EXAMINATION OF FOX DISTRIBUTION PATTERNS

1993 INTERNAL REPORT

by

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for

BP EXPLORATION (ALASKA) INC.
900 E. Benson Boulevard
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EXECUTIVE SUMMARY

Research conducted in the Prudhoe Bay, Alaska, area in the 1970s suggested that the Arctic fox population may benefit from the presence of oil field development. An artificial food source (principally, garbage) and artificial den sites in developed areas may contribute to increased numbers of foxes. A large fox population may result in increased predation on tundra nesting birds, and could pose a health threat to oil field workers and other wildlife because of the possibility of rabies and other diseases.

The most important step to ensure a naturally variable Arctic fox population is to eliminate artificial food sources available to foxes. This can be accomplished by managing food wastes so they are not available to foxes and other wildlife (e.g., grizzly bears, polar bears, ravens, gulls) and by educating oil field workers about problems associated with feeding foxes. Direct control of Arctic fox by removal (trapping, etc.) would be effective, but would likely provide only a short–term solution. Other options, such as translocation of foxes outside the Prudhoe Bay area, the use of contraceptives to reduce fox productivity, and the use of an oral vaccine to reduce the threat of rabies, may be less effective and require further study.

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EXAMINATION OF FOX DISTRIBUTION PATTERNS

Several researchers have suggested that Arctic fox populations may be artificially high in the Prudhoe Bay oil field (PBOF) area due to benefits derived from artificial food sources (Eberhardt 1977; Fine 1980; Eberhardt et al. 1982; 1983a, b; Burgess et al. 1993). Artificial food, which provides an abundant and consistent food supply for Arctic fox, tends to supplement the often irregular supply of natural food which, under normal circumstances, probably acts to control fox numbers (Macpherson 1969, Speller 1972). Current problems related to the presence of Arctic fox in the Prudhoe Bay area are the predation of nests of many bird species, and an apparent increase in the number of individuals or groups of foxes habituated to humans and human activity. This increased contact between foxes and humans creates a safety issue because of the potential threat to humans should a rabies epizootic occur in the local fox population. To assess these problem areas, it is necessary to identify areas of fox concentrations, to identify resources which are available and beneficial to foxes, and to identify the extent to which these resources are used by local foxes.

Methods

Information was gathered in several ways to identify problem areas caused by the presence of Arctic fox. Dumpsters, garbage cans, and other oil field facilities were observed to determine the extent of fox use of these sites and to identify areas of fox concentration. Additional observations were made opportunistically during road surveys or at any other times that foxes were located. When possible, foxes moving along the road system were followed to determine how far individuals range and how they use the oil field. Information recorded included date, time of day, type of behavior, duration of activity, and number of foxes (adults and pups). For foxes which had been marked the previous year (Burgess et al. 1993), an effort was made to identify

color combinations of neck collars and ear tags and to record any ear tag numbers. Conversations with oil field workers and other environmental scientists also identified problem areas associated with Arctic fox. This information was used to identify options for reducing human/fox interaction (Management Options, this report).

Results

Artificial Food Sources and Availability of Artificial Dens

Two features of the developed portions of the oil field seem to attract Arctic fox. Both the presence of artificial food sources and the availability of artificial den sites tend to cause foxes to congregate in developed areas.

Oil field dumpsters and garbage cans provide some Arctic fox with an extra food supply beyond that which occurs naturally on tundra habitats. Numerous observations of unmarked adults and pups were made at dumpsters, garbage cans, and in and around various oil field facilities. Additionally, at least five marked adult foxes were observed at the gravel pad supporting BPX's Base Operations Center (BOC).

The pad at the BOC also supported at least 11 fox pups which used two artificial dens located on the pad. There were frequent observations of these pups being fed artificial food (from dumpsters) and natural prey items by two marked adults. It is believed that these pups were whelped in den 52 located on the tundra west of Gathering Center 3 (GC–3), and later moved approximately 1 km north to a utilidor (artificial den 126) located near the dumpster behind the kitchen of the BOC. Pups were first observed at the utilidor on 4 July when eight were present with a marked adult. They were often observed scavenging at the base of the dumpster. By mid–July, the pups were observed ranging to most other areas of the pad, but continued to use the utilidor at least until we departed Prudhoe Bay on 4 August.

Four pups, believed to be from the same litter, were frequently observed in another artificial den (den 141) located on the east side of the pad. These pups were fed by at least one of the same adults associated with the pups at the utilidor. These two adults were also observed several times at den 52. On 21 July, six pups were present at den 126, four at den 141, one near the operations warehouse, and two were known to still be present at den 52. Thus, we felt that at least 13 pups had been whelped at den 52.

Foxes gain access to dumpsters by climbing or jumping up the sides of these open containers. When several dumpsters are placed side by side, foxes may jump from one container to the next. Foxes may also gain access to dumpsters when there are holes in the dumpster near the bottom, or when the container door, which is hinged at the top, is pushed open slightly at the bottom by the garbage inside.

An unmarked adult was frequently observed bringing food (natural and artificial) to six pups under a trailer on a small pad west of Santa Fe Pad (den 136), approximately 2 km northwest of the BOC. These pups were later moved to another artificial den (den 137) located a short distance away between Santa Fe Pad and Gathering Center 1 (GC–1). On 29 June, the adult was observed bringing a brown paper bag to one pup at den 136. The adult then entered an open door of a building on Santa Fe Pad and brought food from the building to five pups at den 137. This adult returned to the building several more times, each time returning to den 137 with more artificial food for the pups. Eventually, these pups began to leave the immediate area of the two artificial dens and were observed daily on other portions of Santa Fe Pad. They would often be seen at the base of dumpsters where they could find food scraps, some of which had been tossed out by gulls.

Foxes were also observed at dumpsters on pads which had rigs and camps. These pads typically have small camps which house drilling personnel. Four pups were frequently observed at an artificial den (den 139) on one of these pads (U–Pad). At least some of these pups could be enticed to approach vehicles, and it is suspected that they had probably been habituated by feeding from oil field workers.

On 13 July, an adult fox was observed opening lunch bags located on a small flatbed trailer on K–Pad. The lunch bags belonged to workers who were on the tundra approximately 100 to 200 m away.

On several occasions, foxes were observed at night entering the open doors of buses parked adjacent to Annex 3. During the mornings and evenings, these buses bring workers to and from various work places in the oil field. Foxes were attracted to these buses by the presence of food remains left by the workers. On several occasions, foxes also were observed in the beds of pickup trucks parked overnight near the BOC, presumably looking for scraps from lunch bags.

In addition to obtaining food from dumpsters, open buildings, or opportunistically from unsuspecting oil field workers, Arctic fox probably obtain food by direct feeding from field personnel. On several occasions, oil field workers were observed feeding foxes. The fact that foxes in all parts of the field can often be enticed to approach and wait patiently by whistling or rustling a paper bag strongly suggests that feeding by oil field workers may be widespread.

Movement of Individual Arctic Fox Within the PBOF

By recording the color combinations of neck collars and ear tags and the numbers on ear tags of marked foxes, we were able to document the movements of some individuals in the oil field. Color combinations were relatively easy to record, but

numbers on ear tags were small and difficult to see unless foxes were at close range and stationary.

The most frequently recorded marked foxes were the pair of adults observed feeding pups at various locations near the BOC. Both of these individuals were also observed bringing food to pups or acting territorial at den 52. It should be noted that two other marked adults were also observed at den 52. These foxes were not observed feeding or interacting with pups at the den. Eberhardt et al. (1983a) also observed more than two adults at some dens, and attributed this to site fidelity for a specific den or home range.

Another adult fox observed near the BOC was observed with pups at three artificial dens. These were den 110 on A–Pad, approximately 4 km southwest of the BOC; den 135 on X–Pad, approximately 5.5 km south of the BOC; and den 130, approximately 1 km east of A–Pad. No other marked foxes observed at the BOC were observed at any great distances from the BOC.

A marked adult fox observed on W–Pad was subsequently observed with three pups on S–Pad, approximately 6.5 km to the north. Another marked fox in this area, observed at a culvert south of S–Pad, was later seen south of the Spine Road, approximately 5 km.

On two occasions, an unmarked adult, possibly the same individual, was followed and observed moving significant distances. On 6 July, an adult was observed at den 43 in the Kuparuk River drainage near the Spine Road. The adult left the den and was followed by one of two pups at the den. The two foxes followed the Spine Road east across the Kuparuk River and turned south on the access road toward Service City. They eventually crossed the tundra to den 23, west of N–Pad, where the adult and pup were greeted by six other pups. Prior to this time, den 23 had been inactive. This

observation represents movement of pups from a natal den (den 43) to a secondary den (den 23). The total distance traveled was approximately 5 km.

On 12 July, possibly the same adult was observed on the Spine Road near GC–1 with what appeared to be a dinner roll in its mouth. The fox traveled generally north and west along the Spine Road to the turnoff for N–Pad, at which point it moved across the tundra and delivered the food to pups at artificial den 132, a culvert located approximately 1 km north of den 23. During the next half hour the adult and pups moved south to den 23 and were joined by a second adult. The total distance traveled by the first adult from GC–1 to den 132, where pups were first encountered, was approximately 9.5 km. If we assume that this journey began at one of the dumpsters near the BOC, the closest place where the fox could likely have acquired the dinner roll, the total distance traveled from the food source to the pups would approach 12 km. If this movement and use of artificial food is representative of other foxes in the area, the sources of artificial food available in PBOF could have a significant effect on the fox population by enhancing productivity and survival of fox pups.

Discussion

Other workers have also noted the use of artificial foods and dens by Arctic fox. Fine (1980) found garbage in 26 percent of the fox scats that he analyzed in his study area in the PBOF. He also reported foxes receiving handouts from oil field workers. He suggested that processed food was highly digestible and left fewer remains in scats than natural foods, and felt that garbage was used more extensively than his scat analysis indicated. Fine also estimated that more foxes were present in the Prudhoe Bay area during the winter than the summer due to the availability of artificial foods. The occurrence of garbage in scats collected in the Prudhoe Bay area by Garrott et al. (1983)

was only 6 percent, but they also felt that the use of garbage by foxes was more extensive than this figure indicated.

Eberhardt (1977), while studying Arctic and red foxes at Prudhoe Bay and at construction camps along the Trans–Alaska Pipeline corridor, reported that foxes were attracted to camps by the availability of artificial food at garbage dumps and handouts from workers. He also reported that foxes use areas underneath buildings during the winter for shelter, and what appeared to be foxes begging for food by standing on the road waiting for approaching vehicles to stop. Eberhardt et al. (1982) stated that foxes used oil–developed areas for feeding, denning, and resting, and that use of these sites became more common late in the rearing season as juveniles became more mobile.

Urquhart (1973), while studying Arctic fox on Banks Island in the Canadian Arctic, found that foxes were attracted to seismic camps and staging areas by the availability of food in the forms of garbage, sewage, handouts, frozen food stored under trailers, and the presence of permanent shelters. The number of foxes was highest during the fall and early winter and decreased by January and February. This would correspond to the period after the denning season when juvenile foxes become more mobile.

The availability of artificial dens in the PBOF provides Arctic fox with a great number of possible den sites, many of which are located close to food sources. These artificial dens may be preferred to natural dens by foxes, in some cases, because they are inaccessible to predators, such as the brown bear (*Ursus arctos*). Brown bears dug up several natural dens during this study and are known to be predators of Arctic fox (Garrott and Eberhardt 1982, Burgess et al. 1993). As pointed out by Garrott et al. (1983), the availability of artificial dens and food in developed areas may affect the survival, reproduction, and disease transmission in local populations of Arctic fox.

Conclusions

In the PBOF, Arctic fox supplement their food supply by visiting dumpsters, and by opportunistically entering open doors of buildings, buses or any other area where food scraps may be available. Dumpsters supply artificial food for foxes with dens in the immediate area, and also for foxes with den sites at greater distances. One fox was observed bringing artificial food to pups at a den which was probably 12 km from the food source. Foxes also get handouts from oil field personnel. This practice may be widespread since foxes in all parts of the oil field seem to be habituated to humans and will wait next to a parked vehicle as if expecting a handout.

In addition to the artificial food supply, foxes also benefit from the presence of culverts, pipes, crawl spaces, utilidors, and the undersides of buildings and trailers, which provide artificial den sites. Artificial den sites are not only close to artificial food sources, but also may afford more protection from predators, such as brown bears, than natural den sites.

It is likely that the Arctic fox population in the PBOF may be artificially high. The presence of a high number of foxes in developed areas creates a safety issue related to the potential threat of exposure of oil field personnel to rabies. Furthermore, the presence of high numbers of foxes may have an adverse effect on tundra nesting bird populations, particularly waterfowl.

MANAGEMENT OPTIONS

Though not conclusive, investigations in the Prudhoe Bay region have suggested that Arctic fox populations may be existing at higher levels than would occur naturally in the absence of the oil field and related development (Eberhardt 1977; Fine 1980; Eberhardt et al. 1982; Eberhardt et al. 1983a, b; Garrott et al. 1983; Burgess et al. 1993). These studies indicate that the presence of an abundant artificial food source (various garbage sources and direct feeding by oil field personnel) and the availability of numerous artificial sites suitable for denning are responsible for these higher fox numbers. Our study indicates that the Arctic fox population in PBOF has been stable for the past two seasons, and use of artificial food and artificial denning sites is extensive. The lack of any pre-development data precludes drawing definite conclusions regarding the effect of the oil field on the fox population.

However, Arctic fox are conspicuous around some oil field facilities and are obviously attracted to these sites. Large numbers of foxes near oil field facilities are undesirable, not only from the standpoint of potential risk of exposure of oil field workers to rabies, but also because of potential increased predation on prey species (particularly certain high profile bird species) which could occur if fox populations were artificially high.

Based on the current available information, the development of a management plan to reduce the number of human/Arctic fox interactions near oil field facilities seems warranted. Whether or not actual fox control measures should be conducted in PBOF needs to be determined after further discussion and consideration. If fox populations are artificially high in PBOF, reducing the factors which attract foxes to oil field facilities, or eliminating fox use at certain sites entirely, may be sufficient for controlling the fox population.

The following options are designed to reduce or eliminate fox use of oil field facilities. Without the beneficial effects of oil field facilities, fox populations, if artificially high, should return to natural levels in a short time. Some options have a higher priority than others. We believe the first two options, dealing with the elimination of artificial food sources, are the most important. Other options will be useful to a lesser extent; and some may be impractical, either logistically or technologically. In all cases, Alaska Department of Fish and Game sanction is needed.

Option 1: Elimination of artificial food sources. The use of dumpsters as a food source is one of the prime fox attractants to oil field facilities. Foxes gain access to dumpsters in three ways: 1) through the open tops of the containers; 2) through holes worn through sides of dumpsters near the bottom; and, 3) through doors, which are hinged at the top, being pushed open near the bottom by the weight of garbage inside the container.

Dumpsters should be covered, thus eliminating fox access from above. Containers should also be periodically maintained by repairing holes which allow fox access. When dumpsters are emptied, workers should make certain that doors are completely closed and secured. In lieu of these measures, dumpsters could be enclosed in fenced areas which would not permit fox access.

During the current study, few foxes were observed at the North Slope Borough landfill, although fox use of garbage dumps has been noted by other workers (Eberhardt 1977, Fine 1980). At this time, it is unclear how extensively foxes use the North Slope Borough garbage disposal site. This landfill site is to be closed and the new location managed to minimize access by foxes, bears, and gulls.

Our observations indicate that foxes will enter buildings, buses, and beds of pickup trucks in search of food, and will grab unattended lunch bags or other food

sources whenever possible. Oil field personnel can solve these problems by securing doors to buildings and buses, and by placing lunches and other food sources in locations not accessible to foxes or using bear/fox–proof containers. Information on how to address this problem could be included in the educational program suggested for Option 2 (below).

Option 2. Elimination of direct feeding of foxes by oil field workers. The practice of feeding foxes is probably widespread and has been noted by others (Urquhart 1973, Eberhardt 1977, Fine 1980, Garrott et al. 1983). It is likely that many oil field personnel are unaware of the potential negative impacts they may cause to tundra nesting bird species, or the potential health risk that foxes pose to humans.

The environmental training given to all field personnel (employee and contract) should be augmented to stress the importance of maintaining fox and other wildlife populations at natural levels. In addition, oil company policies prohibiting feeding wildlife should be widely disseminated and enforced.

Option 3. Elimination of fox use of artificial den sites. Arctic fox use culverts, pipes, crawl spaces, utilidors, trailers, and buildings as secondary dens. Because of the large number of potential artificial den sites, it may be impractical to try to exclude foxes from all available areas. However, it may be practical to exclude foxes from artificial dens which are used repeatedly, such as the utilidor near the BOC. Because of the variety of structure types used as artificial dens, methods to deter fox use of specific dens may require site–specific solutions. One method for excluding foxes from artificial dens is discussed briefly in Option 7 (below).

Option 4. Direct control measures to decrease the number of foxes. Direct control measures (i.e., removal by trapping) have proven successful for controlling Arctic fox in the past (Anthony et al. 1991). However, direct control measures can be

costly (Steck et al. 1982). Should a rabies outbreak occur in the PBOF fox population, direct control probably would be necessary to protect oil field workers.

Option 5. Capture and relocation of foxes to areas outside of the Prudhoe Bay region. Arctic fox, especially habituated ones, are easily captured (Burgess et al. 1993) and the relocation of captured foxes is not difficult. However, there are some problems associated with this option. Careful study in selecting areas for fox relocation would be required to minimize impacts in those areas. Also, Arctic fox are migratory at certain times of the year and may travel great distances (Chesemore 1967, Northcott 1975, Wrigley and Hatch 1976, Eberhardt and Hanson 1978). Relocating Arctic fox to other areas may be impractical, since many of the relocated foxes probably would return to Prudhoe Bay. Because of the large numbers of foxes involved, it may also be economically impractical to remove and relocate Arctic fox.

Option 6. Use of contraceptives to reduce fox productivity. Because of possible public or agency opposition to removal of Arctic fox by trapping, and because of potential hazards related to some methods of fox removal (i.e., poisoning), the use of oral contraceptives may be a feasible method to control fox populations. Experiments using diethylstilbestrol (DES) to reduce reproductive performance in foxes and other animals have produced conflicting results. Linhart and Evans (1964) reported that captive female red foxes failed to produce kits when they were fed DES between nine days prior to and ten days after mating. Travis and Schaible (1962) reported an almost complete failure of normal reproductive processes in mink when DES had been ingested after implantation. However, Allen (1982) noted statistically insignificant DES–related changes in reproductive performance in free–ranging red foxes that had ingested DES at rates $\geq 70\%$. The positive results of some studies provide incentive for further studies, but alternative compounds and delivery systems should be considered. Timing and effective delivery methods for Arctic foxes still need to be determined.

Option 8. Aversive conditioning. Aversive conditioning has been studied as a tool to control some types of predation by treating food which mimics natural prey with distasteful chemicals. Predators that eat treated food develop a taste aversion which they associate with a particular prey and, subsequently, avoid that prey. In a controversial experiment, Gustavson et al. (1974) reported that, after eating treated rabbit and sheep meat, coyotes developed an aversion to these prey species. In a more recent study, Conover (1990) treated chicken eggs with a distasteful chemical and found that raccoons, possums, and skunks developed a conditioned aversion response. He felt that, from a management standpoint, it might be possible to reduce mammalian predation on bird eggs by placing treated eggs into the environment before the onset of the laying season. Nicolaus (1987) found that various predators (mainly ravens) developed a taste aversion to eggs after exposure to treated crane eggs.

Using taste aversion to discourage foxes from using artificial foods may have some practical application. There are relatively few primary sources of artificial food (i.e., dumpsters) and these could be easily baited with treated artificial food. To deter foxes from accepting handouts from workers, foxes could also be fed treated artificial food from vehicles.

Other types of adversive conditioning have been used for many years in the training of domesticated animals, and as a deterrent to exclude wild animals from certain areas. Devices such as electrical shock collars, electrical fences, and cattle prods have been used as negative reinforcement during animal training sessions. In bush camps in Alaska, shotguns loaded with bird shot have often been used to drive bears away from garbage areas, cook tents, or other camp locations. Varying degrees of success have been achieved, particularly with respect to the use of adversive conditioning on wild animals. Bears are often only temporarily frightened by the noise and sting of bird shot and frequently return in a short time.

In PBOF, foxes have become habituated to humans and show little fear of man. They are accustomed to the loud noises of trucks, generators, and other oil field equipment and would probably not be easily frightened by loud noises. The large number of individual foxes also means that negative reinforcement is like to be difficult.

Option 8. Use of an oral vaccine to reduce rabies threat. Captive Arctic and red foxes have been successfully immunized against rabies with the use of oral vaccines, although it has been suggested that more studies be conducted before any effort is made to control rabies in wild fox populations (Winkler and Baer 1976, Follmann et al. 1988). Since a live virus vaccine is used, its affect on potential non–target species and the affect of multiple ingestions over a short period of time should be determined. Steck et al. (1982) reported that, during field studies in Switzerland, an oral vaccine administered in chicken heads seemed to "freeze" any progression of the disease and was more cost effective than other methods of control. An oral vaccination program in Ontario successfully delivered bat to 70% of free–ranging foxes; however, bait success and effective vaccination are not synonymous. Control of rabies by vaccination of wildlife is dependent upon several factors including efficacy of the vaccine, immunity rate required to prevent the spread of rabies, economic limitations of the control program, and population dynamics (Voight et al. 1985).

The use of an oral vaccine may have promise in the future as a means of preventing rabies epizootics and minimizing the threat of rabies to humans. Whether or not this is a sound management practice for the Prudhoe Bay area at this time is unclear. Vaccination of Arctic fox for rabies could strengthen the population and cause fox numbers (in a population already considered artificially high by some) to increase. The rabies virus occurs naturally in Arctic fox and may be an important factor in population control.

Conclusions

The reduction or elimination of artificial food sources as outlined in options 1 and 2 appear to be the most appropriate first step in solving problems associated with Arctic fox in the Prudhoe Bay area. These are probably the easiest and most cost effective options to implement. By eliminating these food sources, foxes will have to depend solely on natural food sources for survival. If the Prudhoe Bay fox population is artificially high, and if the available artificial food does dampen population fluctuations, reliance solely on natural food supplies should restore natural population fluctuations and reduce the population to pre-development levels.

Some options may be impractical for large scale application. The large number of potential artificial den sites make Option 3 (eliminating fox use of artificial dens) difficult to implement except on a site-specific basis, and difficulties associated with relocating large numbers of foxes to new areas make Option 5 impractical. Because of adverse public opinion and lack of information concerning the local population dynamics, Option 4 (permanent removal of foxes by trapping, etc.) may be premature.

Options 6 (the use of oral contraceptives) and 8 (the use of oral rabies vaccine) may be potential solutions, but further research in these areas is recommended prior to large scale implementation of these options. Pilot studies investigating the use and affects of contraceptive drugs and rabies vaccines may be warranted. Similarly, pilot studies investigating the effectiveness of chemicals which produce taste aversions (Option 7) may be appropriate.

The implementation of any single option is not likely to eliminate fox use of oil field facilities; but a sound management plan, based on a combination of these options, should help to reduce or even eliminate fox problems.

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