literature on the impact of petroleum activity on wildlife in the North. Discussion focuses on wildlife harassment; particularly of ungulates. The available literature on caribou, moose, muskoxen and Dall sheep are reviewed. The appendix describes attempts at developing a long-range heart-rate transmitter for monitoring the physiological correlates of harassment. Domestic sheep at rest were found to have heart rates of 72-78 beats/minute. When an observer was standing 7 m away, the rate increased to 92 beats per minute. Capture and restraint were characterized by heart-rates of 240 and 220 beats/minute respectively.

KEYWORDS: Disturbance, Physiology/Industry, Capture and Handling/Ovis, Rangifer, Alces, Ovibos

311. Mackenzie, J.T. 1975. Control of bird pests - "purposeful harassment." Appendix to Geist 1975. 17pp.

A review of techniques used to control nuisance or pest birds by intentional use of mechanical or chemical methods; i.e., "purposeful harassment". The principles found effective in purposeful harassment are thought to have implications for the seriousness of related forms of wildlife harassment. Mechanical scare devices are not universally consistent in their effectiveness; there are response differences between individuals, species and years. Birds quickly become refractory to these devices. Scare stimuli must be extremely intense or complex and unpredictable.

KEYWORDS: Disturbance/Generalized Stimuli/Birds

312. Mair, M. 1976. A bibliography of the impact of environmental disturbance on mammals (primarily ungulates). Unpubl. Rpt. Prep. for Renewable Resources Consulting Services Ltd., Edmonton. 38 pp.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

313. Maguire, H.F. and C.W. Severinghaus. 1954. Wariness as an influence on age composition of white-tailed deer killed by hunters. N.Y. Fish and Game J. 1(1):98-109.

Analysis of kill statistics for the opening days of hunting season shows that young males are the least wary cohort in white-tailed deer. Cited in Behrend and Lubeck 1968.

KEYWORDS: Behaviour/Hunting/Odocoileus

314. Marcum, C.L. 1975. Summer-fall habitat selection and use by a western Montana elk herd. Ph. D. Thesis, Univ. of Mont., Missoula. 188 pp.

Logging activities displaced deer at higher elevations. Roads open to vehicular traffic during hunting season were avoided by more than one mile. More heavily forested areas were used during hunting season. Roads closed to traffic were more heavily used than roads which remained open. Cited in Allen et al. 1976.

KEYWORDS: Distribution/Hunting, Roads, Ground Vehicles/ Cervus

315. Marcum, C.L. 1976. Habitat selection and use during summer and † fall months by a western Montana elk head. Pages 91 - 95 in S.E. Hieb (ed.), Proc. Elk-logging Symp., Moscow, Idaho. 143 pp.

Habitat use data were collected by tracking radio-collared elk. Major roads were used significantly less than their availability. Use of spur roads and 4-wheel drive tracks did not differ from that expected from their availability. Closed roads were used more than expected.

KEYWORDS: Distribution/Roads, Ground Vehicles/Cervus

316. Marshall, A.D. & R.W. Whittington. 1968. A telemetric study of deer home ranges and behaviour of deer during managed hunts. Proc. S.E. Assoc. Game Fish Comm. Conf. 22:30-46.

Movement data were obtained from five white-tailed deer on Clark Hill Wildlife Management Area. During managed hunts, daytime movement patterns differed from those prior to and after the hunt. Deer movement increased as hunting pressure increased perhaps due to a lack of understory vegetation in the study area. Five hunters per 100 acres is enough to "move" deer in such an area; 10 hunters per 100 acres is sufficient to produce a "heavy kill". Cited in Neil et al. 1975.

KEYWORDS: Movements, Behaviour/Hunting/Odocoileus

317. Marshall, A.D. and R.W. Whittington. 1966. A telemetric study of deer home ranges and behaviour of deer during managed hunts. Proc. S.E. Assoc. Game and Fish Comm. 22:30-46.

White-tailed does do not leave their home ranges when hunted.

KEYWORDS: Distribution, Movement/Hunting/Odocoileus

318. Martell, A.M. 1976. Mackenzie Delta wildlife: An historical review of man's impact. Exhibit 445 entered before the Mackenzie Valley Pipeline Inquiry, Inuvik. 20 pp.

An historical review of man's impact on animals in the North.

KEYWORDS: Population Dynamics/Industry, Hunting, Human Presence/ Various Species

319. Martell, A.M. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 120:18317-18325; A review of the history of man's impact on mammals in the North. Because of the lack of baseline data, loss due to disturbance would not have been recognized until quite late.

Vol. 120:18339-18345; A government program to develop a data base is necessary to assess and moderate disturbances.

Vol. 120:18337-18338; There has been little work done to determine the effect of disturbances. The onus of proof that a population will not be disturbed is on the party proposing development.

Vol. 120:18345-18346; There is no doubt that development will cause increased wildlife disturbance. Disturbances due to man's activities and travels has more of an effect on population than does hunting.

KEYWORDS: Population Dynamics, Disturbance/Hunting, Civilization/ Various Species

320. Mautz, W.W. 1971. Confinement effects on dry matter digestibility † coefficients displayed by deer. J. Wildl. Manage. 35(2): 366-368.

The effect of severe confinement on apparent dry-matter digestibility coefficients of two white-tailed deer was investigated. Severe confinement is a traumatic experience. When first placed in collection crates, the deer had marked decreases in ability to digest a pelleted ration. This effect disappeared by the 9-12th days.

KEYWORDS: Stress, Physiology/Capture and Handling/Odocoileus

321. McCann, J.L. 1956. Ecology of the mountain sheep. Amer. Midl. Natur. 56(2):297-325.

If undisturbed, mountain sheep are by nature unsuspicious. Ewes and juveniles were found to be tolerant of humans but rams were wary probably because they were hunted.

KEYWORDS: Behaviour/Hunting, Human Presence/Ovis

322. McCool, S.F. 1978. Snowmobiles, animals and man: Interactions and
† management issues. Trans. N. Amer. Wildl. and Nat. Resour. Conf. 43:148.

In a section entitled "Some Characteristics of Snowmobile - Wildlife Research" the author states that conclusive, ecosystemic effects of snowmobiling on the natural environment have not been identified. "Research is conducted primarily in piecemeal fashion, guided principally by the interests of individual researchers." Efforts are "...noncumulative, redundant, and noncomparable because of differing methodologies definitions, and conceptual approaches." The problem is not research quantity or quality. "It is a problem of systematically exploring the nature of the phenomenon, defining subproblems and managerial information needs, assigning priorities and developing and implementing a research organization with a research application and utilization philosophy." There has been an inability to reach a concensus on impacts. The author cites the contradictory results between Bollinger et al. (1973) and Dorrance et al. (1975), between Bury et al. (1976) and Bury (1978). He suggests that there is no consensus on the meaning of "impact" and that the notion is managerial rather than scientific. Almost all studies identify effects at the point of impact; permanent, long range changes are rarely assessed.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

323. McCourt, K.H., J.D. Feist, D. Doll, and J.J. Russell. 1974. Dis-
* turbance studies of caribou and other mammals in the Yukon and Alaska, 1972. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Series, Vol. 5. 245 pp.

Comprised of three separate sections dealing with (a) the reactions of Dall sheep and caribou to simulated compressor station noise, (b) response of caribou to cutlines and (c) reactions of caribou, moose and grizzly bears to aircraft.

Caribou were subjected to compressor sounds at 5 locations during spring and fall migration, during summer movements and during the calving period. In all cases, there were no demonstrable effects beyond 1/2 mile. Dall sheep were subjected to compressor noise in one situation. Most sheep left the immediate area.

On winter range, caribou use cutlines and winter roads for local travel. They prefer lines where vehicular traffic results in shallower snow. In spring, cutline use was independent of snow conditions and dependent on orientation of the line relative to general direction of movement.

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McCourt, K.H. - 1974

At elevations under 300 ft, caribou reacted more to a Bell 206 helicopter than to a Cessna 105 fixed-wing aircraft. Above 300 ft there was no difference. Above 1000 ft elevation, reactions were infrequent. Larger groups reacted more often and more frequently at low elevation. No seasonal differences were noted. Moose usually reacted to aircraft under 200 ft but fixed-wing aircraft over 600 ft elicited no response. Grizzlies were more sensitive to aircraft than moose or caribou. There was no obvious altitude effect in their response.

KEYWORDS: Disturbance, Behaviour, Distribution, Movements/ Aircraft, Noise, Roads, Pipelines/Alces, Ursus, Ovis, Rangifer

324. McCourt, K.H. and L.P. Horstman. 1974. The reaction of barren-
* ground caribou to aircraft. Chapter I in R.D. Jakimchuk (ed.), The reaction of some mammals to aircraft and compressor station noise disturbance. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Series Vol. 23.

Caribou reaction to aircraft was found to depend on distance from the aircraft, terrain, group size, and season. Between 13% and 56% of all groups (depending on season) reacted strongly to aircraft closer than 300 diagonal ft while 1% to 14% reacted strongly to aircraft between 300 and 600 diagonal ft. The larger groups were more reactive to low flights during calving and the winter and more reactive to higher flights during the calving, summer and dispersal periods. The overall ordering of reactivity by season was Post-calving > Winter > Spring Migration > Calving > Fall Migration > Summer Movement.

KEYWORDS: Behaviour/Aircraft/Rangifer

325. McCullough, D.R. 1969. The tule elk: Its history, behaviour and ecology. Univ. of California Pr., Berkeley and L.A. 209 pp.

Elk bunch and watch airplanes and helicopters but usually do not run. It is extremely difficult to drive tule elk with an airplane. Sonic booms are frequent and elicit only a momentary alarm which disappears when the jet sound is heard. Elk apparently differentiate gunshots from sonic booms by the jet sound. Elk become accustomed to certain regularly seen vehicles but are alarmed by strange ones. The velocity of the wind and the automobile is more important than the kind of vehicle.

KEYWORDS: Behaviour/Aircraft, Noise, Ground Vehicles/Cervus

326. McEwan, E.H. 1968. Hematological studies of barren-ground caribou. Can. J. Zool. 46:1031-1036.

The hematology of wild caribou was compared to that of captive caribou. Blood glucose was much higher in wild caribou probably due to the excitement of capture. Blood glucose can increase by 40% due solely to excitement.

KEYWORDS: Physiology/Capture and Handling/Rangifer

327. McKaymie, R. 1975. Testimony in Proceedings at inquiry. Alaska Highway Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. C-23:2311; Caribou should easily be able to cross a pipeline four feet in diameter.

KEYWORDS: Movements/Pipelines/Rangifer

328. McLennan, K.A. 1972. Annual game report, Resolute Bay, N.W.T.: Grise Fiord, N.W.T., July 1971 - June 1972. Gov't. of the N.W.T., Game Management Serv., 7 pp.

It is suspected that oil exploration has caused muskoxen to disappear from some areas. Cited in Riewe 1973.

KEYWORDS: Distribution/Industry/Ovibos

329. McMillan, J.F. 1954. Some observations on moose in Yellowstone † Park. Amer. Midl. Natur. 52(2):392-399.

Moose were studied in two areas; one heavily used by tourists and one rarely visited. In the former area, moose quickly became habituated to humans each summer. A slow, quiet approach to 25 yards could usually be made. Flight distance was greater when moose feed in water. Moose which run into timber do not go far. Cows with calves are flushed from timber with more difficulty than bulls. Lying moose are less easily frightened than feeding ones. Moose learn to recognize individual humans and allow them to approach closer. The unhabituated moose were not approachable closer than 150 yards. If frightened away, they were not seen again that day. Moose respond most to sounds resulting from twigs cracking or brush rustling. Not reactive to speaking, shouting, whistling, automobile horns, engine backfire and other highway sounds.

KEYWORDS: Behaviour/Human Presence, Noise/Alces

330. MacPherson, A.H., G.H. Watson, J.G. Hunter, and C. Hatfield. 1972. Potential effects on social values in wildlife and fisheries resources. Pages 79 - 88 in R.F. Legget and I.C. MacFarlane (eds.), Proceedings of the Canadian Northern Pipeline Research Conference, 2 - 4 February, 1972. Natl. Res. Counc. Can. Tech. Memo No. 104, NRCC 12498.

The main concern regarding the effect on caribou by northern pipeline development is deflection from traditional migratory routes. Dall sheep and grizzly bears are susceptible to helicopter harassment. More information is needed on wildlife disturbance.

KEYWORDS: Disturbance, Movements/Aircraft, Pipelines/Rangifer, Ovis, Ursus

331. Mech, L.D. 1966. The wolves of Isle Royale. Fauna of the National Parks of the U.S. Fauna Series No. 7. U.S. Gov't. Printing Office, Washington, D.C. 210 pp.

Wolves quickly habituate to aircraft. Packs encountered less frequently showed more concern. "Apparently, wolves become conditioned by the continued presence of an aircraft that causes them no harm." (p. 36).

KEYWORDS: Behaviour, Habituation/Aircraft/Lupus

332. Memphis State University. 1971. Effects of noise on wildlife and
† other animals. Prep. for the U.S. Env. Prot. Agency, Off. of Noise Abatement and Control, Document NTID300-5, Wash., D.C.

A literature review treating the effects of noise on laboratory and farm animals together with the demonstrated and suspected effects on wildlife. Contains 104 references. In laboratory animals, noise elicits a typical stress reaction with a variety of measurable changes such as increases in blood pressure, available glucose, corticosteriods, and changes in the adrenal glands. Prolonged exposure can result in exhaustion of the animal's resources and death. An animal raised in a stress-free environment can be adversely affected by very mild noise stresses. Noise superimposed on another stress can be very damaging. Noise can have an effect on reproductive performance. Sound stimulation in mothers can produce abnormalities in unstressed offspring. In general, the sound levels utilized in laboratory experiments were much higher than usually found outside of the laboratory. Long-term experiments have not been done. Farm animals seem largely unaffected by aircraft noises. Very little work has been done on the effect of noise on wild animals with the exception of attempts to scare birds.

KEYWORDS: Stress, Physiology/Noise/Various Species

333. Miller, F.L. 1974. A new era - are migratory barren-ground caribou and petroleum exploitation compatible? Trans. N.E. Sect. Wildl. Soc. 31:45-55.

Not seen.

KEYWORDS: Disturbance/Industry/Rangifer

334. Miller, F.L. and E. Broughton. 1973. Behavior associated with
† mortality and stress in maternal-filial pairs of barren-ground caribou. Can. Field Natur. 87(1):21-25.

Observations on the mother-young bond in barren-ground caribou. Results consist of a series of isolated observations. These show a marked reluctance for either the mother or the young to break the bond due to helicopter disturbance, or to the death of either the dam or the calf.

KEYWORDS: Behaviour, Reproduction/Aircraft/Rangifer

335. Miller, F.L. and E. Broughton. 1974. Calf mortality on the † calving grounds of Kaminuriak caribou during 1970. Can. Wildl. Serv. Rpt. Series No. 26, Inf. Can., Ottawa.

A study of the causes of mortality in caribou fawns of the Kaminuriak herd. The authors found three calves dead from injuries apparently from trampling during flight from wolves or aircraft. This suggests that aircraft overflights during the peak of calving could introduce a significant mortality in fawns.

KEYWORDS: Mortality, Reproduction/Aircraft/Rangifer

336. Miller, F.L. and A. Gunn. 1977. A preliminary study of some observable responses by Peary caribou to helicopter induced harassment, Prince of Wales Island, Northwest Territories, July - August 1976. Can. Wildl. Serv. Progr. Notes No. 79, 23 pp.

The authors observed and harassed 2674 caribou in 597 groups during summer. In all, 87.4% of individuals responded to overflight by the helicopter. Bulls responded less while lower, slower flights elicited larger responses. Cargo slinging flights and the landing of work parties was simulated. Caribou responded more to people on the ground than to the helicopter.

KEYWORDS: Behaviour/Aircraft/Rangifer

337. Miller, F.L. and A. Gunn. 1977. A preliminary study of some observable responses by muskoxen (Ovibos moschatus) to turbo-helicopter induced harassment, Prince of Wales Island, Northwest Territories, July - August 1976. Can. Wildl. Serv. Progr. Notes No. 78. 17 pp.

A Bell 206 turbo-helicopter was used to simulate reconnaisance flights, cargo-slinging flights and landing of ground parties. In total 1363 muskox response samples were obtained from 92 observations of 498 muskoxen harassed by 212 flights. Only one group was observed to gallop more than 1 km. Groups resumed normal activity within 4 - 17 minutes of harassment. However, 48% of responses were extreme and 33% were strong. At least 75% of the flights caused stress. These flights were as high as 325 m above ground level and as much as 3 km horizontally from the animals.

KEYWORDS: Behaviour/Aircraft/Ovibos

338. Miller, F.L. and A. Gunn. 1978. Responses of Peary caribou and muskoxen to helicopter harassment, Prince of Wales Island, Northwest Territories, 1976 - 1977. Can. Wildl. Serv. Rpt. CWSC - 2675 (two volumes). 588 pp.

Not seen.

KEYWORDS: Behaviour/Aircraft/Ovibos, Rangifer

339. Miller, F.L. and A. Gunn. 1978. Caribou and muskoxen response to * turbo-helicopter harassment on Prince of Wales Island: Preliminary Report, 1977. Can. Wildl. Serv., ESCOM Rpt. No. AI-08, Ottawa.

Report of a 1976 study on the reactions of Peary caribou and muskoxen to harassment by a Bell 206 turbo-helicopter. Helicopter harassment simulated the following: (a) reconnaissance and inspection flights, (b) cargo slinging and (c) ground party landings. In 212 flights, 1,363 muskox samples were obtained. Groups were observed to react to 93.6% of overflights but normal activity generally was resumed within 4 - 26 minutes. Formation of the species - typical defense formation was the most characteristic response. Any flight lower than 325 m above ground level or at a diagonal distance of 3 km often produces stress.

A total of 87.4% of 2,337 caribou responded detectibly to helicopter harassment. Bulls were less responsive than cows or immature caribou. Caribou in larger groups responded more than ones in smaller groups. Low elevation flights elicited greater responses. The roles of sun position and wind direction require further analysis.

KEYWORDS: Behaviour/Aircraft/Ovibos, Rangifer

340. Miller, F.L. and A. Gunn. 1979. Responses of Peary caribou and * muskoxen to helicopter harassment. Can. Wildl. Serv. Occ. Pap. No. 40, Ottawa. 90 pp.

This represents the most complete and careful study of overt behavioural reactions to aircraft harassment which has been completed to date. The authors' abstract is given in full:

> "This report provides information on overt behavioural responses of Peary caribou (Rangifer tarandus pearyi) and muskoxen (Ovibos moschatus) to simulations of three likely categories of helicopter activity that would be associated with construction of a gas pipeline in arctic Canada. The study was carried out on Prince of Wales and Russell islands, Northwest Territories, in summers 1976 and 1977. One three-man team and a Bell 206B turbo-helicopter were used in July and August 1976, and four

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Miller, F.L. - 1979

two-man teams and a Bell 206B were used in June-August 1977. All helicopter harassment overflights were flown at less than 400 m above ground level (m agl): mostly below and above 200 m agl in 1976 and 1977, respectively. The maximum response of an animal during an overflight was taken as a measure of harassment. In total, 3939 individual maximum response samples (IRS) of Peary caribou were obtained during 671 harassment overflights and 4011 IRS of muskoxen during 315 overflights: 64.0% of the Peary caribou samples and 43.6% of the muskox samples responded overtly to the helicopter overflights. It was judged that the 12.1% (477) of the Peary caribou samples and the 21.0% (841) of the muskox samples that were still responding at the extreme level after completion of the overflights represented the animals most seriously affected by the helicopter harassment. Helicopter landings were made on 116 occasions near 736 Peary caribou samples and 69 touchdowns near 1192 muskox samples. In total, 28.7% (211) of the Peary caribou IRS and 12.3% (147) of muskox IRS responded at the extreme level to the harassment. Our results indicated that (a) the responsiveness of cows and calves of both species and solitary bull muskoxen, (b) group size and type, (c) number of calves in a group, (d) the position of the sun and direction of the wind relative to the helicopter flight, (e) previous activity of the animals and (f) the terrain where the animals were sampled are all factors contributing to the level of response exhibited by harassed animals. There was an inverse relationship between response level and the altitude of the helicopter overflights or the distance away for a helicopter landing and our recommendations were based on that relationship. Evidence for habituation was detected within but not between sets of passes simulating cargo slinging. The levels of harassment did not cause any visible pathological conditions or lead to group splintering or calf desertion. It is not known, however, what the actual short-term costs of harassment to the individuals were in energy, or what are the potential long-term effects to the populations. If we are to advise wisely on the conservation of Peary caribou and muskoxen, there is a vital need for additional baseline data, especially on affinities for and locations of critical areas such as calving grounds, post-calving areas, rutting areas and migratory routes.

KEYWORDS: Behaviour/Aircraft/Ovibos, Rangifer

341. Miller, F.L., C.J. Jonkel and G.D. Tessier. 1972. Group cohesion * and leadership response by barren-ground caribou to man-made barriers. Arctic 25:193-202.

A corral with drift fences was placed at a point in the traditional migration route where caribou cross a narrow part of a larger lake. Caribou refused to enter the corral. Some delayed their migration northwards until they found ways to circumvent the barrier, others overcame the obstacle directly and continued their course. A discussion suggests that either route deviation or hesitation could be detrimental to cow and calf survival.

KEYWORDS: Movement/Fences/Rangifer

342. Miller, F.L., R.H. Russell, and A. Gunn. 1977. Distributions, movements and numbers of Peary caribou and muskoxen on western Queen Elizabeth Islands, Northwest Territories, 1972 - 1974. Can. Wildl. Serv. Rpt. Ser. No. 40, Inf. Canada, Ottawa, 55 pp.

"Muskox groups stressed by aircraft usually react in one or a combination of three ways: (1) stand their ground, and form a defense circle; (2) flee to surrounding high ground and form a 'ring'; (3) take flight and continue to run, sometimes for several kilometers before stopping."

KEYWORDS: Behaviour/Aircraft/Ovibos

343. Miller, F.L., R.H. Russell, A. Gunn. 1977. Inter-island movements of Peary caribou (Rangifer tarandus pearyi) on Queen Elizabeth Islands, Arctic Canada. Can. J. Zool. 55(6):1029-1037.

Observations of caribou tracks which paralleled, but did not cross, a bulldozer track on the sea-ice from Mould Bay to Eglinton Island in the Arctic Islands.

KEYWORDS: Movements/Roads/Rangifer

344. Moen, A.N. 1973. Wildlife ecology. W.H. Freeman, San Francisco. 458 pp.

A treatment of the energy relations of wild animals. Chapter 7 is an especially useful review of energy metabolism, its measurement and the factors which influence it. The social and psychological effects on metabolism are treated on pages 130 - 131. It is noted that noise definitely affects heat production in deer. Newborn fawns are particularly sensitive in this respect while well-trained adults raise heat production in response to rather common and frequent noises.

KEYWORDS: Energetics/Noise/Odocoileus

345. Moen, A.N. 1976. Energy conservation by white-tailed deer in the winter. Ecology 57(1):192-198.

Energy expenditures of white-tailed deer were estimated from weather conditions and degree of activity as determined by tracking. Energy conservation measures such as reducing the general level of activity, seeking more level land and lesser snow depths, and walking more slowly can reduce winter energy needs of a 60 kg white-tailed deer by 1000 kcals per day. "Unnecessary losses may be prevented by disturbing deer as little as possible, minimizing harassment by dogs and snowmobiles ...".

KEYWORDS: Energetics/Ground Vehicles, Predators/Odocoileus

346. Moen, A.N. 1978. Seasonal changes in heart rates, activity, metabolism, and forage intake of white-tailed deer. J. Wildl. Manage. 42(4):715-738.

A series of equations is developed to estimate metabolism and forage consumption from measured heart rates and seasonal activity patterns. It is concluded that white-tailed deer are well adapted for winter energy conservation but that any disturbance is a potential depressant of productivity.

KEYWORDS: Energetics/Generalized Stimuli/Odocoileus

347. Moen, A.N. and S. Chevalier. 1977. Analysis of telemetered E.C.G. † signals from white-tailed deer. Pages 118 - 125 in F.M. Long (ed.), Proc. 1st Int. Conf. Wildl. Biotelem., Univ. of Wyoming, Laramie. 159 pp.

Use of telemetric equipment allows examination of cardiac dynamics which are often not accompanied by overt changes in behaviour or activity. Bradycardia is associated with the hiding behaviour of fawns. Very often, a deer will not appear to be afraid of a stimulus although there may be a pronounced tachycardia. A table lists heart rate responses to certain stimuli given as multiples of the pre-stimulus rate. Examples: other deer, 1.25 - 2.50; lawnmowers and airplanes, 1.08 - 1.95; wolf howls, 0.43 - 1.65; rustling grass, more than 3.00.

KEYWORDS: Physiology/Predators, Airplanes, Noise, Generalized Stimuli/Odocoileus

347a. Mølmen, Ø. and T. Skogland. 1979. Prehistoric and present habitat distribution of wild mountain reindeer at Dovrefjell. Second Intern. Reindeer/Caribou Sump., Røros, Norway.

The use of obstructions such as lead fences and cairns by early hunters has not led to a disruption in traditional movements in reindeer. Cited in Klein 1979.

KEYWORDS: Movements/Fences, Hunting/Rangifer

348. Monaghan, H. 1976. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 127:19392; Impact of seismic operations on bears includes man/bear conflicts at camps, den-site disturbance and aircraft disturbance. Seismic operations may overlap with grizzly bear emergence from dens in the spring.

Vol. 127:19393-19399; Information on seismic impact on caribou is based on chance or short-term observations. Caribou reactions are variable. Work on Bathurst Island showed no strong reaction to seismic activity or blasting. Gray found aircraft disturbance to be harmful to muskoxen. Urquhart indicated individual muskoxen may suffer injury and calves may be abandoned.

Seismic operations are unlikely to affect Dall sheep but aerial harassment needs control. More research is needed in several areas of harassment.

Vol. 127:19418-19419; There are no studies of the effect of seismic activity on physiological stress.

Vol. 127:19433; There is no evidence for decreased population levels due to seismic work except for presence and absence of populations. For example, there is evidence for displacement of muskoxen but they may return.

Vol. 127:19437; A sensitive time for grizzly bears is as they emerge from their dens. No significant impact to caribou could have occurred on Bathurst Island due to the minimal number of animals.

Vol. 127:19440; Hoffman's report on caribou reaction to ski-doos and seismic activity is impressionistic.

KEYWORDS: Behaviour, Disturbance, Stress/Industry/Ovis, Rangifer, Ovibos, Ursus

349. Monaghan, H. 1976. Comments on the impact of seismic operations on wildlife in the N.W.T. Exhibit No. 481 entered before the Mackenzie Valley Pipeline Inquiry on behalf of C.O.P.E. 19 pp.

Begins with a review of what is currently known about the impact of seismic exploration on wildlife and what we need to find out. Makes specific recommendations for regulation of seismic programs to avoid significant and long-term impact.

KEYWORDS: Disturbance/Industry/Various Species

350. Moore, A.U. 1968. Effects of modified maternal care in sheep and goats. Pages 481 - 529 in G. Newton and S. Levine (eds.), Early experience and behavior. C.C. Thomas, Springfield.

A review of forty years of work on the effects of neonatal stress in sheep and goats. Animals stressed by classical Pavlovian conditioning early in life exhibit shorter life-spans and a decreased ability to raise young although they may superficially appear to be normal. Discusses at length the Pavlovian concept of "inhibition" which ranges from quiet watchfulness to catatonic "frozen flight".

KEYWORDS: Behaviour, Stress, Mortality, Reproduction/ Laboratory/Ovis

350a. Morehouse, T.A., R.A. Childers and L.E. Leask. 1978. Fish and † wildlife protection in the planning and construction of the Trans-Alaska oil pipeline. Interagency Energy-Environment Res. and Dev. Rpt. FWS/OBS - 78/70, Biol. Serv. Prog., Fish and Wildl. Serv., U.S. Dept. Interior. U.S. Gov't. Print. Off., Wash., D.C. 131 pp.

An analysis of government involvement in fish and wildlife surveillance during the planning and construction of the Trans-Alaska pipeline. Pages 80 - 84 discuss the problems involved with big-game crossing structures. Quotes memoranda and letters illustrating the "behind the scenes" maneuvering. On the basis of Child's work, biologist decided that no elevated structure would allow free-passage to caribou. Alyeska maintained there were alternate explanations. Based on experience with the Davidson Ditch, biologists felt that moose, cows and calves would pass under a pipeline elevated 5-1/2 ft but antlered bulls might not. An eight-foot clearance was recommended. There was no specific information on bears or bison but biologists felt these species would pass under the pipe.

KEYWORDS: Movements/Pipelines/Rangifer, Alces, Ursus

351. Morgantini, L.E. 1978. Ecology and behavior of the Banff -- Ya-Ha-Tinda elk herd and the effects of harassment. Progr. Rpt. submitted to Parks Canada, May 1978. 21 pp.

Report on a study of movements, herd dynamics, habitat selection, range condition, seasonal energy budgets and harassment of elk in Banff National Park and the adjacent Ya-Ha-Tinda Ranch. Opening of a usually closed gravel road for the servicing of an oil rig resulted in "disorientation" in grazing herds and retreat to cover from the usually exploited open grasslands. During the hunting season, a herd of 250 animals moved to alpine ranges generally used only in summer.

KEYWORDS: Behaviour, Distribution/Ground Vehicles, Hunting/Cervus

352. Morgantini, L.E. and R.J. Hudson. 1978. Human disturbance and habitat selection in elk. In Symp. Elk Ecology and Management in the Jackson-Yellowstone Region, April 3 - 5, 1978, Laramie, Wyoming.

In an area which had been subjected to heavy elk hunting for several years, elk utilized open areas near roads only during the early morning, evening and at night. In a similar area not subjected to such heavy hunter predation, elk could be observed in the open at any time of the day. During the hunting season, elk moved farther from roads and into higher elevation areas. This resulted in a 70% decrease in grassland use, a 65% increase in use of open mountain slopes, a 20% increase in the use of forested areas. Harassment therefore "caused an extensive use and overgrazing of marginal sectors of the potentially available grassland."

KEYWORDS: Behaviour, Distribution/Hunting/Cervus

353. Morgantini, L.E. 1979. Habitat selection and resource division in wildlife communities. M.S. Thesis, Univ. of Alberta.

Not seen.

KEYWORDS: Behaviour, Distribution/Ground Vehicles, Hunting/ Cervus

354. Morkridin, V.P. 1961. Control of harmful predators. Pages 311 - 325 in P.S. Zhigunov (ed.), Reindeer Husbandry/ Trans. from Russian, Israel Program for Sci. Transl., U.S. Dept. Commerce, Springfield, Va.

The introduction discusses the harmful affects on reindeer of harassment by wolves. Wolves may cause reindeer to scatter and die while the remainder of the herd graze restlessly and lose condition. Herdsman must crowd the herds which results in reduced weights and overgrazing. Wolf attacks during the rut and calving period increase the percentage of barrenness and fawn loss.

KEYWORDS: Behaviour, Reproduction/Predators/Rangifer

355. Mossop, D.H. 1976. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 137:20878-20895; A statement of the management problems faced by the Yukon Game Branch due to the construction and maintenance of a northern pipeline. In case after case, caribou, Dall sheep and grizzly bears disappear in areas opened to human activity. Access problems go beyond the simple process of allowing better opportunities for hunters. The corridor concept on the Dempster Highway, designed to allow caribou to cross certain sections, has not worked.

KEYWORDS: Population Dynamics, Movements/Roads, Civilization, Pipelines/Rangifer, Ovibos, Ursus

356. Mowat, F. 1970. Sibir. McClelland and Stewart Ltd., Toronto, 313 pp.

"We circled at low altitude and I expected the milling mass of beasts (reindeer) to stampede, but they only flung back their heads so their antlers ranged the sky like a forest shaken in a gust of wind. They were used to helicopters, which visited them at least once a week ...".

KEYWORDS: Behaviour/Aircraft/Rangifer

357. Muller-Schwarze, D. 1972. Responses of young black-tailed deer to predator odours. J. Mammal. 53:393-394.

Fawns react to predator odours of which they have had no previous experience. Furthermore, they are most affected by scents from predators normally preying on them; coyotes and mountain lions. This suggests an innate response to a dangerous stimulus.

KEYWORDS: Behaviour/Genetics, Predators/Odocoileus

358. Muller-Wille, L. 1975. Changes in Lappish reindeer herding in northern Finland caused by mechanization and motorization. Pages 122 - 126 in Proc. 1st. Intl. Reindeer/Caribou Symp., Univ. of Alaska, Fairbanks.

An anthropological discussion of the effects of the introduction of snowmobiles and motorbikes into reindeer herding. "After a drive by snowmobiles, the reindeer seem to be quite exhausted in the corral and become nervous and easily frightened. The harmful effects are still debated."

KEYWORDS: Behaviour/Ground Vehicles/Rangifer

359. Murie, A. 1934. The moose of Isle Royale. Univ. of Michigan Mus. Zool. Misc. Publ. 25. 44 pp.

A compendium of moose biology. There is much divergence of opinion regarding the activity of the moose's senses because moose show great inconsistency in reaction. Moose habituate well to man. Sounds are not particularly alarming to moose. Smell and sight are used to identify sources of sound and they dictate the nature of the reaction. Eyesight seems relatively poor while smell and hearing are highly developed. Observations of a fear reaction to human smell by calves but not adults suggest an instinctive fear of man.

KEYWORDS: Behaviour/Human Presence/Alces

360. Murie, O.J. 1935. Alaska-Yukon caribou. N. Amer. Fauna Ser. No. 54, U.S. Dept. Agric., Wash., D.C. 93 pp.

A compendium of caribou biology with many anecdotes. The caribou's eyesight is not remarkable but not poor. When a strange object is sighted, they seem unable to understand it and often circle to get its scent. Scent is the source most used for warning of danger. Caribou do not depend greatly upon hearing and tend to disregard sounds. Does are more alert than bucks. Cites cases of captured caribou dying of overexertion.

KEYWORDS: Mortality, Behaviour/Capture and Handling, Noise/Rangifer

361. Mutch, G.R.P. 1977. Mammals. Pages 217 - 234 in Interdisciplinary Systems Ltd. Initial environmental evaluation of the proposed Alaska Highway gas pipeline, Yukon Territory. Alaska Highway Pipeline Panel, Winnipeg. 691 pp.

A systematic assessment of potential impact on 10 mammal species by the Alaska Highway gas pipeline. The magnitude of impact was assessed to be greatest for Dall sheep followed by grizzly bears. It was estimated that construction-related disturbance would cause Dall sheep to withdraw from up to 50% of the area within 8 km on either side of the right-of-way. This area represents 18% of the winter range in the Corridor. Most of this withdrawal will probably be temporary. Available information on disturbance to Dall sheep by human-related phenomena is reviewed. It was estimated that grizzly bears will vacate a strip up to 1.6 km wide on either side of the right-of-way. Persistent disruption might cause evacuation of denning ranges which are of restricted distribution. Bears are very sensitive and susceptible to aircraft harassment, particularly in the spring. Wolves are expected to follow ungulates in range shifts away from construction zones. The extent to which wolves change dens as a result of disturbance is unknown. It was estimated that woodland caribou would vacate up to 50% of their range within a strip 1.5 km wide on each side of the right-of-way. This is about 4% of their range in the Corridor. Disturbance is expected to be minor mostly because they do not form large aggregations. Elk and moose expected to withdraw from 50% of their habitat within 1.5 km of the right-of-way. Aircraft harassment of elk mule deer is expected to be minor due to the dense vegetation in which the animals spend most of their time. Moose are relatively undisturbed by man. Moose disturbance will be most critical during the winter.

KEYWORDS: Distribution, Disturbance/Pipelines, Aircraft/ Alces, Rangifer, Lupus, Ovis, Ursus

362. National Academy of Sciences. 1970. Vertebrate pests: Problems and control. Volume 5 in Principles of plant and animal pest control, Wash., D.C.

The general effectiveness of devices to scare pests away is dependent upon the availability of alternate food sources. Cited in Mackenzie 1975.

KEYWORDS: Disturbance, Distribution/Generalized Stimuli/ Birds

363. National Energy Board. 1977. Reasons for decision: Northern Pipelines. 3 Vols., National Energy Board, Ottawa.

A 3 volume statement of the decision by the National Energy Board to accept the Foothills (Yukon) application. Chapter 6 of Volume 3 treats environmental concerns. A summary is given of each group's environmental studies, their conclusions and the mitigative measures prepared. An assessment is made of each group's environmental statements. Disturbance of wildlife emerges as a predominant concern.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

364. Neff, D.J. 1977. Effects of motor vehicle closure on game populations. Final Rpt., Arizona Game and Fish Dept., Fed. Aid in Wildl. Rest. Proj. W-71-R.

To determine the effect of motor vehicle exclusion on deer and elk populations and hunter use, all roads in two 11,200 acres and 12,160 areas in Arizona were closed in April 1972. Fecal pellet group counts indicated no effect of road closure on elk and deer use. Elk avoid areas where cattle graze. Extravehicular activity caused more disturbance than passage of vehicles. Only 18% of deer and 15% of elk did not run from passing vehicles. Elk in Arizona do not seem as sensitive to roads and traffic as those reported from Montana (Lyon 1975) and Idaho (Roberts 1974).

KEYWORDS: Behaviour, Distribution/Hunting, Human Presence, Ground Vehicles/Cervus

365. Neil, P.H., R.W. Hoffman, R.B. Gill. 1975. Effects of harassment on wild animals - an annotated bibliography of selected references. Colo. Div. Wildl. Spec. Rpt. 37. 21 pp.

A compilation of 68 annotated references dealing with harassment of wildlife. Emphasis is on the effects of off-road vehicles, free-roaming pets, urbanization and hunting.

KEYWORDS: Disturbance/Civilization, Ground Vehicles, Predators, Hunting/Various Species

366. Nelson, M. 1966. Problems of recreation use of game ranges. Trans. Desert Bighorn Counc. 10:13-20.

A discussion of the effect on desert bighorns of picnicking camping, exploring, hiking, hunting and desert dwelling. None of these taken singly can be considered as exerting a limiting influence on sheep. The question is asked "What effect does human intrusion have on bighorn sheep?" Bighorns have shown considerable versatility in human interactions. Bighorn sheep in the Parker Dam area on the Colorado River live directly above private residences. Sheep at Lake Havasu pay little attention to speedboats and water-skiers. On the other hand, there are many cases of bighorns reacting unfavourably to human intrusion. After a 3-year intensive trapping program on the Kofa Game Range, bighorns abandoned the range for several years. In the Hatchet Mountains of New Mexico, a population crashed following institution of a hunting program although hunter kill was not adequate to explain the loss. It is concluded that "... we cannot afford to risk the possibility of any loss of animals to human intrusion if by management we can prevent the overlapping of human recreation with bighorn sheep native habitat." (p. 20).

KEYWORDS: Population Dynamics, Distribution/Human Presence, Civilization, Hunting/Ovis

367. Nichols, L. 1972. Productivity in unhunted and heavily exploited † Dall sheep populations. In L. Nichols and W. Heimer, Sheep Report Vol. XIII, Proj. Progr. Rpt., Fed. Aid in Wildl. Rest. Proj. W-17-3 and W-17-4. Alaska Dept. Fish and Game, Juneau, Alaska.

"It is possible that the frequent close counting (by fixed-wing aircraft) had some effect on lamb survival through harassment. Some sheep -- usually yearlings and lambless ewes -- became excited over the close approach of the plane. Most, however, paid little attention or merely moved casually away. It was often necessary to "buzz" bedded animals several times before they would even stand. Standing or feeding sheep frequently refused to move unless pushed. The frequent harassment certainly did not force an observable number of sheep to abandon their range. No unnatural movements were noted, and sheep could be seen in the same general areas day after day."

KEYWORDS: Behaviour, Distribution, Population Dynamics/ Aircraft/Ovis

368. Nikolaevskii, L.D. 1968. Reindeer hygiene. Pages 57 - 77 in P.S. † Zhigunov (ed.), Reindeer Husbandry. Transl. from Russian by the Israel Program for Sci. Transl., U.S. Dept. Commerce, Springfield, Va. 348 pp.

A discussion of the diseases of reindeer, their aetiology and treatment. Two diseases seem to have a clear association with stress. Necrobacillosis, or foot rot, occurs in reindeer which are exhausted by harassment or haulage. Emphysema occurs in animals which are chilled during hard work. Exertion during late pregnancy can lead to abortion.

KEYWORDS: Pathology, Reproduction/Husbandry/Rangifer

369. Nishikawa, Y. and E.S.E. Hafez. 1968. Reproduction in horses. Pages 289 - 300 in E.S.E. Hafez (ed.), Reproduction in farm animals. Lea and Febiger, Phila.

During the 5th and 10th months of pregnancy, horses are endocrinologically susceptible to abortions. It is wise to avoid large amounts of physical exercise at this time.

KEYWORDS: Reproduction/Other Stimuli/Other Mammals

370. Nolan, J.W. and J.P. Kelsall. 1977. Dall sheep and their habitat in relation to pipeline proposals in northwestern Canada. Can. Wildl. Serv., Mackenzie Valley Pipeline Invest., Ottawa. 64 pp.

A survey of Dall sheep habitat along the Mackenzie Valley pipeline route. Sheep fear the sight and sound of aircraft. Low-flying aircraft are more disturbing than ones at high elevation. Helicopters are more disturbing than fixed-wing aircraft. This type of disturbance is worst during winter, the lambing period, and near mineral licks. The noise of compressor stations might keep sheep away from critical ranges.

KEYWORDS: Behaviour, Distribution/Aircraft, Pipelines/Ovis

371. Nixon, C.W., H.K. Hiller, H.C. Sommer and E. Guild. 1968. Sonic booms resulting from extremely low altitude supersonic flight: measurements and observations on horse, livestock and people. AMRL-TR-68-52.

Sonic booms have little effect on animal behaviour. Cited in Espmark et al. 1974.

KEYWORDS: Behaviour/Aircraft, Noise/Various Species

372. Norbert, N. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 47:4523; Oil companies are building roads everywhere and tearing up the land. There are no longer any caribou, mink, marten, lynx and beaver. Muskrats are very scarce.

KEYWORDS: Distribution/Industry/Rangifer, Other Mammals

373. Norton, D.W. 1976. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 197:31027-31035; One of the reasons for the decline in the Western Arctic caribou herd is the proximity of calving grounds to Prudhoe Bay.

KEYWORDS: Population Dynamics/Industry/Rangifer

374. Novakowski, N.S. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 102:15709-15710; Grizzly bears have been harassed in the Richards Island area but have survived.

KEYWORDS: Disturbance, Population Dynamics/Generalized Stimuli/Ursus

375. Olsen, N.A. 1971. Spatial and population dynamics of Dall sheep (Ovis dalli dalli Nelson) on Sheep Mountain, Yukon Territory. Prog. Rpt. 12 pp. Typescript.

Mentions heart ruptures in Dall rams that had died during capture. In one case, heart rupture was the real cause of death in a ram attacked by wolves. Cited in Kucera 1974.

KEYWORDS: Pathology, Mortality/Predators, Capture and Handling/Ovis

376. Oosenburg, S. 1976. Range relationships and population dynamics † of the Burwash-Uplands caribou herd, Yukon Territory. M. Sc. Thesis, Univ. of Waterloo, Waterloo, Ont. 180 pp.

A study of distribution and abundance of mountain caribou on the Burwash-Uplands. Describes the mountain caribou's tendency to avoid humans and flee when approached.

KEYWORDS: Behaviour/Human Presence/Rangifer

377. Oxley, D.J. and M.B. Fenton. 1976. The harm our roads do to nature and wildlife. Can. Geogr. J. 92(3):40-45.

A popular article outlining the diverse detrimental effects roads have on wildlife. Some species are reluctant to cross roads. It is difficult to predict the results of the resulting population fragmentation.

KEYWORDS: Movements/Roads/Various Species

378. Palmer, L.J. 1934. Raising reindeer in Alaska. U.S. Dept. Agric. Misc. Publ. No. 207. 40 pp.

Both reindeer and caribou take particular care of their fawns for the first 12 - 14 days during which time they are wary and avoid humans. Thereafter, human presence is again tolerated.

KEYWORDS: Reproduction, Behaviour/Human Presence/Rangifer

379. Parker, J.S.C. and A.D. Graham. 1971. The ecological and economic basis for game ranching in Africa. Pages 393 - 404 in E. Duffey and A.S. Watt (eds.), The scientific management of animal and plant communities for conservation. 11th Symp. Brt. Ecol. Soc., Oxford, Blackwell.

"The essence of domestication is the disappearance of the prey reaction to a predator (man) on the part of the domesticate. In the absence of pain another alarming stimuli emanating from man, animals soon relax their avoidance of him or aggression towards him - they become tame". This relaxation is quite resilient as evidenced by the fauna of Murchison Falls and Queen Elizabeth National Parks which remains habituated to the heavy tourist traffic despite the shooting of 2,000 elephants and 10,000 hippopotamus.

KEYWORDS: Behaviour, Habituation/Human Presence/Various Species

379a. Parovschikov, V. Y. 1965. Wild reindeer population and
* distribution in the Archangelsk north. Zoologicheakii Zhurnal. 44(2): 276-283. Transl. from Russian by Israel Progr. for Sci. Transl., Jerusalem, 1967. U.S. Dept. Comm. 10 pp.

In the Arkhangelsk region of the USSR, the breeding grounds of wild reindeer between the Onega and Severnaya Rivers are divided by a railway. The Kirov-Kotlas railway "cuts off" the breeding ground of wild reindeer in the Vologda region. Wild reindeer in the European section of the Soviet Union were nearly wiped out during the revolution and granted protection in 1935. In recent decades, the reindeer have begun to reestablish herd identities and migratory patterns. On the White Sea coast the reindeer began a migration in 1956 which necessitated two annual crossings of the Belmorvsk-Onega River railway. Cited in Klein 1979.

KEYWORDS: Movements/Railways/Rangifer

380. Pearson, A. M. 1975. The northern interior grizzly bear, Ursus
† arctos L. Can. Wildl. Serv. Rept. Ser. No. 34. Information Canada, Ottawa. 86 pp.

Report of a comprehensive grizzly bear study in the south-western Yukon from 1963 - 1972. Contains a short section entitled "Behaviour of grizzlies to humans". Bears learned to associate helicopters with capture. They would subsequently run in panic and/or hide in dense willow growths. Grizzlies move with little alertness and are easy to approach. Smell is the sense used for final and absolute identification.

KEYWORDS: Behaviour/Aircraft/Ursus

381. Pearson, A.M. 1975. Northern pipeline development and its implications to wildlife - grizzly bears. Environ. Social Progr., Prelim. Rpt., Northern Pipelines Task Force on Northern Oil Development.

It has been speculated by other authors that suitable den-sites are limiting grizzly bears in the north and that disturbance of these dens by northern development could have an important detrimental effect on populations. The dens of 12 radio-collared bears were located and described. Because of their low intrinsic rate of natural increase, northern grizzlies are more susceptible to population decline as a result of sport or "nuisance" shooting.

KEYWORDS: Disturbance/Industry/Ursus

382. Pearson, A.M. and J.A. Nagy. 1976. The arctic coastal grizzly
† bear and the potential impact of the proposed Inuvik-Tuktoyaktuk Highway. Unpubl. Ms., Can. Wildl. Serv., Edmonton. 9 pp.

Observations and radio-telemetered locations of grizzlies indicate that between Inuvik and Tuktoyaktuk there are fewer bears than in surrounding areas certainly due to the presence of man. Construction of the highway will probably cause increased human-bear interactions and further reductions in numbers of bears.

KEYWORDS: Distribution, Population Dynamics/Human Presence, Roads/Ursus

383. Pedersen, R. 1978. Impact and management of roads in relation to
÷ elk populations. Land Use Symp., Univ. of Wyoming.

During road construction and timber harvest in Oregon, it was discovered that elk avoided habitat within 250 m of the disturbed area. Single lane roads remove 2.7 acres of habitat per mile; for double lane roads the figure is 4.1 acres. If the zone of avoidance is included in this figure, 199 acres/mile of road are lost to elk.

KEYWORDS: Distribution/Roads/Cervus

384. Pelto, P.J. 1973. Technology and social change in the Arctic. Cummings Publ. Co., Menlo Park, Calif. 225 pp.

The Skolt Laps of northern Finland introduced snowmobiles into reindeer herding practices in the mid-1960's. This was associated with a drastic drop in number of reindeer owned and the proportion of men and families involved in herding. Harassment during roundups caused reindeer to scatter into small clusters in rockier and brushier pockets, altering the herding cycle and "de-domesticating" the reindeer. Calf production dropped and average body weights of 2-year old bulls decreased from 31 - 32 kilograms to 25-26 kilograms. There was some evidence of lung damage.

KEYWORDS: Pathology, Physical Condition, Behaviour, Distribution/Ground Vehicles/Rangifer

385. Pendergast, B. and J. Bindernagel. 1977. The impact of exploration for coal on mountain goats in northeastern British Columbia. Pages 64 - 68 in W. Samuel and W.G. MacGregor (eds.), Proc. First Int. Mountain Goat Symp., Kalispell, Mont. Sponsored by N.W. Sect. Wildl. Soc., B.C. Fish and Wildl. Br. 243 pp.

Mountain goat populations typically crash following opening up of an area for coal exploration. One explanation for population declines is harassment. Many guides and outfitters feel that as a response to harassment, goats move to new habitat. This is an inadequate explanation. There are no adjacent areas with suitable habitat. If such habitat did exist; it would already be occupied. Aerial censuses showed no range shifts. Hence, if emigration occurs it is accompanied with die-offs.

KEYWORDS: Distribution/Human Presence, Hunting/Oreamnos

386. Perry, C. and R. Overly. 1976. Impact of roads on big game distribution in portions of the Blue Mountains of Washington. Pages 62 -68 in S.R. Hieb (ed.), Proc. Elk-logging roads Symp., Moscow, Idaho. 143 pp.

Also available as Washington Game Department Applied Res. Bull. No. 11, 1977. Washington Game Dept., Olympia. 37 pp.

Roads were classified as main roads, secondary roads and primitive roads. Pellet group transects were read adjacent to these roads. "All roads caused a significant reduction in elk use of meadows, particularly west and south slopes from 0.2 to 0.8 km away." "In open forests, all roads reduced elk use: main roads to 0.4 km, secondary roads to 0.8 km, and primitive roads to 0.2 km." Elevation and degree of slope does not affect elk use. East-facing slopes were associated with minimal impact for unknown reasons.

KEYWORDS: Distribution/Roads/Cervus

387. Peterson, R.L. 1955. The North American moose. Univ. of Toronto Pr., Toronto. 280 pp.

A comprehensive study and literature review of moose biology. In general, hearing and smell is highly developed but sight is somewhat deficient. Moose will often ignore visual and auditory stimuli and react only when olfactory clues are obtained. Yearlings are not as afraid of humans as are adults. Comments on how moose can and do learn to live closely with humans but that the variable conditions under which moose live has led to controversy about their reactions to man.

KEYWORDS: Disturbance/Human Presence/Alces

388. Pipeline Application Assessment Group. 1975. Mackenzie Valley Pipeline assessment: Environmental and socio-economic affects of the proposed Canadian Arctic Gas Pipeline on the Northwest Territories and Yukon. Min. Ind. Affairs and Northern Dev., Ottawa. 442 pp.

A broadly based assessment of the effects of the Mackenzie Valley pipeline. Contains chapters on Dall sheep and the Porcupine caribou herd which include dicussions of disturbance. Also included is a chapter reviewing and assessing data on aircraft harassment.

KEYWORDS: Disturbance/Pipelines/Aircraft/Ovis, Rangifer

389. Ponomarev, A.S. 1938. Material on the development of young reindeer on the pastures of the northern Urals. Transl. from Russian by Instit. Polar Agric., Leningrad, Reindeer Industry Ser. 3:211-242.

Abandonment of new-born reindeer calves occurred most frequently following a disturbance. The majority of abandoned calves belonged to yearling mothers. Cited in Lent 1964.

KEYWORDS: Reproduction, Behaviour/Generalized Stimuli/ Rangifer

390. Preobrazhenskii, B.V. 1968. Management and breeding of reindeer. †
Pages 78 - 128 in P.S. Zhigunov (ed.), Reindeer Husbandry. Transl. from Russian by the Israel Program for Sci. Transl. U.S. Dept. Commerce, Springfield, Va. 348 pp.

A treatment of herding and breeding practices used by Soviet reindeer herders in the far North. A point that is made repeatedly is that reindeer must be spared unnecessary disturbance to ensure health, maximal weight gains, and successful reproduction. During the fly season, reindeer must be kept on elevated windy areas or they will tend to circle in tight groups. This exhausts reindeer, causes them to lose weight and facilitates the spread of disease, particularly necrobacillosis (foot rot). Reindeer which are allowed to graze freely without herding gain weight more rapidly. The better the state of nourishment during the breeding season, the more successful the rut. Therefore, it is imperative to organize fall and summer grazing in a "tranquil atmosphere". A winter loss in the doe's body weight of 17 - 24 % can result in resorption of the fetus. Careful tagging and registration of newborn fawns rarely results in desertion by the dam. Desertion as a result of disturbance is usually seen only in young does calving for the first time.

KEYWORDS: Reproduction, Behaviour, Physical Condition, Pathology/Husbandry/Rangifer

391. Price, R. 1972. Effects of human disturbance on Dall sheep. †
Alaska Coop. Wildl. Res. Unit., Quart. Rept. 23(3):23-28.

A study of the population parameters, range use patterns, seasonal groupings, interactions and reactions to human disturbance in the Dall sheep of the Atigun River in the Brooks Range. Aircraft noise was the main cause of disturbance. Sheep reaction was dependent on wind direction, closeness, intensity of noise, sheep location, and duration of disturbance. Helicopters generally fly closer, slower and are usually noisier ("rotor popping") and cause great disturbance. Sheep are more easily disturbed when at a lick. Specific incidents are described.

KEYWORDS: Behaviour/Aircraft/Ovis

392. Progulske, D.R. and T.S. Baskett. 1958. Mobility of Missouri deer and their harassment by dogs. J. Wildl. Manage. 22:184-192.

Harassment by dogs causes white-tailed deer in Missouri to run long distances. The effects of continued harassment (310 chase records in one year) may have been serious but could not be evaluated.

KEYWORDS: Movements, Behaviour/Predators, Chasing/Odocoileus

393. Quimby, R. 1974. Grizzly bear. Chapter II in R.D. Jakimchuk (ed.), Mammal studies in northeastern Alaska with emphasis within the Canning River drainage. Renewable Resources Consulting Services Ltd, Can. Arctic Gas Study Ltd. Biol. Rpt. Series Vol. 24.

Pages 73 - 77 discuss the reactions of grizzly bears to 173 fixed-wing aircraft and helicopters overflight in terms of observed reaction, altitude, type and speed of aircraft and horizontal distance from animal. Fifty-eight percent of bears reacted strongly to a Cessna 185 while 71% reacted strongly to a FH 1100 helicopter. This supports suggestion bears are more sensitive to aircraft than are ungulates.

KEYWORDS: Behaviour/Aircraft/Ursus

394. Rasmussen, A.F. Jr., J.T. March, N.Q. Brill. 1957. Increased susceptibility to herpes simplex in mice subjected to avoidance-learning stress or restraint. Proc. Soc. Exp. Biol. Med. 96(1)A:183-189.

Restraint and causing a mouse to jump a barrier once every five minutes for 6 hours to avoid a shock results in increased susceptibility to herpes simplex virus.

KEYWORDS: Pathology, Stress/Laboratory/Other Mammals

395. Rausch, R.A. 1958. Distribution, movements and dynamics of the rail-belt moose populations. Moose Management Studies, Alaska Game Comm. Job Compl. Rpt. Vol. 12, Proj. W-3-R-12, Work Plan A, Job No. 4, Pages 28 - 109.

A study of moose-railroad conflict in the Lower Susitna Valley was conducted in 1956 and 1957. Horn blast - light manipulation techniques for scaring moose had little effect.

KEYWORDS: Behaviour/Noise, Other Stimuli, Railways/Alces

396. Rausch, R.A. 1967. Some aspects of the population ecology of wolves, Alaska. Amer. Zool. 7:253-265.

"Wolves can live in association with man when afforded some degree of protection. This is typified by a situation in interior Alaska where wolves still travel on the outskirts of Fairbanks, and several active wolf dens are within ten miles of this residential and military complex of some 30,000 people." (p.253). Wolves practice cannibalism during times of stress.

KEYWORDS: Distribution/Civilization/Lupus

397. Ream, C.H. 1979. Human-wildlife conflicts in back country: Possible solutions. Trans. Symp. on the Recreational Impacts on Wildlands. Seattle, Oct. 17 - 19, 1978, in press.

Not seen.

KEYWORDS: Disturbance/Human Presence/Various Species

398. Reed, D.F. 1973. Deer underpass evaluation. Colo. Div. Wildl., Game Res. Div., Fed. Aid Proj. W-38-R-27, Job Progr. Rpt.

Deer use of concrete underpasses on Interstate 70 were evaluated. Deer increased their use of these structures by 40% from 1971 - 1973. An index of entrance vs. exit activity suggests a reluctance on the part of deer to use the structures. Project results for other years are reported in Job Progress Reports in the same series.

KEYWORDS: Behaviour, Movements/Roads/Odocoileus

399. Reed, D.F. 1973. Effects of a simulated 8-foot fence angle in diverting deer from their established direction of movement. Colo. Div. Wildl. Job Progr. Rpt., Proj. No. W-38-2-27, Work Plan No. 15, Job No. 11.

Ninety foot sections of 8-foot high fence were constructed across deer trails at various angles. Of 19 deer approaching, 9 returned the way they came. The sample size was inadequate for any conclusion. Project results for other years are reported in Job Progress Reports in the same series.

KEYWORDS: Movements/Fences/Odocoileus

400. Reed, D.F. and T.N. Woodard. 1975. Deer-vehicle accidents. Pages 8 - 12 in O.B. Cope (ed.), Colorado game research review: 1972 - 1974. Colo. Div. Wildl., St. Publ. Code DOW-R-R-G72-74.

Report on a continuing study of deer responses to fences, one-way gates, deer guards and underpasses. Does moved parallel to a fence for mean distances of .6 km; for bucks the mean was .9 km. Deer guards were not effective. Video records of 4,450 approaches to, and 1,739 entrances into, an underpass shows deer display three overt responses: look-up, muzzle-to-ground, and tail-up. The "look-up" suggests deer are reluctant to use the underpass. In total, 65% of the local deer migrated successfully through the underpass.

KEYWORDS: Movements, Behaviour/Roads, Fences/Odocoileus

401. Reed, D.F., T.N. Woodard, and T.M. Pojar. 1975. Behavioural
† response of mule deer to a highway underpass. J. Wild. Manage. 39(2):361-367.

A concrete underpass under Interstate 70 in Colorado was monitored for deer use over four years. A mean of 345 deer passed through the underpass seasonally. About 60% of the local population used the structure. The large number of approaches per successful passage and the frequencies of certain behavioural responses indicated an initial and continued reluctance to use the underpass.

KEYWORDS: Behaviour, Movements/Roads/Odocoileus

402. Reed, D.F. and T.N. Woodard. 1977. Deer-vehicle accidents. Pages 8 - 12 in O.B. Cope (ed.), Colorado game research review: 1975 - 1976. Colo. Div. Wildl., St. Publ. Code DOW-R-R-G75-76.

Results for 1975 - 1976 of deer reactions to fences, one-way gates, deer guards, underpasses and overpasses. Supplements earlier results. Research into overpasses suggest only a slight reluctance to cross them.

KEYWORDS: Behaviour, Movements/Roads, Fences/Odocoileus

403. Reid, R.L. 1961. Physiological disorders of grazing livestock:
† II. Proc. Int. Grassl. Congr. 8:657-600.

Pregnancy toxaemia (blood poisoning) can occur in well-nourished domestic ewes when they are fasted during a period of psychological stress such as transport or yarding. It is linked with altered blood glucose levels associated with hormonal imbalance in the direction of adrenal cortical hyperactivity. Experiments have shown that the psychological stresses associated with removal to a new environment evoke far greater adrenal responses than climatic stresses.

KEYWORDS: Stress, Reproduction/Husbandry/Ovis

404. Reid, R.L. and S.C. Miles. 1962. Studies on carbohydrate metabolism in sheep. The adrenal response to psychological stress. Aust. J. Agric. Res. 13:282-295.

Transported sheep exhibited increased plasma cortisol values. Movement of sheep, whether this be merely walking from the paddock to enclosed yards or road transport, is stressful. "... the outward appearance of the animals following a stressful procedure gave no indication of the presence of a marked physiological response."

KEYWORDS: Physiology, Stress/Husbandry/Ovis

405. Reimers, E. 1972. Growth in domestic and wild reindeer in Norway. † J. Wildl. Manage. 36(2):612-619.

Growth rates in wild and domestic reindeer are compared. Intensive herding of the domestic reindeer is considered responsible for the 23-43% lower dressed weight when compared with the wild population. This may be related in part to herding stress.

KEYWORDS: Physical Condition/Husbandry/Rangifer

406. Rempel, G. 1976. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 116:17652; Road construction as a barrier to caribou movement. Grizzly bear disturbance is discussed.

KEYWORDS: Movements, Disturbance/Roads, Generalized Stimuli/Ursus, Rangifer

407. Renewable Resources Consulting Services Ltd. 1971. A study of the Porcupine caribou herd. Williams Brothers Canada Ltd., Calgary.

Survey flights showed 36 of 52 seismic lines, trails, roads and airstrips had been utilized for travel by caribou.

KEYWORDS: Movements/Roads/Rangifer

408. Renewable Resources Consulting Services Ltd. 1972. Canadian Wildlife Service Arctic Ecology Map Series: Descriptive reports. (2nd ed.). Can. Wildl. Serv., Misc. Publ.

Documentation of key Arctic areas of particular importance to wildlife. Pages 6 - 15 give a brief description of potential impacts on various species.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

409. Renewable Resources Consulting Services Ltd. 1973. Disturbance studies of caribou and other mammals in the Yukon and Alaska, 1972. Prep. for Northern Engineering Services Ltd. 258 pp.

An earlier version of McCourt et al. (1974).

KEYWORDS: Disturbance, Behaviour, Distribution, Movements/ Aircraft, Noise, Roads, Pipelines/Alces, Ursus, Ovis, Rangifer

410. Reynolds, P. 1974. The effects of simulated compressor station * sounds on Dall sheep using mineral licks on the Brooks Range, Alaska. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Ser. No. 23, Chapter 2.

Dall sheep on two mineral licks in the Brooks Range were subjected to the simulated sounds of a 20,000 hp gas compressor station. The licks themselves were subjected to sounds of 58-73 dB. There was no noticeable effects on the numbers of sheep using the lick, their activities, the amount of time spent on the lick, age-sex composition of lick users, or distribution on the lick. The sheep showed strong reactions to helicopters within 150 yards but little or no reaction to ones farther away. There was little or no reaction to suddenly switching on the simulator.

KEYWORDS: Behaviour, Distribution/Noise, Industry/Ovis

411. Riegelhuth, R. 1966. Grizzly bears and human visitation. M.S. Thesis, Colo. St. Univ., Ft. Collins. 80 pp.

"Data indicated that back country (roadless area) visitation by non-hunting recreationists, at present levels of use, is not an important factor with regard to grizzly survival and well-being." Wilderness areas receive detrimental influences from managed areas adjacent to them. Therefore, large wilderness areas are most favourable for grizzlies. Limited data suggest any area smaller than 500 miles^2 must have excellent habitat for a grizzly population to exist.

KEYWORDS: Population Dynamics/Human Presence/Ursus

412. Riewe, R.R. 1973. Final report on a survey of ungulate populations † on the Bjorne Peninsula, Ellesmere Island. Determination of numbers and distribution and assessment of the effects of seismic activities on the behaviour of these populations. Unpubl. Rpt. Dept. Indian Aff. 63 pp.

Pages 26 - 32 discuss the behaviour of Peary caribou and muskoxen in relation to seismic operations. Aircraft flying at altitudes of less than 2000 ft causes muskoxen to stampede. Cites an instance of a herd running in response to a ground approach. The calves were left behind and attached themselves to the humans. Great difficulty was encountered in reuniting the calves with the herd. Only one instance of muskox-seismic interaction was recorded. The muskoxen moved 1-1/2 miles away from the area. A respected bush pilot stated that muskoxen definitely move away from sites of oil exploration. The author feels that the calf crop is adversely affected by vehicle traffic in that stampeding causes abortion and abandonment.

The behaviour of Peary caribou is variable in relation to vehicles and humans. Some caribou try to follow aircraft. Very few caribou were observed during censuses. There was no mass migration of caribou away from seismic activity but evidence of distribution changes in individuals.

KEYWORDS: Reproduction, Behaviour, Distribution/Industry, Aircraft, Human Presence/Ovibos, Rangifer

413. Riewe, R.R. 1973. Grise Fiord hunters. Northern Perspectives 1(7):2-7.

Tape recordings were made of eight senior hunters discussing wildlife. They related that caribou are always far away from Grise Fiord in the summer and the Inuit have to travel far to hunt them. The caribou are moving and disappearing and it is the white man's fault. Caribou are being chased away by aircraft noise and are now found in areas where they have never been before. While the Inuit once thought that there were no more caribou they have now found that caribou have been chased by airplanes and have "made new homes". Muskoxen never remain in an area where there are too many people or too much distraction.

KEYWORDS: Distribution/Aircraft, Human Presence/Ovibos, Rangifer

414. Riewe, R.R. 1977. Analysis of the interaction between wildlife and seismic lines in the vicinity of Aubry-Colville Lakes, N.W.T., Canada. R&R Research Ltd., Prep. for Dept. Indian Aff. North. Dev. 98 pp.

A study of how seismic lines influence the distribution and movements of game and fur-bearing mammals in the vicinity of Aubrey and Colville Lakes, N.W.T. Moose did not use seismic lines while caribou exhibited a moderate tendency to use seismic lines as travel routes when snow conditions warranted it and when the lines ran in a suitable direction. It is unknown how much diversion from normal routes results. Lakes and water systems seemed more important as travel routes than seismic lines. There is a relatively lower productivity of game and fur-bearers on seismic lines. However, since seismic lines cover only 0.18% of the land surface, the effect on carrying capacity is small.

KEYWORDS: Movements/Roads, Industry/Rangifer, Alces

415. Riney, T. 1950. Home range and seasonal movement in a Sierra deer herd. M.S. Thesis, Univ. of California, Berkeley. 42 pp.

Deer in the Jawbone area could not be driven from their home ranges by dogs. Cited in Dasmann and Taber 1956 p. 159.

KEYWORDS: Distribution, Movements/Chasing, Predators/Odocoileus

415a. Ringberg, T. 1979. The Spitzberger reindeer - a winter dormant ungulate? Acta. Physiol. Scand. 105: 268.

In the absence of predators and with restricted winter food supplies, Sralband reindeer have developed winter inactivity and docility. They show little alarm to vehicles or humans and graze within a coal-mining complex.

KEYWORDS: Behaviour/Generalized Stimuli/Rangifer

416. Roberts, H.B. 1974. Effects of logging on elk calving habitat, Moyer Creek. Salmon National Forest, Salmon, Idaho. 23 pp.

Elk are very sensitive to vehicular traffic in Idaho. They tend to avoid roads and cross them only in heavily timbered areas. They often move long distances to avoid logging activity. Cited in Neff 1977.

KEYWORDS: Distribution, Movements/Roads, Industry/Cervus

417. Robinson, C.S. 1935. Truck trails and firebreaks; their use by deer on the Santa Barbara Natation Forest. J. Forestry 33(11): 940-942.

Deer are not driven out by trail invasion of their habitat. Rather, the change in ecological conditions produces a new mixed growth of which deer are quick to take advantage. Cited in Leedy 1975.

KEYWORDS: Distribution/Roads/Odocoileus

418. Robus, M. 1974. Reactions of moose to snowmobile activity. Alaska Coop. Wildl. Unit Quart. Rpt. 26(2):12-17.

A proposal for a project involving radio-tracking of snowmobile harassed moose. Thesis not complete as of December 31, 1978.

KEYWORDS: Disturbance, Movements/Ground Vehicles/Alces

419. Roby, D.A. 1978. Behavioural patterns of barren-ground caribou of * the Central Arctic Herd adjacent to the Trans-Alaska Oil Pipeline. M.S. Thesis, Univ. of Alaska, Fairbanks. 200 pp.

A study of the seasonal and circadian behaviour patterns of caribou on Alaska's North Slope and the effects of various environmental factors (weather, forage, insects, snow, predators, other caribou, the pipeline and haul road) on caribou behaviour.

Of the four Alaskan herds whose ranges have been traversed by roads (Nelchina, Fortymile, McKinley and Delta), all have experienced severe population declines in the last decade. The role of disruption by transportation corridors is unknown.

Speculation on the impact of human disturbance has focused on five major concerns: "(1) the effect on efficiency of forage and habitat utilization, (2) energy cost of reaction to disturbance, (3) socially disruptive consequences of disturbance, (4) associated risk of injury during flight, and (5) effect on daily activity patterns and seasonal budgets."

The distance of caribou to the road was negatively correlated to the frequency of vehicle passage indicating habituation. However, the level of reaction was positively correlated with vehicle frequency. Caribou bunch and travel faster after disturbance. Reactions are decreased when they are lying. During August, caribou remained closer to the road probably due to decreased sensitivity through fly harassment. In the spring, lying was positively correlated with distance to the road while walking frequency and speed was negatively correlated.

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Roby, D.A. - 1978

Groups with calves were, during the summer, very sensitive to the road as reflected by altered activity budgets. During summer, there was no alteration in the activity budgets of cow-calf groups more than 300 m from the road. There was no change in activity budgets farther than 200 m from the road in bull groups during the summer and in all groups during the winter. Individual distance decreased close to the road. Bulls were more tolerant in pipeline crossings and are expected to habituate to them. All classes crossed the road more often where the berm was low. Bulls used the road as a mineral lick and were attracted by early snow melt on the road. Use of the road for travel was infrequent. Bulls often used the road and pipeline for relief from insect harassment.

Conclusions - (1) proximity to pipeline does not significantly disrupt activity, (2) impact of haul road is primarily distributional; cow-calf groups avoid the pipeline corridor, (3) cow-calf groups are very sensitive to humans during the summer, (4) bulls will habituate to the pipeline but avoidance by cow-calf groups will deter habituation in these classes, (5) large groups are more sensitive than small ones, and (6) it is not justifiable to generalize the reaction of caribou based on a single season or cohort.

KEYWORDS: Behaviour, Movements, Distribution/Roads, Ground Vehicles, Pipelines/Rangifer

420. Roseneau, D.G. & C. Warbelow. 1974. Distribution and numbers of muskoxen in northeastern Alaska and the northern Yukon, 1973. Chapter V in K.H. McCourt and L.P. Horstman (eds.), Studies of large mammal populations in northern Alaska, Yukon and Northwest Territories, 1973. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. No. 22.

A muskox group in northern Alaska shifted its 1973 summer range 16 miles from its 1972 summer range. It is speculated that heavy helicopter traffic in the area caused the shift. Muskoxen are sensitive to aircraft at distances of 1/2 to 1 mile.

KEYWORDS: Distribution/Aircraft/Ovibos

421. Roshchevski, M.P., N.I. Konovalov, and V.S. Beznosikov. 1976.
† Cardiac component of the emotional stress in the moose - Alces alces and reindeer Rangifer tarandus. Zhurnal Evoliutsionnoi Biokhimi i Fiziologii 12(4):381-384. (In Russian).

Heart rates were telemetered in moose and reindeer. ECG is affected by movement, season and temperature but most severely by emotional stress. A strange person, alone or with a dog, was used as the irritating stimulus. The animals remain behaviourally unaltered but heart rate changes instantly. The cardiac response is a two-phase process. In the first 3 - 7 seconds the rate increases by 2.4 times in moose and 2.7 times in reindeer. Intervals and deflection of the P, Q, S & T waves all change in such a manner as to suggest unfavourable heart work conditions. This first phase continues until the danger is evaluated. The second phase begins before the irritant stimulus is finished but after it is identified. This is a restoration phase which typically lasts 2 minutes.

KEYWORDS: Physiology/Human Presence/Alces, Rangifer

422. Rost, G.R. 1975. Response of deer and elk to roads. M.S. Thesis,
† Colo. St. Univ., Fort Collins.

Faecal pellet counts were made in .4 km transects perpendicular to roads on deer and elk winter range. Multiple regression showed that deer and elk avoid areas near paved and dirt roads; particularly those areas within .2 km of the roads. Roads on the east-slope were avoided more strikingly presumably due to the greater availability of suitable habitat.

KEYWORDS: Distribution/Roads/Odocoileus, Cervus

423. Rost, G.R. and J.A. Bailey. 1974. Responses of deer and elk to roads on the Roosevelt National Forst. Unpubl. Rpt., Colorado St. Univ., Fort Collins. 19 pp.

Fecal pellet-group densities and seven habitat variables were measured along transects perpendicular to forest roads in Roosevelt National Forest, Colorado. Multiple regression analysis allowed determination of those factors influencing the distance deer and elk maintain from roads. Deer avoidance of roads was greater in the mountain shrub zone than the ponderosa pine zone. Paved, gravel and unimproved dirt roads were all avoided. Limited data suggest elk avoid gravel roads but not dirt roads. The influence of this avoidance on the welfare of deer and elk is unknown. Cited in Neil et al. 1975.

KEYWORDS: Distribution/Roads/Odocoileus, Cervus

424. Rowe-Rowe, P.T. 1974. Flight behaviour and flight distances in blesbok. Z. Tiersychol. 34:208-211.

Flight distance in blesbok was constant throughout the year except during and soon after parturition when it was 4 - 5 times greater. Flight distances were greater in open grassland habitat and where tourists were less numerous.

KEYWORDS: Behaviour/Human Presence/Other Mammals

425. Russell, ?. 1845. Diary of a trapper. (Incomplete reference.)

"When the band (of elk) is first located, the hunters keep at some distance behind to avoid dispersing them, and to frighten them the more a continual noise is kept up by hollering and shouting over them which causes immediate confusion and collision of the band, and the weakest elk soon begin to drop on the ground exhausted." Cited in Baldwin and Stoddard 1973 and U.S. Congress, Senate 1971, pp. 255 - 256.

KEYWORDS: Stress/Human Presence, Hunting/Cervus

426. Russell, R.H. 1977. Personal communication in Tester 1979, p. 89.

Peary caribou were found to be less sensitive to aircraft disturbance under harsh winter conditions.

KEYWORDS: Disturbance/Aircraft/Rangifer

427. Ruttan, R.A. 1974. † Observations of grizzly bear in the northern Yukon Territory and Mackenzie River Valley, 1972. Chapter VII in R.A. Ruttan and D.R. Wooley (eds.), Studies of fur-bearers associated with proposed pipeline routes in the Yukon and Northwest Territories Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Series Vol. 9.

Page 13 discusses reaction of grizzlies to helicopters. Reaction was variable except when bears were on a kill when the reaction was generally "mild". No definition is given of "mild". Appendix B records 139 sightings involving 203 animals with reactions in 57 cases. Some bears ran from aircraft .4 - .9 km away and from aircraft at altitudes of over 1000 m.

KEYWORDS: Behaviour/Aircraft/Ursus

428. Ruttan, R.A. 1974. Observations of moose in the northern Yukon Territory and Mackenzie Valley, 1972. Chapter VI in R.A. Ruttan and D.R. Wooley (eds.), Studies of fur-bearers associated with proposed pipeline routes in the Yukon and Northwest Territories. Renewable Resources Consulting Services Ltd., Can. Arctic Gas Study Ltd. Biol. Rpt. Series Vol. 9.

Moose reacted aggressively towards helicopters on two occasions.

KEYWORDS: Behaviour/Aircraft/Alces

429. Schallenberger, A. 1977. Review of oil and gas exploitation impacts on grizzly bears. 4th Int. Conf. Bear Res. and Manage., Feb. 21 - 24, 1977. Kalispell, Montana.

Not seen.

KEYWORDS: Disturbance/Industry/Ursus

430. Schoonmaker, W.J. 1938. Notes on the white-tail deer in New York State. J. Mammal 19(4):503-504.

In the section on home range, the author concludes "... when wounded or tracked by hunters and when trailed by dogs, the deer (white-tail) may leave its territory, but barring death or accident it usually returns." (p. 504).

KEYWORDS: Movement, Distribution/Hunting, Chasing, Predators/ Odocoileus

431. Schultz, R.D. & J.A. Bailey. 1978. Responses of national park elk † to human activity. J. Wildl. Manage. 42(1):91-100.

A quantitive study of the effects of human activity and intentional harassment on the observability, movements and behaviour of elk in Rocky Mountain National Park. There was no evidence that tourist traffic or planned disturbance affect distribution, bugling activity, behaviour of rutting bulls, timing of movements or willingness to use areas near roads. Elk seem to have become less reactive to humans since the cessation of control hunting. Harems approached by people on foot became disorganized and bulls expended much energy in regrouping the cows. Elk used residential areas at night. Elk are more sensitive to approaching objects during daylight than in the dark.

KEYWORDS: Behaviour, Distribution/Human Presence/Cervus

432. Schultz International Ltd. 1972. Environmental impact study of the Dempster Highway. Folio I. Prep. for Dept. Publ. Works, Vancouver.

An environmental impact study for the Dempster Highway. Vehicular traffic along the highway will cause wildlife disturbance; particularly to grizzly bears. Other species will probably adapt. There is some concern about the highway detouring caribou migrations but little is known. Caribou may avoid the highway or use it as a migration path as they already do in the Ogilvy Mountains.

KEYWORDS: Disturbance, Movements/Roads/Rangifer, Ursus

433. Schweinsburg, R.E. 1974. An ornithological study of proposed gas pipeline routes in Alaska, Yukon Territory and the Northwest Territories, 1971. L.G.L. Ltd., Environmental Research Associates, Can. Arctic Gas Study Ltd. Biol. Rpt. Ser. No. 10. 215 pp.

Appendix III contains records of responses to aircraft by incidentally observed caribou, moose, Dall sheep, muskoxen, grizzly bears, polar bears, wolves, foxes, seals, and whales. Dall sheep were seen on three occasions; flight resulted in all cases. Grizzlies ran in all cases in which a response was indicated. Wolves "appeared panic-stricken" by the aircraft.

KEYWORDS: Behaviour/Aircraft/Ursus, Lupus, Ovis, Rangifer, Alces, Ovibos

434. Scott, I., Q.C. 1975. Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 98:14920-14961; Decrease in populations of the Fortymile, Newfoundland and Churchill herds after man's intrusion indicates the possible if not probable effect of developments such as a pipeline on the herds in the Yukon and N.W.T.

KEYWORDS: Population Dynamics/Civilization, Pipelines/Rangifer

435. Scott, I., Q.C. 1976. Commission Counsel submissions. Subm. to † the Mackenzie Valley Pipeline Inquiry, Yellowknife, N.W.T.

Recommendations by the Commission Counsel at the close of the Mackenzie Valley Pipeline Inquiry hearings. Chapter 2 deals with "Protection of Environment and Land" and has various subheadings such as "Terrestrial and Aquatic Mammals", "Wildlife Management" and "Aircraft Control". The section on mammals is an excellent review of the biology of and potential impacts on caribou, moose, bear, Dall sheep and muskoxen. Recommendations are made to the company and to government. The section on wildlife management calls for more studies on disturbance. The section on aircraft control states that concern about wildlife disturbance by aircraft is "pervasive". Little is known about the different effects on wildlife created by different aircraft types. Proper aircraft selection may significantly reduce disturbance in some species. Most of the concern about aircraft disturbance relates to summer and fall but winter and early spring are also critical for Dall sheep. Dall sheep, moose and caribou can be expected to be more severely affected as the winter advances. A minimum altitude of 2500 feet is recommended for winter and at all seasons over critical areas. Flight corridors and flight periodicity should also be regulated. The government should institute further research on air traffic disturbance with consideration of both short and long-term effects.

KEYWORDS: Disturbance/Aircraft, Pipelines/Rangifer, Alces, Ursus, Ovis, Ovibos

436. Scott, J.P. 1958. Animal behaviour. Univ. Chicago Pr., Chicago. 281 pp.

Hand-raised deer show no fear of humans. Therefore, "... we can conclude that what they fear or do not fear is learned anew from generation to generation." (p. 118).

KEYWORDS: Disturbance/Generalized Stimuli/Odocoileus

437. Segal, A.N. 1962. The periodicity of pasture and physiological functions of reindeer. Pages 130 - 150 in Severnyi olen'v Karel'skoi ASSR. Akad. Nauk SSSR, Moscow. 179 pp. (in Russian)

Activity budgets are useful in assessing the condition of reindeer and their range status. Stress tends to increase the duration of unproductive activity. Cited in Roby 1978.

KEYWORDS: Behaviour/Generalized Stimuli/Rangifer

438. Sealander, J.A., P.S. Gipson, M.E. Cartwright and J.M. Pledger. n.d. Behavioural and physiological studies of relationships between white-tailed deer and dogs in Arkansas. Subm. to Arkansas Game and Fish Comm. by Dept. of Zool., University of Arkansas, Fayetteville.

A series of experiments of questionable morality designed to assess the effects of dog chases on deer. In one study, deer were radio-collared and then chased by dogs. In most cases, deer left their home ranges but returned in all cases within 72 hours. Deer were observed to lose dogs by running down gravel roads then turning 90° into the woods.

In another study, deer were strapped into a circular chase apparatus consisting of a steel rod attached at one end. This allowed the deer to run in a circle as they were chased by dogs. Two pregnant does and a fawn died as a result of this harassment. Heart rates increased dramatically, particularly in the pregnant does and fawns. Rectal temperatures reached 41°C. White-blood cells decreased after chasing while there were increases in blood glucose, blood urea, nitrogen, creatinive, CPK, SGOT and SGPT. Other blood constituents showed great individual variation. It is obvious that pregnant does and fawns are very susceptible to this sort of harassment.

KEYWORDS: Mortality, Physiology, Distribution, Movements/Chasing, Laboratory, Predators/Odocoileus

439. Seal, U.S. and R.L. Hoskinson. 1978. Metabolic indicators of habitat condition and capture stress in pronghorns. J. Wildl. Manage. 42(4):755-763.

An analysis of blood samples from pronghorns captured in a corral-type trap which excited the animals. Capture effects were reflected in levels of lactic dehydrogenase (LDH), creatine phosphokinase (CPK), serum glutamic-oxalacetic transaminase (SGOT), and perhaps serum cortisol.

KEYWORDS: Physiology/Capture and Handling/Other Mammals

440. Seal, U.S., J.J. Ozoga, A.W. Erickson, and L.J. Verme. 1972. Effects immobilization on blood analyses of white-tailed deer. J. Wildl. Manage. 36(4):1034-1040.

A treatment of the problem of obtaining normal or base-line blood chemistry and hematology assays which are free from a stress artifact. Delayed effects of handling were noted after 24 hours, as hemodilution and increased levels of serum enzymes.

KEYWORDS: Physiology/Capture and Handling/Odocoileus

441. Selye, H. 1950. The physiology and pathology of exposure to stress. Acta Inc., Medical Publ., Montreal. 822 pp.

An encyclopedic summing-up of 20 years work by the world's pre-eminent researcher on stress. Data are organized and discussed in relation to Selye's theory of the "General-Adaptation-Syndrome."

KEYWORDS: Stress/Generalized Stimuli/Various Species

442. Selye, H. 1975. The stress of life. (Revised edition) McGraw-Hill, New York. *

A simplified summary of contemporary views on the scientific basis of the stress concept by the concept's originator.

KEYWORDS: Stress/Generalized Stimuli/Various Species

443. Semenov-Tian-Shanskii, O.I. 1975. The status of wild reindeer in the U.S.S.R., especially the Kola Peninsula. Pages 155 - 161 in Trans. 1st Intl. Reindeer/Caribou Symp., Univ. of Alaska, Fairbanks.

Domestic reindeer, which have gone feral and joined wild groups, remain less wary then wild reindeer.

KEYWORDS: Behaviour/Generalized Stimuli, Genetics/Rangifer

444. Sheldon, C. 1930. The wilderness of Denali: Explorations of a hunter-naturalist in northern Alaska. Chas. Scribner's Sons, N.Y. 412 pp.

"... after being frightened by scent, moose go farther without stopping than when frightened by sight." Cited in Peterson 1955 p. 101.

KEYWORDS: Behaviour/Generalized Stimuli/Alces

445. Shiras, G., III. 1912. The white sheep, giant moose and smaller game of the Kenai Peninsula, Alaska. Natl. Geog. 23(5):423-493.

"At times it seems almost impossible to alarm them, {moose} and then when this is accomplished, one wonders whether they ever recover from the shock".

KEYWORDS: Behaviour/Generalized Stimuli/Alces

446. Singer, F.J. 1975. Behaviour of mountain goats, elk and other wildlife in relation to U.S. Highway 2, Glacier National Park. Prep. for Fed. Highway Admin. and Glacier National Park. 96 pp.

A study of the relationship between mountain goats and humans along a section of highway near a lick. Elk are poached heavily along the highway and their flight distance is great. Successful crossings by goats were highly associated with no human presence, light traffic, larger groups, and older female leaders. Mountain goats habituated to trains and sounds of visitors at an exhibit but continued to perceive the sound and presence of passing vehicles as a threat.

KEYWORDS: Behaviour/Roads, Ground Vehicles, Human Presence/ Oreamnos

447. Singer, F.J. 1977. Dominance, leadership and group cohesion of mountain goats at a natural lick, Glacier National Park, Montana. Pages 107 - 113 in W. Samuel and W.G. MacGregor (eds.), Proc. First Int. Mountain Goat Symp., Kalispell, Montana. Spons. by N.W. Sect. Wildl. Soc., B.C. Fish and Wildl. Br. 243 pp.

A study of the behavioural reactions of mountain goats to U.S. Highway 2 and tourists in Glacier National Park, Montana. Several sources of evidence suggest habituation by the goats to traffic and vehicle disturbance. These are: 1) the rate of successful crossings increased as the season progressed, 2) goats shifted crossing points to routes with better cover, and 3) goats rapidly associated the highway and highway noise with danger.

KEYWORDS: Behaviour, Habituation/Roads, Ground Vehicles, Human Presence/Oreamnos

448. Singer, F.J. 1978. Behaviour of mountain goats in relation to † U.S. Highway 2, Glacier National Park, Montana. J. Wildl. Manage. 42(3):591-597.

Mountain goats cross U.S. Highway 2 in Glacier Park, Montana in going to and from mineral licks. In total, 87 crossings involving 692 goats were observed. An estimated 812 crossings occurred during 1975. Groups were more successful at crossing than were individuals, and those led by an adult female with a kid were the most successful groups. Crossings were usually crepuscular. The highway and its sounds were regarded as threats by the goats.

KEYWORDS: Behaviour/Roads, Ground Vehicles, Human Presence/ Oreamnos

449. Skoog, R.O. 1956. Range, movements, population and food habits of the Steese-Fortymile caribou herd. M.S. Thesis, Univ. of Alaska, College. 145 pp.

Pages 27 - 28 discusses the encroachment of civilization into previously wild parts of Alaska and suggest that this entails a decline in area available for caribou with consequent reductions in population sizes.

KEYWORDS: Population Dynamics/Civilization/Rangifer

450. Skoog, R.O. 1968. Ecology of the caribou in Alaska. Ph. D. * Thesis, Univ. of California, Berkeley. 699 pp.

An often cited encyclopedic compendium of caribou ecology in which the herds of Alaska are defined by their "centers of habitation". There was no change noted in the migration patterns of the Arctic, Fortymile, or Nelchina herds attributable to hunting. Caribou movements are influenced to some degree by terrain features; barriers are formed by lakes and rivers (particularly with cake ice), barren areas and burns, while ridge-tops, eskers, stream-beds, hard snow-drifts, frozen lakes and rivers all aid travel. Caribou have keen senses of sight, hearing and smell - the last being most important. They are often aware of predators but do not run off. There is a general lack of alertness and sleeping animals may be approached closely. Large groups are less alert.

KEYWORDS: Movements, Behaviour/Hunting, Generalized Stimuli/Rangifer

451. Skrobov, V.D. 1972. Man and the wild reindeer of Taimyr. (in
* Russian) Priroda 72(3):98-99. Transl. by F. Molnar on file at the library of Foothills Pipe Lines (Yukon) Ltd.

Industrial development has rapidly increased in the Taimyr region. There were 350,000 wild reindeer in the region in 1972. In fall 1967, the reindeer deviated from normal migration routes into a more settled region. The wild reindeer attracted about 6000 domesticated ones and drew them along on the migration. Many reindeer died trying to force their way along and across railways, roads and water pipelines. Losses were particularly high at night and amongst fawns. In fall 1969, a gas pipeline was built which caused great disturbance during the following spring migration. The greatly increased motor traffic in the area agitated the reindeer. Many successfully crossed a pre-existing railway but ran back and forth along the elevated pipeline until reaching places where snow had drifted over the pipe or where it lay on the surface. There they crossed. Many animals were turned back and wandered far to the east before turning north once again. Part of the herd remained in the south throughout the year. The town council of Norilsk issued an order to decrease night-time vehicle use. Artifical crossings were erected at major concentration points. In the fall of 1970, some animals did not make the return trip and wintered to the north of the pipeline. The author concludes that this is an example of how animals are able to quickly and creatively overcome unfavourable circumstances.

KEYWORDS: Movements, Behaviour/Pipelines, Roads, Railways, Ground Vehicles/Rangifer

452. Skuncke, F. 1969. Reindeer ecology and management in Sweden. Biol. Pap. Univ. Alaska No. 8, Fairbanks. 81 pp.

A general treatment of reindeer management with emphasis on range. Wild reindeer are tamed during the "gnat period" by providing them with an open shed with a smoky, peat fire within. Caribou find their own way in to escape flies thereby becoming habituated to men and corrals. They can be driven. This indicates the reduced reactiveness of caribou to humans during the fly season.

KEYWORDS: Behaviour/Human Presence/Rangifer

453. Slaney, F.F. and Co. Ltd. 1974. Environmental program, Mackenzie
† Delta, N.W.T., Canada: Winter study supplement. 74 pp.

Reindeer on the Mackenzie Delta were more reactive to aircraft in May than earlier in the winter. Includes a table where aircraft distance to reindeer is broken down into vertical and horizontal components. In winter, reindeer reacted to an observer on snowshoes at about 300 ft; in May the flight distance increased to 900 ft. Ski-doos are used by herders and are particularly alarming to reindeer. In response to a dynamite blast 2-1/2 miles distant, reindeer ran 100 - 150 ft and resumed feeding. Take-off by a Twin-Otter caused reindeer 1-1/2 to 2 miles away to run. When first exposed to aircraft, three of 10 grizzly bear groups remained bedded or in the den. After being tagged, all bears fled or hid when an aircraft approached. Tagging is obviously a severe disturbance, to grizzlies.

KEYWORDS: Behaviour/Aircraft, Ground Noise, Vehicles, Industry/Rangifer, Ursus

454. Slaney, F.F. and Co. Ltd. 1975. Peary caribou and muskoxen and Panarctic's seismic operations on Bathurst Island, N.W.T.: 1974. Unpubl. Rpt. for Panarctic Oils Ltd. by F.F. Slaney and Co. Ltd., Vancouver. 78 pp.

Very few muskoxen or caribou were observed in the vicinity of seismic crews. Isolated observations suggested that there was little disturbance of either species by seismic activity.

KEYWORDS: Behaviour/Industry/Ovibos

455. Slaney, F.F. and Co. Ltd. 1975. Peary caribou and muskoxen and
† Panarctic's seismic operations on Bathurst Island, N.W.T. 1974. Supplemental Report, Panarctic Oils Ltd., Calgary. 22 pp.

Seismic lines did not affect caribou movement and seismic activity at distances of two miles or more had little effect on caribou behaviour. Caribou within 1/2 mile of seismic activity showed avoidance behaviour. Sixty of 95 muskoxen were observed within 2.2 miles of seismic activity. Those 1.5 miles or more away were unaffected by seismic detonations or aircraft. Two herds within 1/2 mile showed alert postures followed by defensive circling and flight.

KEYWORDS: Behaviour, Distribution/Industry, Noise/Rangifer, Ovibos

456. Smith, D.R. 1954. The bighorn sheep in Idaho -- its status, life history and management. Fed. Aid Wildl. Rest. Idaho Proj. 99-R. Idaho Dept. Fish and Game Wildl. Bull. No. 1, Boise, Idaho.

Pages 50 - 52 discuss the reaction of sheep to man. Mountain sheep are easily approached by an observer on foot. They are somewhat more wary on their summer range than during the winter. Mature rams are the least wary. Lambs and yearlings are the most easily frightened.

KEYWORDS: Behaviour/Human Presence/Ovis

457. Sontag, L.W. and G. Comstock. 1938. Striae in the bones of a set of monozygotic triplets. Amer. J. Div. Child. 56:301-308.

Tranverse lines of increased density occur in children's bones when osteogenesis is disturbed. These lines appeared at different times in a set of identical triplets. The child producing the most striae was undergoing a period of emotional instability.

KEYWORDS: Pathology, Physiology/Generalized Stimuli/Homo

458. Soom, A., J.G. Bollinger and O.J. Rongstad. 1972. Studying the † effects of snowmobile noise on wildlife. Inter-Noise 72 Proc.: 236-241, October 4 - 6, 1972, Wash., D.C.

Rabbits and deer were fitted with radio-collars. Their positions and movements were determined before, during and after snowmobile operation. Rabbits moved more during snowmobile operation and increased their home range sizes. Deer movement increased and one of four deer left the area on one of 8 days but returned the following day.

KEYWORDS: Movements, Distribution/Noise, Ground Vehicles/ Other Mammals, Odocoileus

459. Sparrowe, R.D. and P.F. Springer. 1970. Seasonal activity pattern of white-tailed deer in eastern South Dakota. J. Wildl. Manage. 34(2):420-431.

A study of seasonal distribution and movement patterns of white-tailed deer in South Dakota. Hunting season had a marked effect on deer distribution and movement. Dispersal of over 10 miles was noted. Deer often remained in open fields so they could observe approaches.

KEYWORDS: Behaviour, Distribution, Movements/Hunting/Odocoileus

460. Speight, M.C.D. 1973. Outdoor recreation and its ecological effects: A bibliography and review. Discussion Papers in Conservation No. 4. 50 pp.

A review of the literature regarding ecological changes brought about by outdoor recreation. The focus is on the European situation. Pages 16 - 17 discusses wildlife disturbance in Europe and lists many papers dealing with the subject. Disturbance of animals by recreational activities can cause behavioural changes and breeding failure. Animals of open habitat are most susceptible to disturbance. There are some indications that the effects of disturbance depend more on the frequency of human presence than on the number of people present at any one time.

KEYWORDS: Disturbance, Behaviour, Reproduction/Human Presence/ Various Species

461. Spencer, D.L. and C.J. Lensink. 1970. The muskox of Nunivak Island, Alaska. J. Wildl. Manage. 34(1):1-15.

"When disturbed by aircraft during surveys, such bulls {groups of bulls} seem to initiate traditional defense formations, but are often diverted by a stronger aggressive behaviour and vigorous butting contests result." (p. 11).

KEYWORDS: Behaviour/Aircraft/Ovibos

461a. Stace-Smith, R. 1975. The misuse of snowmobiles against wildlife in Canada. Nature Canada 4(3)3-8.

People engaged in outdoor recreation object to snowmobile noise and therefore assume that the noise disturbs wildlife. This assumption is probably over-rated. Deer appear to adapt well to snowmobiles in areas where man-made noise is common. In remote regions, deer, elk and other ungulates are more easily frightened and may flee from their normal ranges. Studies are inconclusive because the phenomenon is so complex. Response depends upon the type of disturbance, weather, distance, previous experiences and other factors. Results from one area may not apply to another area.

KEYWORDS: Disturbance, Behaviour, Movements/Noise, Ground Vehicles/Odocoileus, Cervus

462. Stefannson, V. 1944. The friendly arctic: The story of five years in polar regions. (New ed.) MacMillan Co., N.Y. 812 pp.

"Occasionally, perhaps frightened by something else, a herd {of muskoxen} will run away on the first approach of danger. If they start running they are more difficult to overtake than caribou, which seldom run more than eight miles." (p. 583).

KEYWORDS: Behaviour, Movements/Generalized Stimuli/Ovibos, Rangifer

463. Stein, M., R.C. Schiara and M. Comarino. 1976. Influence of brain and behaviour on the immune system. Science 191:435-440.

A literature review of the effects of psychosocial stress on infection, neoplasia and immune processes. Suggests that these effects may be related to the hypothalamus although there is no single mediating factor.

KEYWORDS: Physiology, Stress/Generalized Stimuli/Various Species

464. Steinhart, P. 1978. Off we go, into the wild green yonder. Natl. Wildl. 16(4):16-19.

A popular article about aircraft harassment. Gives some examples of species adversely affected. Discusses FAA regulations regarding legal flight altitudes.

KEYWORDS: Disturbance/Aircraft/Various Species

465. Stelfox, J.G. and J.A. Bindernagel. 1978. Caribou behaviour in * relation to human-elk-wolf influences. Jasper National Park 1971 - 1974. Prepared for Parks Canada by the Can. Wildl. Serv., Edmonton. 59 pp.

Mountain caribou in Jasper National Park were found to have a low tolerance for human intrusion into the alpine-tundra. At lower elevations, caribou were more tolerant. Young caribou showed curiosity to humans often approaching before running off. The strongest alarm was produced when humans were scented at close range. Flight occurred at distances of between 200 and 700 m. Grazing was interrupted at distances of less than 350 m. As long as caribou were 100 m uphill and upwind of hikers, they showed little alarm. They reacted with alarm to direct approaches, when hikers were uphill or upwind, and when bright, flapping gear was used. Reactions to humans were less intense when temperatures were below 12°C. Heat and human stresses may therefore be additive and synergistic. It was impossible to analyze the importance of interactions of alarming stimuli classes (distance from humans, weather, topographic location of danger, habitat and sex). Cows with calves had greater flushing distances. Descriptions of six specific instances serve to exhibit the variability of caribou reactions.

KEYWORDS: Behaviour/Human Presence/Rangifer

466. Stephens, D.B. and J.N. Toner. 1975. Husbandry influences on some physiological parameters of emotional responses in calves. Appl. Animn. Ethol. 1:233-243.

Simple restraint and immobilization of calves causes an elevation in heart rate from 100 - 140 beats/minute and more than tripled plasma corticosteroid levels. Transportation effects on heart rate and plasma corticosteroids were greater if the animal was free as opposed to being held in a small wooden cubicle. It is concluded that physiological responses depend largely on the magnitude and novelty inherent in the stimulus.

KEYWORDS: Physiology/Capture and Handling/Bos

467. Sterling, I. 1976. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 122:18547; Seismic activities should be restricted within 5 - 10 miles of polar bear denning areas.

KEYWORDS: Disturbance/Industry/Thalarctus

468. Stringham, S.F. 1971. Calf behaviour and the cow-calf bond in moose. Alaska Coop. Wildl. Research Unit Quart. Rept. 22(4): 12-32.

An investigation into the ontogeny of social behaviour in the moose, population effects on cow-calf relationships, and the behavioural symptoms of stress. Moose gradually became habituated to an observer and allowed approaches to 25 m. In disturbed animals the following reactions occurred: (1) movements became tense, (2) frequency of comfort movements increased from 2 - 5/hr to 20 - 50/hr, (3) elimination increased from 1 - 2/hr to 4 - 8/hr, (4) amount of time spent staring increased, (5) amount of time with the head cocked forward increased, (6) rate of breathing increased from .2 - .5/sec to 2/sec, (7) duration of feeding bouts decreased and (8) duration of rumination bouts decreased.

KEYWORDS: Behaviour/Human Presence, Generalized Stimuli/ Alces

469. Stringham, S.F. 1974. Mother-infant relations in semi-captive Alaskan moose (Akces alces gigas). M.S. Thesis, Univ. of Alaska, Fairbanks. 140 pp.

Not seen.

KEYWORDS: Behaviour/Human Presence, Generalized Stimuli/ Alces

470. Stringham, S.F. 1974. Mother-infant relations in moose. † Naturaliste Can. 101:325-369.

The abruptness with which bedded moose get up and the length of time they spent active thereafter were both associated with the duration and severity of the disturbance. Severity was, in turn, a function of the disturbance type and the psychophysiological state of the moose. As a rest period progresses, sensitivity to disturbance increases. The author hypothesizes that the longer a moose has rested, the greater is its endogenous motivation to arise and therefore, less of an external stimulus is sufficient to elicit a response. When non-habituated moose without calves were disturbed while resting, they typically arose prepared for flight. Cows with neonates exhibit much more of a tendency to "freeze".

KEYWORDS: Behaviour/Generalized Stimuli/Alces

471. Summerfield, B.L. 1974. Population dynamics and seasonal movement patterns of Dall sheep in the Atigun Canyon area, Brooks Range, Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks.

In the author's experience, Dall sheep habituate well to aircraft as long as the flight patterns are regular and the sheep are not approached too closely. In nearly all instances in Alaska, where roads have been built near or through Dall sheep habitat it has been necessary to stop or closely restrict the sheep kill. It is possible that the synergistic effects of hunting and human activity could lead to range abandonment even if the hunting pressure were light.

KEYWORDS: Behaviour, Population Dynamics/Hunting, Roads, Aircraft/Ovis

472. Summerfield, B.L. and D.R. Klein. 1974. Population dynamics and † seasonal movement patterns of Dall sheep in the Atigun River Canyon. Quart. Rpt. Alaska Coop. Wildl. Res. Unit 25(4):16-19.

Construction of the Trans-Alaska Pipeline has to this date had little effect on Dall sheep. A road was built past the base of the mountain within one mile of a major wintering and lambing area. Sheep remained in the area with no decriment to the lamb production. Air traffic was light to moderate during lambing.

KEYWORDS: Reproduction, Distribution/Pipelines, Aircraft/Ovis

473. Surrendi, D.C. and E.A. DeBock. 1976. Seasonal distribution, population status and behaviour of the Porcupine caribou herd. Can. Wildl. Serv., Mackenzie Valley Pipeline Investigations, Ottawa. 144 pp.

Contains sections on caribou response to aircraft and the Dempster Highway. Caribou reactions to aircraft were divided into 5 behavioural categories. The closer the aircraft, the more extreme the caribou response. There appeared to be a threshold valve of about 75 m below which responses dramatically increase. Subjectively, helicopters initiated panic and escape responses at greater distances than fixed-wing aircraft. At aircraft elevation of 15 m, 71% of caribou exhibited panic; this figure decreased to 35.5% at 60 m. Above 240 m there was no observable panic or escape reaction. Caribou were most sensitive in spring and early winter. Caribou in open habitat did not react as violently as those in heavily forested situations. Bedded caribou were less sensitive. Larger groups reacted more violently to aircraft than smaller ones.

Caribou were observed to approach the Dempster Highway on 36 occasions. Approaches were reversed or interrupted in 22% of cases, 69% were successful and 9% crossed but recrossed to join again with parts of the group which refused to cross over. Caribou approaching the road in a timbered area were more cautious than in open areas. Caribou were very sensitive to vehicular traffic on the road. Disturbed caribou frequently crossed the highway at night after traffic had ceased. There appeared to be an aversion to walking on the gravelled surface of the road. Raised portions of the highway induced avoidance behaviour. Caribou often walked parallel to the road.

KEYWORDS: Behaviour/Aircraft, Roads, Ground Vehicles/Rangifer

474. Surrendi, D.C., M. Dennington, E.A. DeBock. 1975. Seasonal distribution, population size, composition and behaviour of the Porcupine Caribou herd. Exhibit 374 entered before the Mackenzie Valley Pipeline Inquiry, Yellowknife.

An earlier draft of Surrendi and DeBock (1977).

KEYWORDS: Behaviour/Aircraft, Ground Vehicles, Roads/Rangifer

475. Sweeney, J.R., R.L. Marchinton and J.M. Sweeney. 1971. Responses of radio-monitored white-tailed deer chased by hunting dogs. J. Wildl. Manage. 35(4):707-716.

Studies were done in three separate areas in the South to assess the responses of white-tailed deer to chasing by domestic dogs. Chases averaged 33 minutes in duration and 2.4 miles in distance. Deer left their home ranges but returned in one day or sooner.

KEYWORDS: Distribution/Chasing, Predators/Odocoileus

476. Swope, H.M. 1972. Big game research. Pages 1 - 20 in L.E. Yeager (ed.), Colorado game research review: 1970 - 1971. Colo. Div. Wildl., St. Publ. Code GFP-R-R-G70-71.

Pages 6 - 7 describe the initiation of a study of underpass used by deer continued by Reed and Woodard. The number of deer using the underpass increased by 31% between 1970 and 1971.

KEYWORDS: Behaviour, Movements/Roads/Odocoileus

477. Symington, F. 1965. Tuktu - the caribou of the northern mainland. Can. Wildl. Serv., Ottawa. 92 pp.

Caribou are more approachable when in herds rather than small groups. They are less frightened by human approach during the migration than at any other time. "... caribou are most inconsistent in their behaviour; no one can accurately predict their actions and reactions." (p. 32).

KEYWORDS: Behaviour/Human Presence/Rangifer

478. Tanner, J.M. 1962. Growth at adolescence, 2nd ed., Blackwell, Oxford.

A comprehensive treatment of human growth during the adolescent years. "That adverse psychological conditions may cause a degree of retardation in growth is a thought that comes naturally to mind, particularly when a possible mechanism exists in the response of the pituitary and adrenals to stress of this nature. Clean-cut experiments on such an issue are usually very hard to find, however, and opinions tend to be founded on desire rather than fact." (p. 135).

KEYWORDS: Physiology/Generalized Stimuli/Humans

479. Taylor, R.S. 1973. Report of Russian trip of Canadian Gas Working Group to Norilsk, Moscow, and Leningrad , September 24 - October 9, 1973. Draft Rpt., Can. Arctic Gas Study Ltd. 49 pp.

East-west pipelines lie across normal migratory paths of 300,000 reindeer in the Taimyr. Although buried in some sections, the pipeline is elevated on pilings for the most part. There are a number of special underpasses 4 - 6 m high and 45 - 60 m long. Local Russians said the pipeline caused disturbance to the reindeer in the first year but thereafter it was ignored. Several thousand reindeer were observed to ignore the pipeline. Reindeer grazed on both sides of the line and passed freely under and over it by leaping over areas close to the ground.

KEYWORDS: Behaviour, Movements/Pipelines/Rangifer

480. Taylor, S. n.d. Personal communication cited in Calef (1974) p. 114.

A herd of reindeer in the Taimyr region of the U.S.S.R. were initially confused by an elevated pipeline but began crossing under it after the first year.

KEYWORDS: Behaviour, Movements/Pipelines/Rangifer

481. Tester, F.J. (ed.). 1979. The potential, social, economic and environmental impacts of the proposed Polar Gas Pipeline on the District of Keewatin, Northwest Territories. 2 vols. To be published by Dept. Indian Aff. and North. Dev. in autumn, 1979.

Volume 2 assesses the potential environmental, social and economic impacts of the Polar Gas Pipeline through the Keewatin District. Chapter 5.2 discusses the biology of caribou and potential impacts on the species. The problems of physical barriers, predator advantage, aircraft harassment, increased access, and cumulative and synergistic effects are discussed.

KEYWORDS: Movements, Behaviour, Mortality, Population Dynamics, Distribution/Aircraft, Pipelines, Roads, Civilization, Hunting/Rangifer

482. Tester, J.R. and K.L. Heegen. 1965. Deer response to a drive census determined by radio-tracking. Bioscience 15:100-104.

Description of the panic behaviour of white-tailed deer during a census drive. Two radio-collared deer were pushed from their home ranges but returned by late evening. "The disturbing effects of the drive appear to have been very short lived since we could not detect any difference in the range of movement on the activity patterns of the deer immediately following the census". (p. 104).

KEYWORDS: Distribution/Chasing/Odocoileus

483. Texter, E.C. Jr., C.-C. Chou, H.C. Laureta and G.R. Vantrappen. 1968. Physiology of the gastrointestinal tract. C.V. Mosby Co., St. Louis. 262 pp.

Pages 111 and 169 mention the effects of emotion on the gastrointestinal tract's function. Emotion can slow the rate of passage of flood through the stomach and increase the secretion of HCl.

KEYWORDS: Physiology/Generalized Stimuli/Various Species

484. Thiessen, J.L. 1976. † Some relations of elk to logging, roading and hunting in Idaho's Game Management Unit 39. Pages 3 - 5 in Hieb, S.R. (ed.), Proc. Elk-logging-roads, Symp., Moscow, Idaho. 143 pp.

Distribution of hunter elk kills were compared for 1973 and 1961 (prior to intensive logging). Of the 1961 kill, 43% came from currently roadless areas while 65% of present hunt came from such areas. This indicates that increases in roads result in decreases in elk.

KEYWORDS: Distribution/Roads, Hunting/Cervus

485. Thomas, D.C. 1977. Major concerns of northern pipelines relative to terrestrial mammals. Appendix 4 in P.J. Rennie (ed.), A broad environmental comparison of northern Canadian natural gas pipeline routes: Third edition with specialist appendices. Prep. for the Interdepartmental Comm. on Oil by Can. For. Serv., Dept. of Env., Ottawa.

An assessment of the major concerns about the impact of the 12 proposed northern gas pipeline routes. Each concern for each species on each route was rated from one star (low concern) to three stars (great concern). Harassment of caribou, muskox and Dall sheep is viewed as a major concern on several routes.

KEYWORDS: Disturbance/Pipelines/Rangifer, Ovibos, Ovis

486. Thomas, D., I. Beck, C.A. Doose, J.D. Fleming, S.L. McDonnell, R.W. Morse, K.R. Kincaid, D.F. Reed and T.N. Woodard. 1977. Deer vehicle accidents statewide and methods and devices to reduce them. Colo. Div. Wildl., Fed. Aid W-125-R-3, Work Plan 1, Job Nos. 1 - 6, Job Progr. Rpt., p. 23 - 41.

A several-faceted and on-going study of methods and devices to reduce deer-vehicle accidents. Jobs 3 and 4 involve evaluation of deer responses to underpasses and overpasses. Deer usually show alert behaviour and trot out of underpasses suggesting reluctance to use them. Tentative results suggest narrowing width of overpass from 4.93 to 2.48 m has little effect on deer response.

KEYWORDS: Behaviour, Movements/Roads/Odocoileus

487. Thompson, R.F. and W.A. Spencer. 1966. Habituation: A model phenomenon for the study of neuronal substrates of behaviour. Psych. Rev. 73(1):16-43.

A useful review of the psychological concept of habituation as a response decrement resulting from repeated stimulation.

KEYWORDS: Habituation/Generalized Stimuli/Various Species

488. Thompson, W.R. 1957. Influence of prenatal maternal anxiety on emotionality in young rats. Science 125:698-699.

A test of the hypothesis that emotional trauma during pregnancy can affect the emotional chacteristics of the offspring. Female rats were conditioned to expect a shock at the sound of a buzzer. They were then mated. When pregnant they were subjected to the buzzer but no shock. Experimental offspring showed greater latencies in activity, leaving the cage, and in finding food. These effects lasted into adulthood.

KEYWORDS: Behaviour/Laboratory/Other Mammals

489. Thomson, B.R. 1971. Wild reindeer activity, Hardangervidda, July - December, 1970. Rpt. of Norwegian IBP, Statens Viltundersokelser, Trondheim. 83 pp.

A comparison of the activity budgets of wild reindeer at different seasons. During the hunting season of September 1970, many licenses were issued in an attempt to reduce the herd. Reindeer activity was drastically altered. "The reason for herd disturbance in the hunt is not the death of an individual reindeer per se, nor only the occasional noise from shooting, but the whole barrage of human sights, scents and sounds to which they are subjected." Groups were continually being disturbed. The amount of time spent grazing was reduced to 30%; a 15 - 20% reduction. Likewise, time spent lying down was 17%; a 10% reduction. Running and trotting decreased energy intake and also created greater energy demands on the animal. It is unlikely that a positive energy balance could be maintained which is particularly unfortunate since this period is an important fattening period between the fly and rutting seasons.

KEYWORDS: Behaviour, Energetics/Hunting/Rangifer

490. Thomson, B.R. 1972. Reindeer disturbance. Deer: J. of Brit. * Deer. Soc. 2:882-883.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli/Rangifer

491. Thomson, B.R. 1973. Wild reindeer activity, Hardangervidda
† 1971. Statens Viltunderskoler and Norway IBP. Rpt. to Grazing Proj. of Norwegian IBP, Trondheim. 76 pp.

A study of reindeer activity patterns in Norway. "The reaction of reindeer to an alerting stimulus depended on the time of year, the type of stimulus and the intensity of the visual, olfactory or auditory stimulus received by the deer. Thus, reaction to the scent or sight of a person, or the sight of an eagle flying, is greater than to a raven flying, while there is usually least response to a raven on the ground, common-gulls and foxes. Reindeer are less readily alarmed and put to flight in summer than at other times, especially when they are in huge herds, and always when they are harassed and disturbed by flies. The mature male at rutting time shows little awareness or fear of external stimuli which would put him to flight at other times of the year." The effect of disturbance is usually short-lived. In the 1970 hunt, reindeer were disturbed every 20 minutes on average. The resulting reduction in grazing and lying time and increase in running and trotting time makes it doubtful whether they could maintain a positive energy balance.

KEYWORDS: Disturbance, Behaviour/Hunting, Generalized Stimuli/ Rangifer

492. Thomson, B.R. 1977. The behaviour of wild reindeer in Norway.
* Ph. D. Thesis, Univ. of Edinburgh, Edinburgh. 428 pp.

A major study on wild reindeer population size, life cycle, behaviour and activity and energy budgets. Section 7.9 deals with human disturbance while Chapter 8 treats the energetic consequences of disturbance by hunting. The wariness of reindeer depends on season and exposure to hunting. During winter, approach of man within 1 km often causes flight while in summer, reindeer occasionally graze to within 10 m of a stationary observer. Males in the rut are particularly unwary. Disturbances occurred once every 7 - 8 hrs in winter, once every 3 hrs in summer and once every 18 mins during the hunting season. Humans were the predominant cause of alarm. A model of reindeer energy expenditure based on activity budgets showed the energy loss to be 3.84 x basal metabolic rate (BMR) during the hunting season as opposed to 1.46 x BMR during the remainder of the winter. This translates into a 6.6% increase in annual energy needs resulting from the hunt.

KEYWORDS: Disturbance, Energetics/Human Presence, Hunting/ Rangifer

493. Thorne, E.T. 1975. Normal body temperature of pronghorn antelope and mule deer. J. Mammal. 56(3):697-698.

Body temperatures of semi-tame mule deer and pronghorn antelope were monitored with implantable temperature sensitive transmitters. There were no effects caused by resting, standing, walking, or eating. Excitement resulting from "induced stress" produced significant temperature increases.

KEYWORDS: Physiology/Generalized Stimuli/Odocoileus, Other Mammals

494. Topinski, P. 1975. Abnormal antler cycles in deer as a result of stress-inducing factors. Acta Theriol. 20:267-279.

Deer bucks of several species were stressed either by introducing strange males, removing dominant males, or causing a fear reaction to humans. Such stress inhibits antler-shedding.

KEYWORDS: Physiology/Human Presence/Various Species

495. Townsend, M.T. and M.W. Smith. 1933. The white-tailed deer of the Adirondacks. Bull., N.Y. St. Coll. Forest., Syracuse Univ. 6(1):151-385.

"Merriam ... states that 'in localities that are much frequented by man they [deer] keep to their beds during the greater part of the day, and feed mostly by night; while in remoter sections the reverse seems to be true.'" If disturbance is too great, deer leave the locality.

Cited on pages 148 - 149 in Severinghaus, C.W. and F.L. Cheatum. 1956. Life and times of the white-tailed deer. Pages 57 - 186 in W.P. Taylor (ed.), The deer of North America. The Stackpole Co., Harrisburg, Pa. and The Wildlife Management Inst., Wash., D.C. 668 pp.

KEYWORDS: Behaviour, Distribution/Human Presence/Odocoileus

496. Tracy, D.M. 1977. Reaction of wildlife to human activity along * Mount McKinley National Park Road. M.S. Thesis, Univ. of Alaska, Fairbanks. 260 pp.

An evaluation of human activities along the Mt. McKinley Park road on the behaviour of caribou, moose, Dall sheep, brown bears and red foxes. One hundred trips were made along the road (either in the shuttle-bus or a pick-up). This was supplemented by 300 hr of intensive observations.

Within 100 m of the road, 61% of caribou exhibited visible reactions to the shuttle-bus. Beyond 400 m, fewer than 10% reacted. Between 0800 and 1700 hr, there were an average of 4.5 mild and 2.5 strong reactions; this is several times the natural frequency of alarm. People getting out of the buses or making noise increased caribou reactions. Larger groups showed greater sensitivity. Calves were more reactive than cows and travelling caribou more sensitive than lying or feeding ones. Later in the tourist season, reactions were decreased either due to habituation or a larger proportion of bulls. Near the road, travel activity increased at the expense of feeding activity. Caribou cross the road readily but with obvious caution and their direction of travel is often altered.

After the spring opening of the road, there was no reduction in moose numbers near the road. Moose distribution was inversely proportional to distance from the road; 80% were within 200 m. Within 20 m, 50% showed no reaction to buses, 20% a mild reaction and 29% a strong one. There existed a positive correlation between response strength and nearness to the road. Cow-calf groups were more responsive than solitary cows or bulls. The response of moose to disturbance is very subtle; they may never look at the bus but graze off into dense cover. "Because many disturbance studies depend on interpreting the instantaneous visible responses to a disturbance, the level of sensitivity in moose is probably often underestimated." (p. 104).

There was no effect of the road on Dall sheep distribution although use of the road area was greater in the past. Sheep cross the road very warily. There was a significant positive relation between distance to the road and level of disturbance. Sheep may be approached on foot rather easily. Lambs were never seen within 200 m of the road. There were consistently more bears seen far from the road than near it. Within 200 m of the road, 56% of bears showed no reaction to the bus; 12% showed mild reactions and 32% strong ones. Between 0600 and 2100 hr, a typical bear within 200 m of the road experiences 0.8 mild reactions and 2.2 strong ones. Noises were particularly frightening to bears. Tentatively, single bears seemed

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more sensitive than ones in groups. Travelling bears were more reactive than ones lying down.

Pages 202 - 205 contain a useful discussion of general biological principles relating to wildlife responses to humans.

KEYWORDS: Behaviour, Distribution/Roads, Ground Vehicles, Human Presence/Ursus, Alces, Ovis, Rangifer

497. Tracy, D.M. and S.C. Dean. 1976. Effect of traffic on caribou along the road in Mount McKinley National Park, Alaska, AIBS Symp., Corvallis, Ore. August, 1975.

Not seen.

KEYWORDS: Behaviour, Distribution/Roads, Human Presence, Ground Vehicles/Rangifer

498. Trevis, L. Jr. 1959. Man's effect on bighorn in the San Jacinto - Santa Rosa Mountains. Desert Bighorn Counc. Trans. 3:69-74.

From the poolside at Palm Springs, one can watch bighorns on the slopes above. An old ram wandered through the streets of town in 1958. Cited in Wilson 1969.

KEYWORDS: Behaviour, Distribution/Human Presence, Civilization/ Ovis

499. Ulberg, L.C. and P.J. Burfening. 1967. Embryo death resulting from adverse environment on spermatozoa or ova. Am. Soc. Anim. Sci. 25(3):571-577.

Fetal dwarfing and embryo mortality is attributed to elevated temperatures in farm animals. Cited in Sealander et al. n.d., with the comment that disturbance raises body temperatures.

KEYWORDS: Reproduction/Generalized Stimuli/Various Species

500. U.S. Bureau of Land Management. 1968. The California desert; A recreational study of the desert public domain lands of California under the jurisdiction of the Bureau of Land Management. Prep. by Calif. St. Off. of the BLM and the West. Reg. Off. of the Nat. Park Serv., Sacramento. 377 pp.

Noise and presence of motorized vehicles is frightening bighorn sheep from their natural habitat and forcing them into unsuitable areas where grazing is poor and water is scarce. Cited in Heath 1974.

KEYWORDS: Distribution/Ground Vehicles/Ovis

501. U.S. Bureau of Land Management. Undated. Land report and environmental impact statement (Stump Creek Wildlife Habitat Area, Idaho). Unpubl. memo, Salt Lake City, Utah. 5 pp.

Snowmobile activity creates changes in the daily routine of elk but no direct mortality. Elk are more sensitive to the sight and sound of snowmobiles than are deer. Cited in Bury 1978.

KEYWORDS: Behaviour/Ground Vehicles/Cervus, Odocoileus

502. U.S. Bureau of Land Management. 1971. Environmented statement issued by the Burley District, BLM, upon closure of an area of the Stump Creek Wildlife Habitat, Utah. Incomplete reference.

Elk keep 1/2 mile between themselves and snow machines. They are frightened as much by noise as by sight. Disturbed animals head into timbered areas for concealment. The return to more favourable areas may take several hours or days. Deer display more tolerance to snowmobiles than do elk. They do not move as fast nor as far. Cited in Baldwin and Stoddard 1973, p. 22 - 23.

KEYWORDS: Distribution, Movements/Ground Vehicles, Noise/ Cervus, Odocoileus

503. U.S. Congress, Senate. 1971. Committee on Congress, Noise Control
* Act of 1971 and ammendments. Hearing before the Subcommittee on the environment, 92nd Congress, 2nd Session on S.1016, to control the generation and transmission of noise detrimental to the human environment and for other purposes and S.1566, to amend the Federal Aviation Act of 1958 in order to provide more effective control of aircraft noise. June 28, 30 and July 26, 1971, Part I, Wash., D.C., U.S. Gov't. Print. Off. 626 pp.

Unexpected, unwanted, or excessive noise causes the pupils to dilate, blood vessels to constrict, blood pressure to rise and blood cholesterol to increase. Noise makes people more irritable and more likely to show irrational or neurotic behaviour. Constriction of blood vessels aids in inducing hypertension, ulcers and coronary disease (p. 51).

Elk and deer become aware of snowmobiles at distances of 3/4 mile. They tend to move as the snowmobile approaches with the operators never becoming aware of their presence. Elk may run for four miles through deep snow and often uphill. Studies in Idaho showed a herd of 150 - 200 elk to be driven completely off their wintering grounds. Bodies were found in the snow with death attributable to shock caused by stress (p. 256). The head of BLM's Division of Wildlife believes that the primary cause of deer and elk declines in the western U.S. is attributable to noise and harassment (p. 255). Cited in Heath 1974.

KEYWORDS: Physiology, Pathology, Stress, Movements, Distribution, Mortality, Population Dynamics/Noise, Ground Vehicles/Cervus, Humans, Odocoileus

504. U.S. Congress, Senate. 1971. Committee on Interior and Insular Affairs. Snowmobiles and other off-road vehicles, Hearing before the Subcommittee on Parks and Recreation, 92nd Congr., 1st Session, on study of effects of rapidly expanding use of all-terrain vehicles on public lands, May 21, 1971, Wash., D.C., U.S. Gov't. Print. Off.

Not seen.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

505. U.S. Department of the Interior. 1972. Final environmental impact statement: Proposed Trans-Alaska Pipeline. Rpt. 206 921 6, Fed. Task Force on Alaska Oil Dev., Wash., D.C.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli, Pipelines/Various Species

506. U.S. Department of the Interior. 1976. Alaska Natural Gas Transportation System: Final Environmental Impact Statement. U.S. Gov't Print. Off., Wash., D.C. 9 Volumes.

The final version of the environmental impact statement issued by the U.S. Department of Interior in response to an application to cross U.S. Federal Lands with a natural gas pipeline. Treats the route from Prudhoe Bay to California and the Midwest via the Mackenzie Valley. Volume I is an overview while Volumes 2 and 3 treat Alaska and Canada respectively. Describes the pipeline route and the environment and suggests probable environmental impacts and mitigative measures. In both the Alaska and Canada volumes, the status and potential impacts on each mammal species are treated separately. Volume 2 suggests that an abandonment of caribou calving grounds would result in herd reductions of 50 percent.

KEYWORDS: Disturbance, Population Dynamics/Pipelines/Various Species, Rangifer

507. U.S. Federal Power Commission. 1976. Alaska natural gas transportation systems: Final environmental impact statement. 4 volumes.

The final environmental impact statement of the Federal Power Commission with respect to the El Paso Alaska System. Contains a seven page summary of expected effects on mammals which includes disturbance.

KEYWORDS: Disturbance/Pipelines/Various Species

508. U.S. Federal Power Commission. 1975. Alaska Natural Gas Transportation Systems: Draft environmental impact statements. 4 vols.

The draft environmental impact statement of the Federal Power Commission with respect to the El Paso Alaska System. Contains a seven page summary of expected effects on mammals including disturbance.

KEYWORDS: Disturbance/Generalized Stimuli/Various Species

509. U.S. Federal Power Commission. 1977. Environmental assessment of the Taylor Highway-Klondike Highway realignment. 72 pp.

A supplement to the Federal Power Commissions final environmental impact statement on the El Paso Project after the National Energy Board of Canada's announcement that natural gas should be routed through Canada along the Alaska Highway route. Treats the realignments along the Taylor and Klondike Highways. The short section on Canadian wildlife states that there is insufficient information for a meaningful assessment of disturbance and other impacts.

KEYWORDS: Disturbance/Pipelines/Various Species

510. Urquhart, D. 1973. The effects of oil exploration activities on caribou, muskoxen and arctic foxes of Banks Island, N.W.T. Unpubl. Rpt., N.W.T. Game Manage. Div.

During fall, Peary caribou usually remained at least 2 miles from seismic camps and drill rigs when they were situated in open, flat areas. In hilly country, they approached closer. Caribou showed reluctance to cross seismic lines and walked parallel to them. Older lines were crossed more readily.

KEYWORDS: Distribution, Movements/Roads, Industry/Rangifer

511. Van Ballenberghe, V. 1976. First interim report of the river-
† pipeline technical evaluation study, Joint State/Federal Fish and Wildl. Advising Team, Spec. Rpt. No. 1, Anchorage.

A progress report on the study of moose-pipeline interactions between October 1974 and December 1975. In total, 208 moose were marked and 30 were radio-collared. All contacted the pipeline on migration. Fifty-seven crossings by 78 moose were read from tracks. Most moose crossed under the pipeline where clearances were 64 - 79 inches. In two instances, moose paralleled the line for 150 yards before crossing.

KEYWORDS: Movements/Pipelines/Alces

512. Van Ballenberghe, V. 1977. Second interim report on the effects of the Trans-Alaska Pipeline on moose movements. Joint State/Federal Fish and Wildl. Advisory Team, Spec. Rpt. No. 10, Anchorage.

Review of 1974 - 1976 work on the moose-pipeline interaction. Of 803 successful crossings, 70% were in areas with vertical clearances between 6 - 9 feet. When snow was 7 or more inches in depth, crossings were in areas with significantly greater clearances. Although some crossings occurred in areas with only 49 inches of clearance, some were deflected in areas where the clearance was as much as 122 inches. Most crossings were with a straight approach and little hesitation.

The author cites observations on moose behaviour in the vicinity of the Davidson Ditch, a 40-inch above-ground water siphon built in 1925 in the Chatanika Valley north of Fairbanks. These observations suggest moose will not move under a pipeline which is less than 5 feet above the ground, that moose never parallel a pipe more than 1/2 mile before crossing, and that moose almost never cross over a buried pipeline. Even when habituated to the Ditch, moose showed considerable effort in avoiding the pipe and tried to move around the ends.

KEYWORDS: Movements/Pipelines/Alces

513. Van Ballenberghe, V. 1978. Final report on the effects of the * Trans-Alaska pipeline on moose movements. Joint State/Federal Fish and Wildlife Advisory Team, Spec. Rpt. No. 20.

Final report on the study of moose - pipeline interactions. Of 1068 successful crossings of the pipeline during shallow snow conditions, 57% occurred where the vertical clearance was 6 - 8 feet. The behaviour of deflected moose is described. Snow depths of 30 - 40 inches are hypothesized to cause extensive deflections.

KEYWORDS: Movements/Pipelines/Alces

514. Van Ballenberghe, V., A.W. Erickson, and D. Byman. 1975. Ecology of the timber wolf in northeastern Minnesota. Wildl. Monogr. 43 pp.

Wolves in Minnesota frequent dumps, feed on road-killed deer, and interact with domestic dogs close to human dwellings. Wolves often pass within 50 m of occupied houses. Many wolves are habituated to human presence even though they occasionally get shot.

KEYWORDS: Habituation, Distribution/Human Presence/Lupus

515. Van den Akker, J.B. 1960. Human encroachment on bighorn habitat. Trans. Desert Bighorn Counc., 4:38-40.

Not seen.

KEYWORDS: Disturbance/Human Presence, Civilization/Ovis

516. Vaughn, J.P. 1970. Influence of environment on the activity and behaviour of white-tailed deer (Odocoileus virginianus) along an interstate highway in an agricultural area of Pennsylvania. Ph.D. Thesis, Pennsylvania St. Univ., University Park, Pa. 106 pp.

A study of white-tailed deer distribution and behaviour along a 7.7 mile section of Interstate 80. Most deer were observed in areas with good cover. Most deer were seen between 0100 and 0200 hr. Grazing was the most frequently observed activity. There were significant negative correlations between number of deer and traffic volume and numbers of trucks.

KEYWORDS: Distribution, Behaviour/Ground Vehicles, Roads/ Odocoileus

517. Veale, R.S. 1979. A letter regarding the proposed pipeline route sent to R. Blair, Foothills Pipe Lines (South Yukon) Ltd. by Cable, Veale, Cosco and Morris on behalf of K. Heynen. In Briefs presented before the Yukon Hearings Panel on the ATaska Highway Gas Pipeline proposal, Community Hearing, March 19 - 22, 26 - 29, April 2 - 5, 1979, Whitehorse.

A letter from the lawyers retained by an outfitter, K. Heynen, threatening a law suit if the pipeline is routed through the Ibex River and Mount Michie areas. During the 1977 hearings, Heynen outlined hypothetical impacts on the wildlife in his area. Since that time, intensive activity by helicopter have caused Dall sheep and woodland caribou to leave their preferred areas. This has caused irreparable loss of habitat.

KEYWORDS: Distribution/Aircraft/Ovis, Rangifer

518. Vibe, C. 1972. Personal communication cited in Child and Lent 1973, p. 1.

In the Sondre Stromfiord area of Greenland, caribou traditionally migrated across the valley. The caribou began to experience difficulty in moving through the military base there, though, and have since discontinued use of the area and now circumvent the site completely.

KEYWORDS: Movements, Distribution/Civilization/Rangifer

519. Videsott, R. 1967. Impact ecologique du tourisme et des loisirs dan les parcs Nationaux Italiens. Pages 118 - 120 in Towards a new relationship of man and nature in temperate lands. IUCN New Ser. No. 7.

Chamois and Ibex are scared away by tourists leaving their cars. Consequently, they leave their favoured feeding grounds only returning in the autumn.

KEYWORDS: Distribution/Human Presence/Other Mammals

520. Villmo, L. 1975. The Scandinavian viewpoint. Pages 4 - 9 in † Trans. 1st. Intl. Reindeer/Caribou Symp., Univ. Alaska, Fairbanks.

A discussion of the effects of northern development on reindeer in Scandinavia. Reindeer graze along roads carrying moderate traffic but interrupt their feeding for each car. Therefore, rights-of-way are undergrazed. With proliferation in roads, significant amounts of habitat are underutilized. Tourists bring dogs which are particularly dangerous for pregnant cows. About 200 reindeer are killed annually by trains in Norway. In Sweden 3,800 are killed each year. Shelves of shore ice, resulting from winter release of water from reservoirs, effectively obstruct reindeer movements. Hydroelectric water pipelines also obstruct migration. Power lines affect reindeer but to what extent is not yet clear. Reindeer herders state that it takes 3 - 7 years for the animals to habituate to power-lines. Reindeer fear the noise of the power lines and are reluctant to pass beneath them. In Norway, power lines across traditional migration routes disrupts movement considerably.

KEYWORDS: Movements, Mortality, Behaviour/Predators, Industry, Roads, Railways/Rangifer

521. Vincent, J. 1974. The management of large mammals in Natal, with special reference to utilization for stocking or restocking purposes. Pages 900 - 908 in V. Geist and F. Walter (eds.), The behaviour of ungulates and its relation to management. IUCN Publ. New Ser., No. 24, Vol. 2, Morges.

"... experience has shown that serious losses to adult and unborn animals take place if stresses are imposed at too late a stage {in pregnancy}".

KEYWORDS: Reproduction/Generalized Stimuli/Rangifer

522. Walther, F.R. 1969. Flight behaviour and avoidance of predators in Thomson's gazelle. Behaviour 34(3):184-221.

A study of flight behaviour and predator avoidance in Thomson's gazelles. Contains a section "Flight Releasing Factors" which discusses principles common to all ungulates. Factors influencing flight stimuli include experience, suddenness, direct approach, size, strangeness and sudden stop. "If one compares these flight releasing factors with the factors which elicit the following reaction of young ungulates, one will find they have much in common."

KEYWORDS: Behaviour/Generalized Stimuli/Various Species

523. Wanek, W.J. 1971. Observations on snowmobile impact. Minn. Volunteer. 34:1-9.

"... when deer experience a snowmobile invasion where the machines rarely travel they react violently. This might be detrimental to their survival due to the more rapid expenditure of energy, upsetting the delicate balance between stored body fat and harsh winter environment." Cited in Lodico 1973.

KEYWORDS: Behaviour, Energetics/Ground Vehicles/Odocoileus

523a. Warbelow, C., D. Roseneau & P. Stern. 1975. The Kutchin caribou fences of northeastern Alaska and the northern Yukon. In studies of large mammals along the Mackenzie Valley Pipeline from Alaska to British Columbia.

A description of Kutchin caribou fences used to direct the movements of caribou by native hunters until early in the twentieth century. Comparison of modern movement patterns with orientation of the fences suggests no major shifts in movement patterns since the fences were built.

KEYWORDS: Movements/Fences/Rangifer

524. Ward, A.L. 1973. Elk behaviour in relation to multiple uses on † the Medicine Bow National Forest. Proc. West. Assoc. Game and Fish Comm. 53:125-141.

Nine elk were radio-collared and their movements assessed in relation to forestry roads, an interstate highway, tourist use and forestry operations. Although elk did not spend much time feeding in areas where noise levels reached 62 dB for cars and 70 dB for trucks, they did not react to noise when feeding. Few elk were seen within 300 yards of the interstate. Elk seemed cautious about crossing major roads; the interstate is a complete barrier to movements. Elk are rarely seen by motorists on the interstate; if however they do see elk and leave their cars for a closer look, the elk immediately move out of sight. Only 14.2% of elk observations were within one-half mile of people involved in out-of-vehicle recreational activities. Elk maintain 1/2 mile distance from timber harvest operations.

KEYWORDS: Distribution, Behaviour/Human Presence, Roads, Ground Vehicles/Cervus

525. Ward, A.L. 1974. Effects of timber harvest on mule deer and elk. † Proc. 18th Rocky Mountain Forest Industries Conf. 17 pp.

Ten cow elk were radio-collared and their movements assessed in relation to timber harvest. Elk prefer to remain at least 1/2 mile away from people involved in timber harvest, but will return to the area within three weeks of the cessation of activity. Logging and recreational roads have little effect on elk activity within 300 yards once elk become used to them. Elk cross roads mainly at night.

KEYWORDS: Distribution/Industry, Roads/Cervus

526. Ward, A.L. 1976. Elk behaviour in relation to timber harvest † operations and traffic on the Medicine Bow Range in south-central Wyoming. Pages 32 - 43 in Heib, S. (ed.), Proc. Elk-logging-road Symposium, Moscow, Idaho. 142 pp.

Radio-telemetry, time-lapse photography and track counts were used to assess elk behaviour in relation to logging and traffic. Elk preferred to remain 1/2 mile away from logging activities but returned to the area soon after activity stopped. Traffic on small roads had little effect on behaviour, particularly beyond 1/4 mile.

KEYWORDS: Distribution, Behaviour/Roads, Industry/Cervus

527. Ward, A.L. 1977. The effects of highway operation practices and facilities on elk, mule deer and pronghorn antelope. Proj. No. 942-41-42-13-0088-33F2-6-2580. 53 pp.

Not seen.

KEYWORDS: Behaviour, Distribution/Roads/Odocoileus, Cervus, Other Mammals

528. Ward, A.L., J.J. Cupal, A.L. Lea, C.A. Oakley and R.W. Weeks. 1973. Elk behaviour in relation to cattle grazing, forest recreation and traffic. Trans. N. Amer. Wildl. and Nat. Resour. Conf. 38:327-337.

The same data, presentation and conclusions as Ward (1973).

KEYWORDS: Distribution, Behaviour/Human Presence, Roads, Ground Vehicles/Cervus

529. Ward, A.L., J.J. Cupal, G.A. Goodwin and H.D. Morris. 1976.
* Effects of highway construction and use on big game populations. Final Rpt. No. FHWA-RD-76-174, U.S. Dept. Transportation, Ntl. Tech. Inf. Serv., Springfield, Va.

A major study on the effects of highways on elk, mule, deer and pronghorns. Deer are well habituated to highways. They jump fences and readily cross rights-of-way. Some live within 1/2 mile of Interstate 80 and are often seen within 100 yards of the highway where noises of 70 dB are common. One telemetered doe crossed I-80 29 times in 14 months. Elk are far more sensitive to traffic and human activity. They prefer to remain at least 1/4 mile away particularly in daylight. Humans outside of vehicles are particularly disturbing to elk. They are not reluctant to cross small forest roads at night when the traffic volume is low. A cow and spike bull elk were telemetered for heart rate. Heart rates indicate that elk are acutely aware of activities around themselves and that they differentiate between human activities with and without danger (traffic vs hunting). Overt behavioural responses are not always correlated with physiological responses. There is no indication that elk and deer showed significantly reduced tendencies to cross forest roads near intensive recreation areas. During hunting season, elk cross less often in open areas and more often where trees closely approach the road.

KEYWORDS: Physiology, Behaviour, Distribution, Movements/ Roads, Ground Vehicles/Cervus, Odocoileus

540. Welch, B.L. and A.S. Welch. 1970. Physiological effects of noise. Plenum Pr., N.Y. 365 pp.

Contains 27 articles dealing with the effects of noise on disease resistance, endocrine and metabolic function, the cardiovascular, reproduction and neurological systems, and sleep.

KEYWORDS: Stress, Pathology, Physiology, Behaviour/Noise/ Various Species

541. Welles, R.E. and F.B. Welles. 1961. The bighorn of Death Valley. * Fauna of Ntl. Parks of U.S., Fauna Ser. No. 6, U.S. Gov't. Print. Off. 242 pp.

Description of the natural history of the desert bighorn. Contains a large section on wariness and reaction to noise. The degree of wariness varies with the individual and its experiences. Ewes with lambs are very wary otherwise there is no age-sex effect. A confident leader can inspire confidence in followers. The authors describe a slow habituation process until a previously wary band repeatedly crossed a highway and became indifferent to attempts to scare them. Honking horns, shouts and gunshots had no effect. Human usurption of springs and cattle grazing causes range abandonment.

KEYWORDS: Habituation, Behaviour/Human Presence, Noise, Roads/ Ovis

542. White, R.G., B.R. Thomsen, T. Skogland, S.J. Person, D.F. Holleman and J.R. Luick. 1975. Ecology of caribou at Prudhoe Bay, Alaska. Pages 151 - 187 in J. Brown (ed.), Ecological investigations of the tundra biome in the Prudhoe Bay Regina, Alaska, Biol. Pap. Univ. of Alaska, Spec. Rpt. No. 2, Fairbanks. 215 pp.

On page 181 it is mentioned that there are two caribou populations at Prudhoe Bay. One is resident, the other migratory. The resident caribou have habituated to road traffic while the migratory ones have not.

KEYWORDS: Habituation/Ground Vehicles/Rangifer

530. Ward, I.L. 1972. Prenatal stress feminizes and demasculinizes the behaviour of males. Science 175:82-84.

Pregnant rats were subjected to stress in the form of restraint coupled with bright lights. Their male offspring showed low levels of copulatory behaviour and high rates of female lordotic posturing. This is attributed to stress-mediated alterations in the ratio of adrenal to gonadal androgens during sexual differentiation.

KEYWORDS: Stress, Physiology, Behaviour/Laboratory/Other Mammals

531. Watson, G.H., W.H. Prescott, E.A. DeBock, J.W. Nolan, M.C. Dennington, H.J. Paston, I.G. Stirling. 1973. An inventory of wildlife habitat of the Mackenzie Valley and the northern Yukon. Prep. by Spec. Habitat Eval. Group, Can. Wildl. Serv., for the Enviromental-Social Program Northern Pipelines, Task Force on Northern Oil Dev., Report No. 73 - 27, Inf. Canada. 152 pp.

Together with a seven volume atlas, this represents an inventory of wildlife habitat along the Mackenzie Valley pipeline corridor. Contains relevant biological and distributional information on moose, caribou, Dall sheep, grizzly bears, arctic fox, muskrat, beaver, waterfowl and raptors. Suggests biological implications of pipeline development and makes specific recommendations.

KEYWORDS: Disturbance/Pipelines, Aircraft/Rangifer, Alces, Ovis, Ursus

532. Webb, R. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 116:17675-17676; Reactions of grizzly bears to aircraft and people.

Vol. 116:17719-17724; Grizzly bears avoid camps while polar bears do not.

KEYWORDS: Distribution, Behaviour/Aircraft, Civilization/ Ursus, Thalarctus

533. Webb, R.H. and H.G. Wilshire. 1978. A bibliography on the effects of off-road vehicles on the environment. U.S. Geological Surv. Open-file Rpt. 78-149. 16 pp.

Not seen.

KEYWORDS: Disturbance/Ground Vehicles/Various Species

534. Not used.

535. Webster, A.J.F. and K.L. Blaxter. 1966. The thermal regulation of two breeds of sheep exposed to air temperatures below freezing point. Res. Vet. Sci. 7:466-479.

Contains incidental information on the energy costs of excitation in domestic sheep. Cited in Geist 1975.

KEYWORDS: Energetics/Generalized Stimuli/Ovis

536. Weeden, R.B. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 54:7476-7477; Caribou are wilderness animals requiring large, undisturbed areas for seasonal movements. If caribou were to abandon their calving areas north of the proposed prime route, they might not be successful in calving elsewhere.

Vol. 54:7474 and ff.; A listing of environmental impacts pertaining to the various corridors. Includes disturbance to wildlife.

Vol 75:11063-11073; The effect of the Prudhoe Bay gathering lines on caribou access to fly-free areas is not yet known.

Vol. 75:11104-11120; Historically, increased activity in an area is known to affect caribou. The intense aerial activity before ground support facilities are in place can lead to abandonment of traditional calving grounds.

Vol. 76:11198-111206; The impact of highway development on a caribou herd was described using the Fortymile herd as an example.

Vol. 76:111251-11134; The Arctic Gas development would have a detrimental effect on caribou by decreasing their ability to calve and reducing range size by physical obstruction.

KEYWORDS: Population Dynamics, Disturbance, Distribution/ Pipelines, Aircraft, Roads/Rangifer

537. Weeden, R.B. 1975. Prepared testimony of Dr. Robert B. Weeden before the Berger Inquiry on arctic gas pipeline alternative. Exhibit 178 entered before the Mackenzie Valley Pipeline Inquiry, Yellowknife. 33 pp.

Increased access and human activity have historically had adverse impacts on reindeer and caribou herds. The caribou is a wilderness animal requiring large, undisturbed areas for its seasonal movements. Harassment by aircraft during calving could result in calf abandonment. Disruptions in normal movements could cause partial or entire abandonment of a traditional calving range with catastrophic effects on the population. Polar bears are extremely sensitive to disturbance. Disturbance thresholds for arctic animals are generally unknown but some species will adapt while the more wilderness-dependent and rare ones will disappear. Noise can cause physiological stress and can force animals from preferred areas.

KEYWORDS: Stress, Disturbance, Population Dynamics, Reproduction/Pipelines, Civilization, Generalized Stimuli, Aircraft/Rangifer, Thalarctus

538. Weeden, R.B. and D.R. Klein. 1971. Wildlife and oil: a survey of critical issues in Alaska. Polar Rec. 15:479-494.

A survey of points of conflict between petroleum development in the North and wildlife populations. Biologists have almost no answers to the questions asked. "There remains one major uncertainty regarding direct effects on wildlife: the question of the behavioural reactions of wild animals to oilfield activity."

KEYWORDS: Disturbance, Behaviour/Pipelines, Industry/Various Species

539. Wehausen, J.D. and L.L. Hicks, D.P. Garber and J. Elder. 1977. Bighorn sheep management in the Sierra Nevada. Trans. Desert Bighorn Counc. 21:30-32.

Not seen.

KEYWORDS: Disturbance/Generalized Stimuli/Ovis

543. Whitney, P.H. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 99:15165; A discussion of the impact of highways on caribou.

Vol. 100:15208-15214; The possibility of the Bluenose herd being deflected by a highway or pipeline and absorbing the reindeer herd should be investigated.

Vol. 100:15266-15270, 15374; Discussion of the effects of aircraft harassment.

KEYWORDS: Disturbance, Movements/Pipelines, Roads, Aircraft/Rangifer

544. Widdowson, E.M. 1951. Mental contentment and physical growth. Lancet 1:1316-1318.

A study of the effects of increased rations on growth in two orphanages in post-war Germany. In Orphanage A, where calories were supplemented by 20%, children actually gained less weight than in Orphanage B, where calories were suboptimal. Orphanage A was headed by a woman who terrorized the children with public and unjustified rebukes particularly at mealtime. The psychological effects seemed to outweigh the better diet. These findings are corroborated by the fact that eight of this woman's "favorites" gained weight faster than children in Orphanage B. Cited in Tanner 1962.

KEYWORDS: Physical Condition/Generalized Stimuli/Homo

545. Wilson, L.O. 1969. The forgotten desert bighorn habitat requirement. Trans. Desert Bighorn Counc. 13:108-113.

There are four major wildlife requirements; food, water, cover and space. The first three are often dealt with by managers but what about space? Encroachment on living space is the greatest threat to desert bighorns. There are so many written descriptions of sheep existing close to humans that administrators fail to realize the necessity for living space. Sheep in Utah are seen an average of 11.0 miles from Highway 95 and are known to have crossed the highway only 5 times in the last few years.

KEYWORDS: Distribution/Roads, Civilization/Ovis

546. Windsor, J. and A. Gill. 1975. Land-use conflicts in the Campbell Lake Hills area, Northwest Territories. Prep. for the Environmental Social Committee by the Can. Wildl. Serv.

In the Campbell Hills near Inuvik, big game populations are presently scarce. Trappers attribute the decline to aircraft activity of Inuvik airport and increased hunting pressure.

KEYWORDS: Distribution, Population Dynamics/Aircraft, Hunting/Various Species

547. Wobeser, G., J.E.C. Bellamy, B.G. Boysen, P.S. MacWilliams and W. Runge. 1976. Myopathy and myoglobinuria in a wild white-tailed deer. J. Amer. Vet. Med. Assoc. 169:971-974. †

Overstraining disease or capture myopathy was observed in white-tailed deer in Saskatchewan. Clinical, clinicopathological, gross pathological and histopathological findings are discussed. The authors have seen similar myopathic conditions in a moose. It is suggested that myopathic conditions may be more common in North American game animals than is generally recognized and that it may occur under "natural" conditions.

KEYWORDS: Pathology, Mortality/Capture and Handling/Odocoileus, Alces

548. Wolkie, S. 1975. Testimony in Proceedings at inquiry. Mackenzie Valley Pipeline Inquiry, before the Hon. Mr. Justice Berger, Commissioner. Allwest Reporting Ltd., Burnaby, B.C.

Vol. 43:4153-4155; Seismic blasts kill seals and fish and frighten caribou.

KEYWORDS: Disturbance/Noise, Industry/Rangifer

549. Woodard, T.N. 1973. An evaluation of deer-proof fence length required to prevent deer movements on or across high speed highways. Colo. Div. Wildl., Game Res. Div., Fed. Aid Proj. W-38-R-27, Game Res. Rpt.

Deer crossings of Highway 82 were reduced by 82% following installation of a 1.1 mile long 8 foot tall fence. Movement parallel to the fences was 0.25 to 1.00 miles.

KEYWORDS: Movements/Fences/Odocoileus

550. Young, E. and P.J.L. Bronkhorst. 1971. Overstraining disease in † game. African Wildl. 25:51-52.

Overstraining disease, also known as "capture myopathy" or "paralytic myoglobinuria" is usually associated with capture however, it has been seen in free-living sable antelope and zebra. It results from overstraining, as the name indicates, usually by excessive chasing. Clinical signs appear anywhere from a few hours to one to two weeks after exercise. Affected animals excrete dark brown urine and manifest clinical signs of muscle degeneration and pain. Others may die of acute heart failure after varying periods of up to two weeks. There may be degeneration of the liver and kidneys and pulmonary oedema. Muscle groups involved in locomotion have a characterisic dull, whitish striated appearance resembling the flesh of fish.

KEYWORDS: Pathology, Mortality/Capture and Handling/Various Species

551. Yukon Wildlife Branch. 1977. Alaska Highway Gas Pipeline Project: † Environmental concerns and recommendations of the Yukon Wildlife Branch. Submitted to the Lysyk Commission. 159 pp.

Discusses the population status and distribution of major wildlife species in the Yukon, suggests the probable impact of the pipeline on these species and makes recommendations for mitigation. Also discusses IBP sites, needs for Wildlife Branch staff increases, the Dempster Highway, and route comparisons. A valuable document for its detailed information on local populations.

KEYWORDS: Disturbance/Pipelines, Roads/Ovis, Rangifer, Ursus, Alces, Various Species

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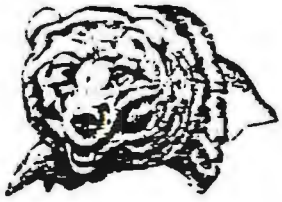
STATE OF MONTANA



DEPARTMENT OF

FISH AND GAME

Helena, MT 59601
August 3, 1979

Mr. Christopher C. Shank
Foothills Pipe Lines, Ltd.
635 Sixth Ave. SW
Calgary, Alberta T2P 0T5

Dear Mr. Shank:

Thank you for your inquiry concerning pipeline-large mammal interactions in Montana. Unfortunately, I am not aware of any specific studies that have been conducted relative to this subject in the state.

We are in the process of siting two large pipelines - one crude oil and one gas - within our borders and are ourselves in need of similar information. Our Department of Natural Resources and Conservation is handling these siting studies, so I have forwarded your letter to them with hope that they might be able to assist you.

Good luck in your endeavors. Enclosed is a recent publication of the U.S. Fish & Wildlife Service that may be of some help.

Sincerely,

Robert R. Martinka, Chief
Bureau of Baseline Studies

RRM:el

Encl.

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Game and Fish Department

CHEYENNE, WYOMING 82002

EARL M. THOMAS
DIRECTOR

August 3, 1979

Christopher C. Shank
Foothills Pipelines (South Yukon) Ltd.
635 Sixth Avenue S.W.
Calgary, Alberta
CANADA T2POT5

Dear Mr. Shank:

Our experience with pipelines has been extensive, but not well documented. Compared with other impacts, pipelines, if placed underground, are of minor significance. The chief problems occur during construction, when animals are displaced by the large increase in human activity, and during maintenance, when there always seem to be people who insist on shooting more than their fair share of animals. Where pipelines have gone through areas of little human activity, the chief impacts have occurred because of the pipeline maintenance road. The continued movement of vehicles down the line for maintenance is not as bad as the fact that it is almost impossible in treeless Wyoming to prevent the public from using the maintenance road. Once they've discovered the road, impacts due to harassment, illegal shooting, and additional habitat destruction accelerate.

Our main concern is habitat loss. Most of the pipelines put through Wyoming have been unreclaimed or poorly reclaimed. That may be no problem where there is extensive rainfall, but here it is a serious matter because most of the areas traversed by pipelines are semi-desert.

We have been able to get seasonal restrictions placed on pipeline construction, with the concurrence of the companies. These restrictions prevent construction during critical wildlife periods (winter, breeding season for game birds, calving areas in some places). Construction is allowed from May 15 - November 15 in areas where there are winter ranges for big game and strutting sage grouse. Where there are no important big game winter ranges, or grouse breeding grounds, construction is allowed yearlong.

As for impacts on large mammals, they have chiefly involved displacement, habitat loss, and deaths due to poaching. We have

seen no population declines, and distributional changes only during construction.

Roads cause us many more problems because they are nearly always fenced in Wyoming. We have large populations of pronghorn in several areas which annually move to and from winter ranges. These movements often cover 50 miles, and some move 100 miles. Pronghorn jump fences seldom, so fencing blocks these movements. An above-ground pipeline would have similar effects. We lost 70% of our Red Desert pronghorn herd in 1972-73 primarily due to interstate highway fencing coupled with winter storms. As a result, we insist on unfenced pipeline rights-of-way.

Pronghorn have been the chief animals affected by pipelines. This has resulted mainly from habitat loss where native species have been replaced by exotics such as crested wheatgrass. Other than this, we have had only minor impact due to pipeline construction, as long as they are underground.

Most of this is merely observations made over the past several years. We've done no research on pipeline impacts. I hope this answers your questions.

Sincerely,

Harry Harju

Harry Harju
Staff Game Biologist

HH:rv

STATE OF IDAHO

DEPARTMENT OF FISH AND GAME 600 SO. WALNUT ST. – P. O. BOX 25
BOISE, IDAHO 83707

August 9, 1979

Mr. Christopher C. Shank
Foothills Pipe Lines (South Yukon) Ltd.
635 - Sixth Avenue S.W.
Calgary, Alberta T2P 0T5

Dear Mr. Shank:

Ref: Your pipeline letter.

The natural gas pipelines buried across Idaho were built at a time when environmental evaluations were not required. If they were to be proposed today, there would be much consternation and flailing with the probable result that they would be rerouted into a less scenic, more used corridor.

Be that as it may, we have not realized perceivable impacts on wildlife as a result of the pipelines. No studies have been made so my comments are subjective. The area of greatest concern lies close to bighorn sheep populations. Fortunately, the line is on the fringe and as far as we can tell is o.k.

We probably have not yet seen all impacts from the placement of these pipelines. Because the lines are in place, it is now considered a precedent and is being justified as the logical corridor of future power-lines, pipelines, etc. This could well mean improved roads, more people and more impacts. In your case, the long term as well as the short term potential effects should be carefully evaluated or the conclusions may be faulty.

Sincerely,

DEPARTMENT OF FISH AND GAME
Joseph C. Greenley, Director

Jerry Thiessen, State Big Game Manager
Bureau of Wildlife

JT:ns

STATE OF
WASHINGTON

Dixy Lee Ray
Governor

DEPARTMENT OF GAME
600 North Capitol Way, GJ-11 Olympia, WA 98504 206/753-5700

August 17, 1979

Foothills Pipeline (South Yukon) Ltd.
635 6th Avenue Southwest
Calgary, Alberta T2P-0T5

RE: Corridor Impacts-Big Game Mammals

Mr. Shank:

Our staff received your request for information on the effects of pipeline construction on big game mammals. It is apparent from our efforts in acquiring information that there are substantial gaps in historical studies which relate directly to pipeline construction. There have been a few studies done on impacts from other linear utility corridor construction such as, B.P.A right-of-ways and roads. Some general comments follow:

1. Increased wildlife use of corridors could cause subsequent increases in hunting impacts due to increased accessibility.

2. Big game, especially elk, avoid active timber removal in construction activities.

3. It has been observed that maximum wildlife benefits from forest succession occur 4 to 8 years after clearing.

4. Adverse impacts can occur in the form of stress within the corridor environment, although impacts on reproduction, etc. have not been documented.

5. Habitat loss to big game species for reproduction, feeding, and wintering activities can be mitigated somewhat be proper revegetation of the corridor edges and corridor proper.

In summary, this is an area that needs long term research here in the Pacific Northwest. Enclosed are two documents

that discuss the impacts of roads and power line right-of-ways on big game distribution and habitat requirements. We hope this information will be of help to you in your efforts.

Sincerely,

THE DEPARTMENT OF GAME

Larry Mc Callum, Applied Ecologist
Environmental Affairs
Habitat Management Division

LMC:jd

Enclosures
1. Powerline Right-of-Way and Wildlife in Forested Mountains

2. Impacts of Roads on Big Game Distribution

VICTOR ATIYEH
GOVERNOR

Department of Fish and Wildlife
OFFICE OF THE DIRECTOR
506 S.W. MILL STREET, P.O. BOX 3503, PORTLAND, OREGON 97208

August 27, 1979

Mr. Christopher P. Shank
Foothills Pipe Lines (South Yukon) Ltd.
635 Sixth Avenue, S.W.
Calgary, Alberta, Canada T2P 0T5

Dear Mr. Shank:

In reference to your inquiry regarding the effect of pipeline construction and maintenance on big game animals, Oregon has not experienced any major adverse impacts to our big game resource from the 700 miles of buried natural gas pipeline within the state. We have, however, noted some minor problems.

The timing of the construction phase of a pipeline project can be critical if the route passes through important wintering or fawning/calving areas during the respective period of wildlife use. Construction activity in these important areas could result in undesirable stress or displacement of animals.

The pipeline corridor may form an unnatural denuded swath through good big game habitat. This artificial opening, void of cover, could affect normal animal movement or seasonal migrations. This situation could be avoided if the corridor were screened with irregular margins, if strips of escape cover are retained, or if vegetation is removed only in irregular, noncontiguous patches. Natural revegetation should be encouraged within the corridor where it does not interfere with normal pipeline operation and maintenance.

Poaching and harassment can be a problem when a pipeline corridor passes close to a population center. This problem could be reduced if road construction was restricted to the absolute minimum, or if the road was physically obliterated at the completion of the project.

We have also noted that in locations where excavation was in basalt formations, some habitat was created for small animals when the excavated material was piled along the right-of-way. This increased habitat for small animals could encourage larger predatory mammals and raptors to frequent these areas.

Please call upon us if we can provide you with any additional information.

Sincerely,

John R. Donaldson, PhD
Director

JRD:ek

Province of
British Columbia

Ministry of
Environment

Fish and Wildlife Branch
400, 1019 Wharf Street
Victoria
British Columbia
V8W 2Y1

YOUR FILE .....

OUR FILE 0961

September 21, 1979

Foothills Pipe Lines (South Yukon) Ltd.
635 - Sixth Avenue, S.W.
Calgary, ALBERTA
T2P 0T5

ATTENTION: Mr. Christopher C. Shank

Dear Mr. Shank:

In response to your letter of August 27, 1979, requesting British Columbia's experiences relevant to pipe-line interactions, I am in the process of having available information brought together.

I will forward the information to your attention, as soon as possible.

Yours truly,

D. J. Robinson,
Acting Director