MOOSE IMMOBILIZATION PROGRAM IN NORTHCENTRAL BRITISH COLUMBIA

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Abstract: The winter of 1981-1982 produced very deep snow in north-central British Columbia, allowing pursuit and capture of moose (Alces alces) on the ground. Helicopters were used to pursue and capture moose in March, 1980, and January, 1981. Ground pursuit produced lower dollar cost and equal labour input, although younger moose and fewer bulls were captured. More moose died when pursuit was on the ground, but the greater number of deaths was probably due to severe winter conditions. Ninety mg fentanyl with 100 mg xylazine immobilized moose in 13 min (SD 5 min) and 4.5 mg etorphine with 100 mg xylazine immobilized moose in 15 min (SD 5 min). Ketamine mixed with xylazine proved to be an ineffective immobilizing mixture.

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After two winters of relatively light snowfalls in northcentral British Columbia, the winter of 1981-1982 produced very deep snow. Snow depths of 150 cm provided the opportunity to pursue and capture moose (Alces alces) using snowshoes and pickup trucks. It also made the normal routine of capturing moose with a helicopter difficult as the deep snow had driven the moose into heavy cover. This paper compares helicopters and ground pursuit as methods of capturing moose and describes moose response to drugs during the immobilization program

conducted north of Prince George, B.C., over the period of March 1980 to February 1982.

MATERIALS AND METHODS

Etorphine hydrochloride (M99) in combination with xylazine hydrochloride (Rompun) and fentanyl citrate in combination with Rompun were the principal immobilizing mixtures used in this program. In the first year of the program ketamine hydrochloride in combination with Rompun was used to immobilize moose. Palmer darts and Cap-Chur guns (Palmer Chemical Co.) were used to inject the immobilizing drugs. Immobilizing activities of M99 and fentanyl were reversed with diprenorphine hydrochloride (M50-50).

Pursuit and Capture

Bell 206 (Jet Ranger) helicopters were used for pursuit of moose during the first two immobilization sessions in this study: March 24 and 25, 1980, and January 30 and 31, 1981. A gunner in the helicopter darted moose in the top of the rump or back muscles from less than 10 m. Alternatively, the helicopter herded moose to a gunner lying in ambush. After darting, the helicopter circled the injected animal until it lay down.

In the deep snow conditions of January and February 1982, moose foundered in the snow and could be run down by men on snowshoes, or moose were darted in hollows which they had constructed in the snow. Snow banks 2 m high often trapped moose on logging haul roads. Such moose could be pursued with pickup trucks, forced over the snow banks and darted while they foundered in the snow within a few meters of the

road. If a moose would not climb the snow bank, it could be driven by one pickup toward a gunner hiding behind a second truck blocking the road. Most animals were darted in the rump, but the shoulder provided an acceptable secondary target. The preferred darting range was 10 m.

After an animal was darted, the crew withdrew from the area during the period of induction. When recumbent, moose were blindfolded. Respiration rate, total length and heart girth were recorded. Radio transmitters and eartags with identifying numbers were attached to immobilized animals.

RESULTS AND DISCUSSION

Ketamine/Rompun

Ketamine mixed with Rompun proved ineffective. Six animals showed variable responses to the drug mixture. A yearling bull was unconscious for nearly four hours after receiving 1000 mg ketamine and 500 mg Rompun. On the other extreme, a cow received 1150 mg ketamine and 900 mg Rompun but remained too strong to be pulled off her feet. The response of moose to ketamine/Rompun was so variable that its use cannot be recommended.

Fentanyl/Rompun

The drug use in 1981 was directed toward finding effective doses of fentanyl and Rompun. Twelve moose were immobilized on January 30 and 31, 1981. Because of small sample size and poor field conditions, conclus-ive data are unavailable. Field observation indicates that doses of 75 mg fentanyl with 70 mg Rompun and 75 mg of fentanyl with 85 mg Rompun immobilized moose, but induction times were too long. However, 90 mg fentanyl with 100 mg Rompun yielded an acceptable induction time.

Ninety mg fentanyl with 100 mg Rompun was the fentanyl/Rompun dose used in 1982. This dose immobilized adult moose in an average of 13 min, with a standard deviation of 5 min (Table 1).

An intramuscular injection of M50-50 was given in the ratio of 1 mg M50-50 for each 6 mg fentanyl. Higher doses were given to animals under stress. Average recovery time was 8 min, with a standard deviation of 5 min.

Haigh et al. (1977) found the fentanyl/Rompun mixture effective when dosages varied between 0.14 mg/kg fentanyl with 0.15 mg/kg Rompun, and 0.53 mg/kg fentanyl with 0.53 mg/kg Rompun. The 90 mg fentanyl/100 mg Rompun applications in the Prince George program produced dosages ranging from 0.26 mg/kg fentanyl with 0.29 mg/kg Rompun to 0.47 mg/kg fentanyl with 0.52 mg/kg Rompun (Table 2). These dosages are within the effective range given by Haigh et al. (1977). When all doses are considered, including those other than 90 mg fentanyl/100 mg Rompun, the minimum dosage equalled 0.23 mg/kg fentanyl with 0.26 mg/kg Rompun. This dosage is also higher than the lowest effective dosage of Haigh et al. (1977). However, in the Prince George program an adult cow received a dose of 225 mg fentanyl with 210 mg Rompun and survived. The dosage was 0.67 mg/kg fentanyl with 0.63 mg/kg Rompun, much higher than the largest effective dosage of Haigh et al. (1977).

M99/Rompun

In 1980, four moose were immobilized with an M99/Rompun mixture. Doses ranged from 3.2 mg M99 with 175 mg Rompun to 4.2 mg M99 with 130 mg Rompun. Induction times and length of time immobilized were not recorded. One animal recovered in 3 min and another in 4 min after

sublingual injections of M50-50. With intramuscular injections of the antidote, one animal recovered in 8 min and another in 10 min.

In 1982 the M99 darts contained 4.5 mg of M99 and 100 mg of Rompun. This drug combination immobilized moose in an average of 15 min, with a standard deviation of 5 min (Table 1). An intramuscular injection of M50-50 was given in the ratio of 2 mg of M50-50 for each mg of M99. Average recovery was 14 min, with a standard deviation of 5 min.

The dose of M99 and Rompun used in this study was similar to that used elsewhere in North America on the medium sized subspecies: 5 to 7 mg M99 for Alces alces andersoni (Lynch and Hanson 1981), and 4 to 5 mg M99 for Alces alces americanus (Roussel and Patenaude 1975). In contrast, recommendations for immobilization of Alaskan moose (Alces alces gigas) include 7 mg M99 combined with 300 mg Rompun (Gasaway et al. 1978) and 8 mg M99 combined with 200 mg Rompun (Franzmann et al. 1982), indicating that increased doses are required for the larger subspecies.

Dosages of M99 in this study ranged from .012 to .016 mg/kg (Table 2) as compared with recommended dosages for the Kenai moose of .025 mg/kg for M99 alone and .02 mg/kg for M99 used with Rompun (Franzmann et al. 1982). The experience of moose being injected with M99 without immobilization (Franzmann et al. 1982) did not occur in Prince George.

Houston's (1970) experiments on Shiras moose (Alces alces shirasi) with M99 provide an extreme contrast with the Kenai results. Houston (1970) immobilized adult moose with dosages of M99 less than 0.009 mg/kg (0.4 mg/100 lb). Although these dosages were never tried in Prince George, they are probably too low to be effective.

Some of the animals immobilized with M99/Rompun tossed their heads, kicked or made rhymthic cycles of movements, characterized by repeated attempts to stand followed by relaxation. These animals were sensitive to noise, particularly metallic clicks. The crew lacked sufficient drug to give all animals supplementary injections, and one animal continued thrashing when given a supplementary injection of 3 mg M99. The solution to the problem was to work quickly and quietly, injecting the antidote as soon as possible. When narcotic stressed moose were injected with antidote, head tossing, kicking and rhythmic struggling ceased.

While stress symptoms were present in several animals injected with M99, they were observed in only two animals injected with fentanyl. The fentanyl animals showing excitation received underdoses due to dart failure. Therefore, excitation in the M99 animals may have been a symptom of underdosing. The dose of drug in a dart was limited by the 5 ml dart capacity. If etorphine were available in a more concentrated solution than M99 (1.0 mg/ml), a dose of 6 mg etorphine with 100 mg Rompun (Haigh et al. 1977) could have been used.

Pursuit and Capture

People using snowshoes and pickup trucks captured moose in deep snow efficiently (Table 3). Twenty moose were captured in 1980 and 1981, using helicopters, at a cost of $775 per moose. Twenty were captured in 1982 alone, using ground pursuit, at a cost of $213 per moose. Whether pursuit was by helicopter or on the ground, labour input was 1.4 man-days per moose.

Pursuit of moose on the ground led to younger moose and fewer bulls being captured than when pursuit was by helicopter. The helicopter crew caught 5 bulls, 14 cows and 1 yearling. The ground pursuit crew caught 2 bulls, 14 cows, 2 yearlings and 2 calves.

Pursuit of moose on the ground was more efficient than the use of helicopters in our program. However, this comparison may be faulty. First, helicopter use in this program was inefficient. Haigh et al. (1977) captured up to 2 moose per hour, depending on the experience of the pilot. Roussel and Pichette (1974) captured 1.7 moose per hour when the helicopter was able to operate efficiently. The Prince George program managed only 0.8 moose per helicopter hour.

Surface pursuit is often used when conditions prevent the use of helicopters (Ritchie and Barney 1972), but the conditions under which surface pursuit is practical are often unavailable. In this program the snow had driven moose into heavy cover, making pursuit by helicopter very difficult. The snow was deep and soft enough for moose to founder but hard enough that a man on snowshoes was easily supported. The snow conditions present at Prince George in 1982 occur only once every 4 to 5 years.

Mortality

Four more deaths occurred among moose captured by ground pursuit than among those captured with the helicopter (Table 3). Six of the 20 moose captured in 1982 were known to have died before summer. Two of the 20 moose captured in 1980 and 1981 died before summer. Autopsies were not performed on any of the animals which died. However, capture myopathy is suspected in cases when the animal endured a stress-

ful chase and died within 14 days of capture near the point of capture. Acidosis in capture myopathy cripples the animals and poisons the kidneys.

The two animals that died when pursued by helicopter probably died of capture myopathy. Both were victims of stressful chases and died 7 to 14 days after capture near the point of capture. Only one of the moose which died after pursuit on the ground had a stressful chase and died near the point of capture. Two others died near the point of capture but their chases were routine.

Three of the moose dying when pursued on the ground probably died of causes other than capture myopathy. Two moose died in early June, four months after capture. Another moose, with a severe infection in her left front leg, died several weeks and 2 km from the point of capture.

Five of 6 animals that died after ground pursuit did not endure stressful chases. Three were not chased at all, but were darted where they were found. The lack of a chase may indicate that severe winter conditions had weakened these animals, predisposing them to death.

Death rates of captured moose have been reported by a number of authors whose principal immobilizing drugs were narcotics. Haigh et al. (1977) lost 6.4% of immobilized moose when the animals were pursued by helicopter. Gasaway et al. (1978) reported a 15.4% mortality rate of moose which were pursued by helicopter, while Lynch and Hanson (1981) documented 6.7% and 25% mortality rates for trapped moose and moose pursued by helicopter respectively. Franzmann et al. (1982) noted an 8.7% death rate for adult moose trapped or pursued by helicopter. When possible capture myopathy deaths are included, the Prince George project

suffered moose mortality rates of 10% when pursuit was by helicopter and 15% when pursuit was on the ground. These death rates are comparable to those of other projects. However, the 30% overall death rate during the severe winter of 1982 compares poorly with the experience of other projects.

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Table 1. Immobilization of moose with fentanyl/Rompun and M99/Rompun, 1982.

	90 mg fentanyl/100 mg Rompun	4.5 mg M99/100 mg Rompun
n	8	12
induction mean + SD	13 ± 5	15 ± 5
Respiration mean + SD	29 ± 13	24 ± 8
time immobilized mean + SD	56 ± 19	59 ± 17
mg M50-50 mean + SD	15.3 ± 2.6	9.7 ± 2.0
Recovery minutes mean + SD	8 ± 5	14 ± 5

Table 2. Dosages of M99/Rompun and fentanyl/Rompun with estimated weights* of yearling and older moose.

		Dosage (mg/kg)			Moose weight (kg)		
	n	mean	min	max	mean	min	max
90 mg fentanyl/ 100 mg Rompun	11	.30/.33	.26/.29	.47/.52	301	191	344
all fentanyl/ Rompun	20	.32/.36	.23/.26	.67/.63	307	191	344
4.5 mg M99/ 100 mg Rompun	10	.014/.32	.013/.30	.016/.35	317	290	338
all M99/Rompun	14	.014/.38	.012/.30	.016/.77	279	228	365

	n	mean ± SD
weight of all adult males	7	313 ± 30
weight of all adult females	28	309 ± 42

*Weight (kg) = -239.97 + 2.07 (total length (cm)), from Franzmann et al. 1978.

Table 3. Comparison of helicopter and ground pursuit.

	pursuit	
	helicopter	ground
cost per moose	$775	$213
labour man-days per moose	1.4	1.4
number captured total	20	20
bulls	5	2
cows	14	14
yearlings	1	2
calves	0	2
mortality total	2	6
possible capture myopathy	2	3