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ABSTRACT

This report describes the conduct of a nine-day trial of cold weather clothing and equipment carried out by four DREO personnel along the west coast of James Bay. The equipment used, i.e., cold weather clothing, sleeping bags, stoves, tent, radios, snowmobiles and sleds, is described and its performance is discussed.

RESUME

Ce rapport décrit le déroulement d'un essai de 9 jours effectué sur l'équipement et les vêtements utilisés dans des conditions climatiques froides. Cet essai fut mené par 4 personnes travaillant au CRDO et il a eu lieu le long de la côte ouest de la Baie James. L'équipement utilisé i.e. les vêtements pour température frodie, les sacs de couchage, les poêles, les tentes, les radios, les motoneiges de même que les traîneaux est décrit et leur performance est discuté.

EXECUTIVE SUMMARY

The nine-day trial demonstrated that the latest version of the experimental cold weather clothing system provided increased protection and that the concept of use was relevant to the type of operation, i.e. an extended, self-contained patrol using light oversnow vehicles. It also showed, that even when using the smallest production snowmobile, one machine was capable of transporting at least two men on such an extended patrol.

Other equipment was also evaluated. It was found that radio communication from James Bay to Ottawa via Bell Canada in Alma, Quebec was possible using a 10 watt, trail radio (SBX-11A). A 100 watt HF set was used to contact Ottawa directly, but its performance was limited by that of the heavy NiCad battery packs. Other effects of the cold on radio equipment were noted.

The packed volume of the prototype high arctic reconnaissance tent used on the trial increased dramatically. Although this insulated tent incorporated a vapour barrier to prevent the accumulation of condensed water in the insulating material, its mass increased by ten kilograms.

From measurements of changes in the mass of sleeping bags used on the trial, no net benefit, in terms of water accumulation, could be ascribed to the use of waterproof but water-vapour permeable "bivy sacs" inside of an unheated tent in extreme cold.

A detailed narrative section describes the daily activities and progress of the trial as well as the route, snow, ice and weather conditions, hazards and the geography of the area.

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INTRODUCTION

In the past three years, the Environmental Protection Section of DREO has carried out four trials of prototype equipment in support of the development of adequate military clothing for cold conditions. These trials and the clothing designs were the result of experience gained on a number of other trials and military exercises (1) and theoretical considerations (2).

The first of these recent trials, TRIAL RUN, was carried out in February 1986. This trial of equipment was also an experiment in trial design. It was an eight day journey by snowmobile on the relatively unpopulated west coast of James Bay. The total distance covered was seven hundred kilometres. A great deal was learned on this trial concerning the techniques of travelling long distances by snowmobile (3, 4). It also showed that such expeditions can provide a more intensive and therefore more realistic test than can the average winter trial (5).

A 1987 prototype clothing system was worn during the next extreme cold trial in Churchill, Manitoba in February 1988. An eight hundred kilometre route to Baker Lake was planned. Mobility problems, combined with communications failures and minor problems with other equipment, notably stoves, tents and clothing resulted in truncation of this trial (6). Nevertheless, three days of travel in extreme weather conditions were sufficient to point out several problems in the design and construction of the clothing system.

The clothing system was improved and was then given a cold-wet trial at Pangnirtung on Baffin Island in August of 1988 (7). The experience in wet-cold resulted in another round of design changes culminating in the production of a limited number of clothing systems for trial by military units in the winter of 1988-89. This version of the cold-dry, cold-wet clothing system was then trialled by DREO on TRIAL RUN II, which is the subject of this report.

Five DREO personnel took part, Randall Osczevski, Brian Farnworth, Brad Cain and Andy Main in the field and Allan Keefe as the base station radio operator in Ottawa. The field party of four travelled up the west coast of James Bay to Ekwan Point, largely along the route of the original Trial Run of 1986. Three snowmobiles were used for this trial to test the feasibility of having two people travel with one machine.

This paper describes the clothing, equipment and travel methods used. A narrative of daily events describes the conduct of the trial, general experience with the clothing system and travel methods and some subjective impressions. The performance of other equipment is also briefly discussed.

CLOTHING

The clothing had four layers. On the upper body, a shirt was worn next to the skin. Although any shirt is acceptable, the Norwegian turtle-neck pullover with neck-zipper (8405-25-114-8110) or the lightweight combat shirt was worn. A pile jacket-liner was worn over the shirt. Next came the jacket, which was made with a nylon shell, Dermoflex-coated to make it water- and wind-proof but water-vapour permeable. A parka, insulated with polyester batting, could be worn when required over this jacket.

Pile trousers were worn next to the skin. Over these, windproof and waterproof trousers made of the same materials as the jacket shell were worn. Thick trousers insulated with polyester could be worn over the windproof trousers when required. A detailed description of the clothing system can be found elsewhere (2). In addition, facemasks and snowmobile helmets with full face, double lens visors were worn by the drivers of the snowmobiles.

TENT AND STOVES

Although each of the three sleds carried a tent for use in emergency, only one of these was used . It was a four-man, semi-cylindrical, insulated tent. This tent had previously been used for four nights during TRIAL RUN 1986. Its dimensions were 2.5 metres, square, by 1.25 metres high at the centreline. Insulated tents must include a vapour barrier to prevent the condensation of water in the insulation. This tent had a vapour barrier of aluminized polyester film, bonded to a layer of continuous filament polyester batting weighing 140 grams per square metre. One improvement over 1986 was a net, suspended from the ceiling and extending the length of the tent for use in drying clothing.

In addition to a tent, each sled carried stoves, fuel and food for use in emergency. MSR Whisperlite stoves were used in the tent. When used for cooking, they were placed under a grill which raised the cooking containers a few centimeters above the flame to reduce the production of carbon monoxide which results when the flame is cooled by a cold metal pot. These stoves have detachable fuel tanks. Stoves could be conveniently refuelled in the tent by exchanging a full tank for an empty one. Fuel tanks were, of course, refilled outside of the tent. Enough fuel tanks could be filled at one time to last more than one day. The tent was heated for several hours in the evening and for two or three hours in the morning. Because the tent was insulated, it could be relatively warm inside even without stoves burning. An unheated, unoccupied, insulated tent can warm up to a temperature close to that of the ground under it. In winter, under the snow, the ground can be much warmer than the air. Of course in summer, especially in permafrost areas, an unheated, insulated tent would be cooler than air temperature.

Light was provided by a battery powered fluorescent lantern. When it was cold, it glowed dimly or not at all. Incandescent lanterns or candles were used while the fluorescent tube and batteries were warming.

COMMUNICATIONS

The failure of communications during the 1988 trial at Churchill had been a major reason for the truncation of that expedition. For TRIAL RUN II, the equipment and the details of radio communication were looked after by EPS personnel. Two 100 watt DE 1000 radio transmitters, an SBX-11A Trail Radio (10) and three Trail Radio antennas and masts were acquired. One of the masts was erected on the roof of the laboratory building at DREO at a height of approximately 16 metres. One of the DE 1000 sets was used as a base station radio operating SSB on 9295 (9296.5) kHz. The other DE 1000 was carried in a heated container on one of the sleds as the primary field radio. Power for the 100 watt radio was provided by packs of NiCad batteries. The SBX-11A, a 10 watt SSB radio was carried as a backup. This radio operates on nine alkaline D-cells.

Arrangements were made with Bell Canada in Montreal to use their northern radio service which has a transmitter at Alma, Quebec. The operator patches the H.F. radio of the subscriber into the regular long-distance telephone network. Details of this service are available from Bell Canada, 700 Lagauchetiere West, Office 24 west 1, Montreal, Quebec, H3B 4L1 or 1-514-870-7835. A similar service is available in Manitoba from Selkirk and Thompson, and in Ontario from Kenora, arranged through Bell Canada in Thunder Bay.

The Ontario Ministry of Natural Resources offered the use of their HF frequency as an additional backup during office hours.

Brackets were affixed to the cargo carrier/backrest of each snowmobile so that poles from the extra mast could be quickly erected to support the ends of the antenna. The top sections of these extra poles were equipped with an eye-bolt. The rope from the end of the antenna was passed through the eye and tied to the snowmobile. This allowed the ends to be pulled up and tension adjusted. Raising the ends of the dipole increases the power radiated in the intended direction (8). The dipole should be set up so that it is perpendicular to a line between the stations for communication at distances of over 300 km.

Short range FM transceivers operating at about 50 MHz were worn for communication between drivers and between the passenger and the snowmobile driver. These were VOX operated for hands-free operation. Earlier attempts to use an earplug microphone were defeated by the high ambient noise level and vibrations of snowmobile operation.

SNOWMOBILES AND SLEDS

Three Elan snowmobiles were used, each pulling a large wooden sled patterned after an Inuit komatik. A few modifications were made to the machines. The seats were improved by the addition of a piece of high density polyurethane foam 10 cm thick. This was attached by two straps so that it could be easily removed if the driver preferred. Handgrip heaters were installed on each machine.

The engines of these machines are air cooled. A modification to the cooling air duct had been made for the Churchill trial so that an extension hose could be connected to the it. The hot air coming from the cooling system of the engine could then be used to heat the right hand or to heat parts of another machine.

Each machine was fitted with a battery charging circuit. Two were for NiCad battery packs for the radio and navigation system, and one was for a 12 V lead acid battery.

Maintaining contact between snowmobiles had proven difficult in other trials. Several minutes and thus several hundred metres could pass before the lead snowmobile driver noticed that one of those behind had stopped. Mirrors had proved to be next to useless in previous years. They either distorted the view excessively or their supports became so brittle in the cold that they broke off at the first hard bump. Short range radios were tested as a means of communication between personnel when travelling. An acrylic camping mirror was affixed to the back of the lead driver's left mitten as a rearview mirror in the event that the radios failed. While it is possible to turn around and look behind while driving, it is hazardous. Since it would have to be done every few minutes, stopping each time would severely reduce the average speed.

Three sleds, nearly 5 metres in length, modelled on Inuit komatiks, were used to carry everything required for a trip of up to twelve days duration. Several modifications had been made since their first use in 1986. The runners were strengthened by the addition of 6 mm fir plywood facing, glued and nailed to the planks of B.C. fir. The crosspieces, which were made from spruce or maple "two by fours", were modified by recessing the area of the lashings so that the load would not rub on them. Although the strength of the crosspieces was reduced by this change, it was still more than adequate.

Upstanders were constructed at the back of each sled with a small area for a passenger to stand at the rear. A sledge bag suspended from the upstanders was convenient for stowage of small, frequently used items, extra load straps and outer clothing layers. At night the helmet was often stowed in it. The upstanders were useful for pushing the komatik when it was stuck in soft snow.

An important modification was the inclusion of a semi-rigid hitch. The new hitch was a bar of ultra high molecular weight polyethylene 5 cm wide, 1.25 cm thick (half-inch) and 2.4 meters long. The bar was bent into an arc with the help of a heat-gun. Each end was fastened to the inside of the runner about 40 cm from the front. A steel "D-ring" was used to connect it to a steel snap hook attached to the hitch plate on the snowmobile. A short cord was used to limit the distance along the arc through which the "D-ring" could slide. This polyethylene was the same as that used to face the sliding surface of the runners. The tow rope was retained for use in hill-climbing when several snowmobiles could be attached in tandem to one sled.

LOAD UNITS

Most of the units of the load were carried in rugged polyethylene boxes 59 x 40 x 45 cm high (L'Hotellier). Boxes of strong cardboard 69 x 46 x 51 cm high were used as ration units carrying sixteen litres of naphtha and rations for sixteen man-days.

Loads were strapped to the sleds with cargo straps which proved to be more convenient than rope lashings (although they may have permitted more lateral movement). Soft, open-celled polyurethane foam sheets ("foamies") were placed between some of the boxes and the crosspieces to prevent this movement.

Each sled carried three load units of gasoline. Three, five gallon (23 litre) plastic fuel cans made up each fuel unit. The cans of each unit were in a cardboard box half of the height of the fuel cans which prevented them from moving separately on the sled. Since each fuel unit was expected to last 340 km, the fuel load was expected to give a range of over a thousand kilometres.

Sled One carried, in addition to the fuel units, the communications and navigation units plus a survival kit and a personal equipment and clothing unit. The communications and navigation unit consisted of two containers, one being a converted medical pannier heated by a charcoal-fuelled personnel heater. It contained the DE 1000 HF radio, Magnavox MX 4102 Satellite Navigator, a video camera and a 35 mm SLR camera. The other part of this unit was a polyethylene box with an experimental heater fuelled by methanol to keep the NiCad batteries for the radio warm. The survival unit included tent, stove, pot, food for three days, three litres of naphtha, flashlight, candles, matches, snow knife and saw, and flares and smoke. A sleeping bag and a small bag containing charcoal elements and several litres of methanol for the heated boxes were strapped on top of the personal and survival kit along with a shotgun. Poles for the antenna mast were strapped to the side of the frame supporting the upstanders.

Sled Two carried the tools, spare parts and lubricants and some emergency rations in a polyethylene box which was twice the size of the others. This box also held the survival unit which included the SBX-11A radio and a tent large enough to house a snowmobile with the cowling open. One ration unit (food and cooking fuel for 4 men for 4 days) was carried. A rifle, a rucksack and a sleeping bag were strapped on top of the load and the antenna poles were strapped to the side.

Sled Three carried a passenger, a ration unit and the cooking unit which contained three stoves, the grate and base, two cooking pots, candles, lantern, spare batteries, flashlight, first aid kit, three man/days of rations, stove spares, naphtha in the stove fuel-containers and miscellaneous food items. It carried the main tent in a box which also held the SARSAT beacon, tent repair kit and a trip-wire alarm. An axe and a rifle were carried on top of the load as were two rucksacks and sleeping bags.

ROUTE

It was intended that the route followed in 1986 be retraced at least as far as Ekwan Point. Although we had not been so informed in 1986, motorized vehicles are not permitted in Polar Bear Provincial Park. We could not therefore plan to drive to Hudson Bay. An option which was considered was a crossing of Akimiski Strait to the north coast of Akimiski Island.

Ice Conditions

The Ice Forecasting Central was consulted immediately prior to leaving. Information on the locations of major leads and ice thickness on James Bay was obtained from recent satellite images. Along the shore and around Akimiski Island, the images showed a wide band of thick ice. The landfast ice extended from 10 to 15 kilometres from shore. A large lead separated it from the much thinner ice cover of the rest of the bay. In early January, James Bay had been covered with ice approximately 15 cm thick. A tidal range of as much as 3.7 metres and a gradual increase in depth with distance from shore allows the tide to retreat a long distance from the high water mark. In some places, at low tide, it is said that the water retreats below the horizon as viewed from the high water line. This favours the formation of the wide fringe of thick, landfast ice. The daily tidal range varies regularly during the lunar month. When the tide is highest, it overflows the ice. The timing of the trial was adjusted to avoid the period of maximum tidal range.

Maps

Aeronautical charts, that is the James Bay and Timmins VFR navigation charts (AIR 5018 and AIR 5009) at 500,000:1, were found to be useful maps. These charts have several features useful for navigation. In addition, the positions of the three communications towers along the route are plotted. Two of these towers are good landmarks, especially when travelling the coast.

NARRATIVE

Deployment

CFB Uplands, Ottawa provided a large tractor trailer and two drivers to carry the equipment from DREO to Cochrane, Ontario. The use of the large trailer made it possible to ship the sleds with their loads intact. In 1986, loads had to be assembled in Moosonee because of the much smaller truck employed. With the larger truck, deployment was much more efficient. The trip to Cochrane from DREO took just under seven hours.

Ontario Northland Railway carried the equipment in a boxcar to Moosonee, Ontario. The charge was the same as it had been in 1986, $350.00 for a minimum weight of 5000 lbs. An extra Elan was taken to Moosonee. Personnel travelled on the same train. The train arrived in Moosonee at 16:30 after a trip lasting five hours. The group rate for four tickets was $99.00, one way. This was one of the last runs to use the old passenger cars.

On arrival in Moosonee, we requested that our boxcar be "spotted" at the loading ramp near James Bay Travel. This can only be done on train-day as there is no yard locomotive in Moosonee. After checking into the Polar Bear Lodge, we advised the Ontario Provincial Police office of our plans and emergency procedures.

After dinner, we removed the four snowmobiles from the load for local transportation leaving the rest of the equipment in the locked boxcar. A short reconnaissance confirmed the location of the start of the winter trail to Ft. Albany.

A team of young hockey players in Moosonee for a tournament checked into the hotel shortly after we did. The presumption that they would all retire early to be fresh for the first game of the tournament proved to be optimistic.

Day 1, January 28

In the morning, after breakfast at the hotel, the loaded sleds were removed from the boxcar. Fuel cans were filled at James Bay Travel and the spare snowmobile, with a few parts removed for spares, stored in a shed behind the garage. At 10:25, we left Moosonee. The early start was encouraging. In 1986 we had not been ready to leave before mid-afternoon.

It was unseasonably warm in the morning, above freezing, with a strong southeast wind peaking at 53 km/h. Since the wind was largely at our backs, it caused no difficulty at the time.

The small transceivers with which we had hoped to maintain contact between the snowmachines proved to be next to useless. The range was too short.

A stop of about one hour was made for lunch. Rations were removed warm from a large dewar flask (vacuum bottle) which had been filled with hot water from the hotel. This was the one time during the trip that we felt inclined to stop for lunch. It was still warm in the shelter of the trees, but the temperature fell during the afternoon. Two of the team were wearing the pile liners under their windproof shells and found this adequate. Two other did not wear the liners, but supplemented their insulation by wearing outer parkas.

The first camp was made 112 km from Moosonee at 1700 h. About 11 km prior to stopping, the communications tower at Cockispenny Pt. was briefly seen over the tops of distant trees. At the camp site, a small trailside bog, the machines were unhitched and used to pack down the soft, knee-deep snow before the sleds were pulled off the trail. After dinner, the temperature had fallen to -14°C. The shotgun was test-fired. Heat and lights were turned off at 21:50 h.

On the trail, the machines had been driven at about 30 km/h. This was top speed for the machine with the passenger sled. The passenger changed to ride on a sled pulled by another machine, which carried the added load with no difficulty. The passenger and the driver switched at intervals. The average speed, using engine elapsed time, was 18 km/h. The trail was quite good with only a

few large drifts. The machines were refuelled with gasoline from the load of the sled which had been intended as the passenger sled.

Less than full throttle was used for travelling. A conscious decision had been made to save some throttle for the return journey. The engine speed of the lead machine was kept at about 4900 RPM. This machine with its loaded komatik was able to travel at a top speed of 35 km/h. The maximum engine speed was 5100 RPM.

Day 2, January 29

This day began at 6:15. Breakfast was taken hot from the large vacuum flask which had been filled with hot water and rations the night before. At 8:55 we were on the trail again. The temperature was -25°C. All participants wore the pile liners and outer parkas. The sled passenger wore the outer trousers as well. One of the drivers later donned the outer trousers. He had been having trouble keeping his hands and feet warm.

South of the Albany River the trail divides. The more travelled route leads west to Ft. Albany. The trail north, past the Ft. Albany "exit" passes through open country. Here the track was crossed by many drifts, as it was lower than the surrounding snow level. An attempt was made to drive on the snow off the trail, but it proved to be too difficult.

The Albany River at this point is divided into two channels by a large island. Near the south shore of this island we stopped to investigate two abandoned, half-sunken, Elan snowmobiles and their sleds. From a distance it was evident that they were all frozen into the ice cover. There was a large area of dark snow nearby which proved to be water on top of the ice. At the scene itself, there was what appeared to be a sleeping bag or quilt which had been soaked with gasoline and set ablaze. An empty red plastic fuel can was nearby as was a pair of icy socks and mukluks frozen into the surface. There were no people in the vicinity.

Obviously the tide had overflowed the river ice. We had hoped to avoid this by timing the trial to the tides. The unusually high tide was probably the result of the strong south east winds of the previous two days. Melting temperatures far upstream a week or two previous, may have contributed by increasing the river flow. The colour of the overflow ice was yellow-brown, sometimes with a slightly greenish tinge. In 1986 such ice had been noted at the mouth of the Lawashi River.

While checking the way to shore on foot, a single snowmobile overtook us. The driver had a quick look and then swung around the area upstream and back along the shore to reach the trail. We followed, but one of our machines, with the komatik on a long rope, swung too wide. The sled broke through and tipped on its side. The driver ejected from his machine as it, too, broke through the ice cover into the water beneath. Fortunately, there was less than 20 cm of water on top of the river ice under the thin, broken shell. Two of the three drivers decided to tow on a long rope in this section. The other felt that the thin shell ice would break whether or not the load was spread out.

Righting the sled was difficult. With a full load it weighed about 400 kilograms. It could only be approached (with dry boots) from one side. Two of us attempted to pull it back onto its runners with no success. This difficulty lead to the invention of a useful technique for righting a loaded sled. The tow rope was detached and fixed to the end of a crosspiece at the bottom, near the water. The rope was run around the load to the dry side and the sled was thus rolled back onto its runners. One person could probably right a sled if the snowmobile were used to pull the rope.

While we struggled to remove our Elan from the ice, several people arrived to salvage the two abandoned ones we had passed earlier. The owner of the machines told us that the channel on the other side of the island was covered with water and slush to an even greater extent. He strongly recommend that we not try to cross it. He and his family had managed to get across the night before but had gone into the slush on this side of the island when the water was waist-deep. They had had a miserable and desperate few hours before being rescued by another snowmobile and taken into Ft. Albany. Having had enough adventure for the day we decided to avoid any further by taking a long detour around the mouth of the river via the trail from Ft. Albany to Kashechewan. Before doing so, we assisted in removing the other machines and sleds from the ice. The ice around and inside of the snowmobiles was easily chopped away with an axe. Looking at the ice-covered engine of one of the machines, we wondered if they would ever get it going again.

The road to Ft. Albany was hard packed and smooth. At 4900 RPM we travelled at 34 km/h. The top speed was 38 Km/h with the engine running at 5200 RPM. At the hospital, we stopped to see if the cafeteria might be open. It wasn't, but we were treated to hot coffee anyway. We left the town at 1500 h for Kashechewan. To find the trail across the river it is necessary to cross the river to the other part of town, pass to the right of the big church and follow the road to its end. The trail dropped abruptly down the bank at the end of the road. It does not follow the power lines.

The ice in this part of the river was very rough and not suitable for large vehicles. Large pieces of ice raised up on end, ridges and soft snow complicated the crossing. An added difficulty lay in the fact that we had only a vague idea of which way to go. Worse, the trail divided into many trails, but, as we later discovered, they all go to the same place. Soon it was possible to see where the trail went up onto an island and through a wide path cut through the forest.

The slope up onto the island was steep and slippery from the passage of many snowmobiles. Because of our large loads, two snowmobiles in series were needed to pull up each of the three sleds. Over the island the trail was wide but its surface was like a washboard. Sometimes the bumps limited our speed to a walking pace. Higher speed caused the snowmobile to pitch and buck wildly (resonance). Near the edges, the trail was newer and the bumps less pronounced. Such trails probably get wider during the season as drivers try to find smoother travel at the edges. Machines with slide rail suspensions seem to be able to travel faster on such roads than we could on the Elan with its bogie wheel suspension.

The village of Kashechewan eventually came into view high on the opposite bank of the river. Locally, this channel is known as "Kash River". In 1986 the trail connecting Kashechewan to the freight trail leading to Attawapiskat had been noted. We therefore hoped to use this branch of the trail to complete the detour of the river mouth. One of the local people led us to its start a short distance out of town on the Mekopaymuko Channel. This channel has the appearance of a small river running between steep banks. A road had been built across the river. Patches of open water, perhaps one or two square metres each, existed at each end of the large culvert under the road. The snowmobile trail led across the culvert, down onto the river ice, up the river a few hundred metres and then straight up the bank through a short, slippery gulley. As before, two snowmobiles were attached in tandem to one sled and the attempt was made to climb the river bank. The front machine had not quite reached the top when the effort stalled. The pathway was too slippery and had a slightly "u" shaped cross section so that only the edges of the track were in good contact. Hoping to be more successful with a longer rope, the sled was backed down the gulley. Unfortunately, it turned sideways and became bogged in deep snow. We expended a great deal of effort getting it back on the trail. The trail at the top of the gulley was not impressive. It was narrow and wound its way between the trees. Other options were explored and it was decided to return to Kashechewan and then travel along the "Kash River" until we found where the end of the freight trail reached it.

The first machine made it back onto the road at the culvert. When the second machine tried, it couldn't make the turn, tipped the driver off onto the road and dove, skis first, into the patch of open water on the far side of the embankment. The sled, with the passenger on the rear came to a stop, balanced precariously, half over the edge of the embankment. The snowmobile, still hooked to the tow bar, hung there, submerged from the skis to the seat. There followed a period of frenzied attempt to pull it out quickly. As it turned out, we might just as well have taken our time.

First, a line was run from the back of the sled to one of the other two snowmobiles. An unsuccessful attempt was made to pull the sled and machine backwards and out of the water. It became obvious that the two would have to be unhitched and retrieved separately. A second line was run to the back of the drowned machine from the third snowmobile. The weight of the suspended machine on the hitch made it extremely difficult to uncouple from the sled. The sled was then pulled away from the brink. The Elan was then pulled, rolled and lifted up onto the road.

Once out of the creek, the water on the snowmobile froze into a coating of ice. Optimistically, we tried to start it but only succeeded in damaging the frozen throttle cable. As the engine had been running when the carburettor had gone underwater, the cylinder and crankcase were full of water. Looking at the ice-covered engine of the machine, we wondered if we would ever get it going again. It was -20°C and beginning to get dark.

When we got back to the village it was dark. We stopped under a streetlight to consider the situation. Several villagers dropped by. One suggested that the Indian Band might rent us the cabin

behind the Band Office for the night. This was arranged and we moved everything into the back yard. There was a good yard light and room to work.

There were two options: to remove the engine and take it inside, or try to dry it out where it was using the heat from the engine of a second snowmobile. The second, easier option was the one we decided to try first. Perhaps fortunately, the length of hose intended for the engine air duct had been left behind at DREO making it was necessary to improvise. The improvised solution was probably far more efficacious.

An outer parka was put over the wet engine and steering column with the handle bars at the shoulders. It was zipped up and the neck opening and one sleeve were closed as well as possible. The parka was open at the bottom with the largest opening under the muffler. A second snowmobile, facing the opposite direction, was placed beside the first and the sleeve of the parka was attached to the hot air duct. The back of the track of this second machine was raised and the idle speed increased. This delivered approximately 5 to 10 kW in the form of hot, dry air to an insulated parka around the engine. Inside the parka it was tropical. Water soon started running off the engine and before long it appeared to be dry.

This treatment was continued for two hours. At the same time, the gas tank was emptied into an empty fuel container by means of a syphon and a small bulb pump. Methanol was poured into the tank (fortunately we had several litres) and pumped through the fuel system. Gasoline was added. The carburettor was replaced by a spare, as was the fuel pump. The crankcase was emptied via the fuel pump vacuum line. With the spark plug removed, the starter cord was repeatedly pulled until the vacuum line stopped spitting out water.

We were concerned about the ignition system, particularly the points. Since they are so awkward to get at, we decided to see if the engine would run before examining them. Care was taken to ensure a flow of heated air over the area in which they are located.

After replacing the feed line in the fuel tank, the engine was primed. On the second pull, at 2230 h, it started and ran. We let it idle for about fifteen minutes and then went into the cabin with a great feeling of accomplishment to eat both lunch and dinner.

While two of us had worked on the snowmobile, on the advice of the OPP, the others unloaded everything from the sleds and took it into the cabin -- except of course, the gasoline. The long day and exhausting day was not over until after midnight. Unfortunately, the cabin was too hot for restful sleep.

Day 3, January 30

The next morning began at 0630. Breakfast lasted until 0800, after which the work on the snowmobile continued. The chaincase had to be drained, rinsed with methanol and refilled. The Bay

store next door had a few minor parts which we could use as spares, but it didn't have the proper throttle cable.

While the author went back to Ft. Albany for a new throttle cable to replace the damaged, but still operable one on the machine, the others were invited to speak to an adult education class where English was being taught as a second language. In the class, many questions were answered to satisfy the curiosity of the community regarding the mission of this strangely dressed and equipped group of outsiders.

After lunch we were on the way again. We were on the "Kash River" a kilometre or so out of town when the "diving" snowmobile quit. The reason was not immediately obvious. At first it was thought that there was no spark, but later this fear proved groundless. The parka was reapplied and the engine heated. When the engine was warm, it was noticed that fluid came out of a tiny hole in the top of the fuel pump in a fine stream when the starter was pulled. Apparently, we had failed to get all of the water out of the crankcase. It had gradually filled fuel pump via the vacuum line, until it had been blocked with ice, stopping its action. The pump was replaced with the one removed the night before and the crankcase was emptied again. The gas tank was emptied and refilled. After four hours, at 1600 h, it started and we were ready to go again.

While the breakdown was being repaired, the other machine and sled reconnoitred the route to the freight trail before returning to the site of the breakdown, leaving two of the sleds unaccompanied (as they had been farther up the trail when the breakdown had occurred). When we finally returned to the sleds some time later, one of them was short six cans of gasoline. Other valuable and less replaceable items, such as the shotgun, had been left in plain sight on the top of the load, but only the gasoline was missing.

North of the Albany River, the trail runs near the shore of the Bay through flat, open country. In the diffuse light under an overcast sky, with some ground drift, this less-used part of the trail was difficult to see. For long distances it was followed by guess and by the occasional unevenness which marked where previous machines had passed. The odd discarded beer bottle helped to assure the lead driver that he was indeed on the right track. Interestingly, after the sun had gone down, the trail was much easier to follow. The headlight illuminated the trail much more effectively than had the diffuse sunlight. Roughness, which defined the edges of the trail produced shadows and the small upended pieces of the broken crust of snow stood out clearly in the headlight beam.

Travelling in the darkness, the leader could check to see if he was still being followed by simply raising his hand. If there was a vehicle following, its headlight would illuminate his hand. The height of the top edge of the shadow of his sled could be used to judge how far back the machine was. The mitt mirror was also used at intervals to see if both machines were there. It proved to be very effective although when it was first used in daylight,

raising the hand to see behind caused some confusion among the following drivers who thought it might be a signal to stop.

We travelled in the darkness until 2000 h when we reached a decent camping spot in the trees at the Big Willow River. The odometer of one of the machines showed that it had travelled 307 km since leaving Moosonee; an average of just over 100 km/day. We were in fact camped a few kilometers past the location of the third camp of 1986 despite the detours and tribulations we had encountered. Crossings have been built at small rivers and creeks. The water runs through culverts under a crossing of fill. The fill was obtained close to the crossing resulting in a flat, cleared area beside the trail which is useful for camping.

The radio mast was set up and an unsuccessful attempt was made to contact DREO. We were too late for the scheduled 1900 h contact. The antenna was changed and redirected to call Alma Radio. This also failed. That frequency was useless due to interference from Radio Jerusalem which was clearly received. The day ended at 2300 h. The communication plan for TRIAL RUN 1989 stated that a missed evening contact would be made up in the morning starting at 0800.

Day 4, January 31

The morning attempt was unsuccessful. The antenna was again changed and redirected to attempt to reach Alma Radio on a different frequency. This time, partial success was achieved. The operator was clearly heard, but our signal was broken to the extent that she was unable to make out the phone number we wished to call. In accordance with the contingency plan for communications, it was decided to drive to Attawapiskat to find a telephone.

A quick check of the Elans revealed that two of them had two broken motor mounting bolts and one had one broken bolt. This had been a problem in previous trips, but such damage was unexpected because of the comparatively easy travel conditions.

The morning temperature was -28°C. There was a searing-cold wind out of the northwest at 40 km/h. By noon, when we were ready to travel, the temperature had improved to -20°C. In open areas the wind was decidedly brisk with some ground drifting. Two started the day wearing the complete clothing system. The others wore everything except the outer trousers. Two to three hours later those without the outer trousers were becoming miserably cold. They put on their outer trousers during a short stop. One wore them with the outer parka tucked into the trousers and the suspenders on the outside, an odd but functional fashion he retained throughout the trip, and the other in the conventional fashion which demanded prior removal of the outer parka. Hands and feet tended to be cold. Travel on this day was less than comfortable.

On the way to Attawapiskat, a tractor-train was passed. It was stalled, awaiting a part for the lead tractor. From the brief conversation we had, it was apparent that word of our presence had probably preceded us.

One of the large river crossings showed signs of overflow. The small, suspect area was investigated on foot before being crossed. The main channel of the Attawapiskat River was reached and the town appeared on the high bank opposite. We stopped at the hospital at 1530 h. to use the telephone. A little girl stared at us as we entered and began the process of removing the environmental clothing and helmets. Later we were told that we looked like "spacemen". In more than one sense, we were. Certainly our outer clothing used up all the space on the coat rack.

While we were having coffee, two OPP officers arrived. From them, we learned where we could purchase gasoline to replace that lost on the "Kash River" (at just over twice the Ottawa price) and of the existence of a trail across country from the village to the coast in the vicinity of the two small islands in Akimiski Strait.

These islands are known locally as the "Twin Islands". The reason for this name is not apparent. There are two islands, shaped remarkably alike, east of Akimiski Is. which bear this name. The islands in Akimiski Strait are very small and are nothing alike. The local pronunciation of "Akimiski" bears little resemblance to the formally recognized spelling. In fact it is much closer to the spelling used in 1719 (9). It sounded like " a - GAH - miss - hay". As I did not realize what the word was until a few seconds after I had heard it, it is difficult to be certain of the actual pronunciation. I am, however, convinced that it did not sound as Polish as it appears.

We also learned that the trail across from the mouth of the river to the western point of this island is sometimes difficult due to open water or flooded ice. With the coast and Akimiski Is. funnelling the high tide into Akimiski Strait, the effect of the strong southeast wind would have been more pronounced than it had been on the Albany River. It is probably safer to cross to Akimiski Is from the area of the "Twin Islands". That part of the strait is very shallow.

The overland trail was described as having several forks leading inland. We were assured that if we took the right hand fork each time we would reach the coast without problems. One of the OPP constables volunteered to show us the beginning of the trail. He met us on his snowmobile at the gas bar and led us over the first few kilometres of the trail. Again, the advantage of the slide rail suspension over our bogie wheel suspension on bumpy terrain was obvious. By watching the head of the policeman, it was apparent that he was subject to only a fraction of the vertical accelerations that we were experiencing. This trail, travelled only by snowmobiles, was much narrower than the one we had been following. A few kilometres farther on we stopped for the night in a bog, among bare tamaracks.

When we stopped at 1700 h the temperature was -30°C. With the setting of the sun, both the wind and the temperature fell. By the time the radio mast and antenna had been set up it was quite dark, with bright stars and aurora. The coaxial cable which had been used to connect the antenna to the radio was replaced with one from the spare radio. The cold, coiled cable was warmed before being

unrolled. Despite the aurora, DREO was successfully contacted to the relief of all concerned.

Day 5, February 1

When the tent warmed up in the morning after the stoves had been lit, the roof began to drip where wrinkles had formed in the mesh lining. The drying net, which was usually filled with an amazing variety of articles, was partly responsible for this since its weight flattened the curve of the ceiling.

When the radio antenna was put away in the morning, the coaxial cable was pushed into the warm tent to allow it to warm up in two metre lengths before being coiled. This was time-consuming. It also made the cable wet with condensation so extra time was needed to allow it to dry. An attempt had been made prior to leaving Ottawa to find a coaxial cable which would withstand the cold. Although such cables exist, none were readily available.

By the time we were beginning to pack the tent away (its packed volume was growing larger with accumulated frost), it was -32°C. The wind rose with the sun. On the trail at 1000h, the wind was noticeable when traversing open areas or frozen lakes. In these sections, the trail played hide-and-seek in the drifting snow. The track divided several times, and occasionally was lost. Open areas and treed zones succeeded one another, until some time after leaving a treed zone, it gradually became apparent that the open area in which we now found ourselves was the coast of James Bay. This had not been obvious because many of the trail segments passing through open areas had been longer than the limit of visibility. The "Twin Islands" with their dark cover of spruce were briefly glimpsed in the blowing snow.

While travelling north on the open shore, the west wind was more keenly felt. The channel between some low islands and the coast was followed. Here the trail was again encountered. At the mouth of the Ekwan River we followed the trail into the trees. This was a mistake. Eventually it became apparent that the trail was leading up the river, probably to a trap-line cabin we had been told about. The lead snowmobile slipped off the narrow trail and rolled into a deep hole. After hauling it out, a reconnaissance indicated that deep snow in the next clear area would make turning difficult. We decided to pull the sleds out backwards. Fortunately the Elans are light enough to be turned without too much difficulty and perform very well in deep snow and bush. The lead machine was driven to the clearing, which proved to be a beaver pond, down the river, over the dam and back through the bush, all in deep, soft snow, to pull out the sled at the end of the line. The two others pulled out the sleds which had been in front of them. A clearing was reached a short way back along the trail where the sleds were turned after the snow had been packed with the Elans. This was exhausting work, which had the benefit of warming everyone. In the trees, out of the wind and exercised, it was warm enough to have stopped for lunch. Being in the middle of a difficult situation, no one suggested it. Once out of the trap, we were back into the wind. At this point, the suggestion to turn around and head south might have been accepted. We were getting tired of pushing sleds and lifting snowmobiles.

The goal for the day became Ekwan Point which could be seen in the distance. From the mouth of the river, a straight course was set for what appeared to be the point. Although it does not appear so on a map, from the mid-point of this leg, the mainland seemed to be very far to the west.

For much of the time, the standard engine speed of 4900 RPM allowed us to travel at only 24 km/h on the soft snow over the ice, shoals and low islands. As we approached the land, to windward and in front of us large, swirling columns of wind and snow formed. They churned across our path to die somewhere out on the limitless expanse of the frozen bay.

A few snowmobile tracks were encountered leading toward what is either a research station belonging to Laurentian University or a goose hunting camp (or both) at the mouth of a small river two kilometres south of the extremity of Ekwan Pt. We drove close to it and briefly halted. It is a complex of buildings and shack-tents. The lack of smoke from any of the many stove pipes signified that it was unoccupied. From a high pole, a large Canadian flag snapped in the breeze. Later that afternoon, in the tent, the passenger was surprised when the subject of the camp was mentioned. He hadn't seen it. The camp had been in view for several minutes as we drove in close to it. We stopped perhaps a hundred metres from it for a brief but distant examination.

The buildings had been upwind. Since the rider had not been wearing a full face visor, he might have missed seeing them when sheltering his face from the wind or dealing with the problems he reported having with misted goggles.

Driving a long distance on a snowmobile is both boring and mentally fatiguing. One would think that there would be a lot of time for abstract thought or for daydreaming, but this is often not the case, especially when there is no smooth road or trail. The mind is often continuously occupied for long periods of time by the tedious tasks of driving or by the problems of the cold. Since the sled passenger has little or no control over the sled at high speed, he need only be concerned with keeping warm and holding on. Riding on a sled is colder than driving a snowmachine, but the passenger at least has the opportunity to exercise and to use both hands.

At 1400h we stopped at the mouth of a creek on the south side of Ekwan Pt. Most of the coastline between the Albany and Ekwan Rivers is low with no detectible slope. Foreshore flats are extensive and the forest is some distance from the water. At Ekwan Point, the coast rises a few meters allowing the forest to reach the shoreline. North of the point, the coast is again low. The trees pull back leaving a barren coastline exposed to the wind. Since we had reached our goal for the day and it was the last, pleasant, sheltered location we could expect for some distance, we stopped to set up camp. The two snowmobiles with working speedometers registered 417 km and 383 km from Moosonee. Engine time from the second machine was 29.5 hours and the overall average speed was therefore 13 km/h.

It had been decided that we would not travel the next day but would use it to work out communication problems, to perform some maintenance on the snowmachines and to carry out a short foot patrol. We therefore attempted to make the camp a little more comfortable by digging into the snow to reach bare ice and then covering the ice with spruce boughs before putting up the tent.

As usual the sleeping bags were arranged so that they were parallel, with the foot of one next to the head of the next. This left a space for the stoves at one end of the tent. When sitting in the tent, each person had one corner. The end of the tent distant from the stoves was colder and the clothing in the net at that end had less chance to dry.

The snowmobiles were refuelled and the radio mast erected. With everyone at last in the tent, a rum ration was in order. It was frozen. Several times in the afternoon a wolf, or a dog, was heard howling some distance southwest of the camp.

The radio and the satellite navigation system were brought in and connected to one of the NiCad batteries. The Magnavox satnav receiver, which used the Transit array of satellites, gave our location as 53 15.85' N, 82 07.03' W. At 1900 h, DREO was successfully contacted. Although we could hear Allan Keefe clearly, he had difficulty reading our transmission. Fortunately, Dr. Lloyd Reed, a ham radio operator in Sudbury, monitored our transmission and relayed our messages via telephone to Allan at DREO.

Day 6, February 2

We slept in until 0730 this morning. The day was cold and sunny, as it would have to be on this date at this location. In our protected location there was little wind. At 0800 and 1000 h, unsuccessful attempts were made to reach DREO on the radio. Alma Radio was also tried without success.

At 1115h Farnworth, Cain and Main went for a hike back along the trail to the complex of buildings most of us had seen the day before, while the author stayed behind to try various combinations of cables, frequencies and radios in an attempt to work out the communication problem. Changing frequencies requires that the antenna be dropped and its length changed by rolling or unrolling its ends. At a temperature of -30°C, the process is time-consuming and uncomfortable. By 1300h when the hikers returned, several combinations had been tried without success. The antenna, leads and microphone where then checked with the voltmeter but no fault was detected. The battery was then tested and found to be low.

Next, the antenna carried for the SBX 11A, identical except for the frequency marks, was set up and connected to the DE1000. Alma Radio was clearly contacted on a frequency with no interference, 5430 kHz, and a telephone call was made to Dr. Rita Crow, Head of the Environmental Protection Section.

With the communication problem resolved, attention was turned to the snowmachines. The tracks of all of them were realigned and

the tension adjusted. One of the machines was backfiring when idling but apparently ran perfectly at speed.

Inspection revealed that all three machines were now missing two of the four bolts which hold the engine to the cross support. The threaded portion of the knurled bolts holding the nut had snapped off. It seems that for our purposes at least, this method of attaching the motor to the springs is either too weak or too rigid.

A reconnaissance showed that the ice in this end of the strait was quite rough. With half of the bolts holding the engines on to the machines broken, we decided not to risk the survivors on that surface. Memories of the "rough ice rodeo" we had been through on Button Bay near Churchill in 1988 were still too fresh. The NiCad battery pack was recharged with the charger on one of the snowmobiles.

Since the tent had become cumbersome when packed, the possibility of using the heat from one of the snowmobiles to dry it out was discussed. Since this would mean that all would have to leave the tent during the process because of the possibility that carbon monoxide from the exhaust might be blown into it, it was not acted upon. Anyway, we still had a box big enough to pack it into.

In the late afternoon the firearms were tested. The two 303's were fired without any difficulty having been completely degreased at DREO prior to the exercise. The Winchester Police twelve gauge shotgun which had fired without problem at -15°C would not fire at -32°C. The firing pin did not strike the shell with enough energy to fire it. The loading mechanism had been degreased at DREO but the firing pin had not. A test firing of the plastic rounds and scare cartridges designed to deter polar bears could not therefore, be carried out. Fortunately, no test subjects presented themselves. Although a polar bear encounter was possible, none was expected. The "wolf" was once again heard howling early in the evening.

The cold was keenly felt during outside activities. The thermometer was not believed by most. Commonly, only the inner parka shell was worn over the pile liner when going out of the tent for short periods, the outer clothing being stowed somewhere in the tent or on the sled. It was partially just a habit to put on the inner layer rather than the insulated outer layer. Because things always take longer than expected, such short exposures resulted in considerable cold stress and the illusion that it was much colder than it was. If we had been equipped with only an insulated parka we would have put it on when going out and would have not been so uncomfortably cold. Back in the tent it was beautifully warm and rather comfortable. In its warmth, almost any adversity and discomfort, which might have dampened our enthusiasm during the day, evaporated in an amazingly short time.

We experimented with a different sleeping arrangement. Ten centimetre thick foam pads which we had carried for seating were arranged next to the walls and the sleeping bags were laid out on top. This left an open space in the centre for the stoves and for

radio equipment. The head room of the centre space had been lost to the drying nets, which were usually full of a variety of articles. A net was a convenient place to put things which might otherwise be misplaced or be in danger of being stepped on. With the new arrangement, the fire was in the centre, all had easier access to the food and water and an equal supply of the heat, and both doors could be used. The tent seemed bigger and everyone could lie down.

Day 7, February 3

The spark plugs of all three machines were examined and two were changed. It was thought that the idling problem with one of the machines might have be caused by carbon deposits in the cylinder since the plug had some carbon on it. Changing the plug seemed to help a little. Later, the problem was eliminated by opening the air screw slightly to make the mixture leaner when idling. This slight adjustment of one-eighth of a turn is within the range suggested by the manufacturer.

The long trek back to Moosonee began at 1100 h. With the temperature below -30°C, the strong west wind at 35 km/h made life difficult. Face protection was a problem. The helmet visors did not prevent the entry of side winds. All clothing was worn.

The tracks we had left on the way north were followed where they were visible. When we reached the vicinity of the "Twin Islands", we left the trail which would have lead us inland to Attawapiskat. Travellers following this route who wish to return via Attawapiskat would be well advised to leave a highly visible mark at the point at which the trail reaches the coast so that it can be found again should a fall of snow precede the return. The place where the trail goes inland is not distinguishable from the rest of the coast. The coast was marked by many snowmobile tracks. In 1986 only one track was seen.

The suggestion that we visit the "Twin Islands" was not received with enthusiasm. It was decided to push on along the coast until reaching the mouth of the Lawashi River. In 1986 we had used this river to reach the coast and thought it would be recognizable. We would then leave the coast to find the comparative shelter of the road which runs through willows and forests for part of its length.

The mouths of the various channels of the Attawapiskat River were crossed. Akimiski Island was visible in the distance. An old track made by two snowmobiles, heading in its direction was crossed. It was not an impressive trail. In the direction of the island, black steam could be seen rising from the leads of open water.

On the shore again, the trail of a lone snowmobile was followed along a trapline parallel to the shore. Most visible traps had been set on poles or on the top of driftwood. Some of these traps had obviously been sprung by large birds. In 1986, a snowy owl had been found in such a trap. A group of goose decoys was also passed. These were the traditional ones made from bunches

of small twigs. One retained the small piece of white cloth imitating the cheek patch of a Canada goose.

We reached the mouth of a large river. It looked like the Lawashi River but we had lost track of how far we were from the main channel of the Attawapiskat River. A short reconnaissance failed to find the road in the remembered distance, half-convincing the driver that it was some other channel of the Attawapiskat River. We continued on down the coast.

In 1986, we had travelled the whole distance to Moosonee on the sea coast and the ice of the Bay. As two of us had already taken the scenic route once, we had little desire to do it again. We thought that the inland trail would be warmer and smoother. The Lawashi river was the only sure route to the trail from the coast other than the Albany River, that we knew of, although it seemed likely that there would be others. Eventually another large river mouth was encountered. This time, reconnaissance proved it to be the Lawashi River.

Travel on the coast was the coldest we had yet encountered. We stopped occasionally to run a bit to rewarm. The passenger was able to exercise while on the move by doing knee-bends but he too, needed to jog a bit from time to time. The driver wearing the insulated trousers in the unconventional fashion over the outer parka may have been warmer than the others. Wearing it this way, the wind was less likely to blow up under the parka.

Upwind hands and feet were much colder than those on the downwind side. The handgrip heaters were used but the effect was not noticeable. The amount of handwear worn probably reduced their effectiveness.

The trail was in excellent condition. The lead machine, which was still pulling the same load as at the beginning was able to travel at 34 km/h at the standard engine speed. We stopped at about 1600h. A few kilometers south of the Lawashi River crossing, an attractive campsite was found on the north side of a small creek in a stand of very large spruce trees. The day's distance had been 77 kilometres. The engine clock recorded 5.9 hours making the average speed for the day 13 km/h.

The radio mast and antenna were set up to contact Alma Radio. It was standard practice for the radio operator to set up the mast and antenna before entering the tent and settling in for the evening. On this occasion, an error was made in setting up the antenna. Rough alignment is achieved by sighting down the antenna wire with the compass on a bearing at right angles to the line joining the stations. This time, however, the ninety degree correction was forgotten. The antenna was therefore set up in the worst possible alignment, perpendicular to its intended direction. Perhaps because the end of the wire nearest Alma angled down into the creek, the error was of no consequence. The radio operator realized the mistake the following day. While driving in the late afternoon and enjoying the memory of the sunrise, the realization that the antenna had been pointed in the wrong direction suddenly dawned.

A call was placed to Lloyd Reed in Sudbury to discuss our transmission problems. Lloyd had been the radio operator during TRIAL RUN 86. Later the SBX-11A was used in an attempt to reach Allan in Ottawa. It worked perfectly, but Allan didn't answer the telephone. We spoke to him later on the DE1000 when he reached DREO for the scheduled contact.

Day 8, February 4

At breakfast the next morning we received visitors. A couple, riding on a snowmobile, stopped in for coffee. They were on their way to Attawapiskat to visit relatives. Despite this delay we were under way at 1015 h. It was -30°C with a strong wind from the southwest. Much of the trail was through open country where the wind was noticeable. Again, hands and feet were cold.

The cat train was at the "Kash River" crossing, awaiting more parts. From the river bank, the ice below appeared to be steaming. The effect was not due to tidal overflow as was first feared, but to ground drift driven by the wind blowing directly down the river. The trail across was visible for only a short distance. One of the men from the cat train caboose told us to aim to the right of the patch of poplars on the distant island.

Two-thirds of the way across, an extensive area of yellow-brown ice was encountered. It had been blown clear of snow. Since no way around could be seen, the ice was tested for about 50 m, on foot, gingerly breaking obviously hollow spaces to see if there might be water underneath. Since a representative sample had proved to be dry, the rest were assumed to be. When we drove out onto the glare surface of the overflow ice, the sleds and snow machines were blown into a line almost perpendicular to the direction we wished to travel. The crossing was slow and tense but without incident. The subsequent crossing of the southern channel, where we had encountered the overflow ice on the way north, was anticlimactic.

We were all cold to some degree. An occasional jog up the trail and back helped to restore body heat. A side trip was made into Ft. Albany, a minor deviation of about 25 kilometres. This shows how attractive a warm building can be. On arrival one of participants felt that he was "becoming seriously cold". We all had cold hands, feet and faces. Some minor patches of frostbite marked the cheeks of one driver.

A cup of coffee in the small cafeteria in the hospital warmed us up quickly. When two of the hospital staff were asked if they had heard a weather forecast, they burst out laughing. After recovering, they explained, "After you've been here for a year or so you don't listen to the news anymore."

At 1530 h we were back on the snow road. We drove into the darkness. An hour before stopping, the radio, which was in a heated container, was turned on so that we would not have to wait through a long warmup period after stopping and could therefore drive longer. The battery was in an unheated, adjacent container. The first night's camp site was reached at about 1830 h, after

having driven 154 km. Although this had taken approximately 7 hours (an hour having been spent in Ft. Albany), the engine clock recorded 9 hours making the average speed 17 km/h. We had begun to use some of the throttle we had been saving.

The radio mast and antenna were erected in time for the evening radio sked. Allan received us weakly, but did not understand our transmissions. The battery voltage was checked and found to be low. Another was tried and it was low as well. The recharged battery was then tried and it too was in the 9 to 10 Volt range. The radio operates best at 12 V. These batteries were close to the air temperature, about -30°C. The antenna was changed and an unsuccessful attempt made to raise Alma Radio. The SBX 11-A was hauled out but the tuning adjustment had vibrated loose. Instead of trying to fix it, attempts at communication were abandoned.

We were visited by a north-bound traveller who welcomed the chance to rewarm over a cup of hot coffee. He spoke only a few words in the time he was with us.

Night travel has its advantages. Chief among them was that at night there was very little wind. Despite our windproof clothing shells, the wind sometimes found its way into the clothing. It sometimes penetrated the neck closures when wearing a helmet with the parka hoods up, or blew in between the hoods, and into the space in front of the face. It made the feet cold, especially the upwind foot in a cross wind. Occasionally, it blew up the pant legs and may have blown in under the parka. The wind made it necessary to wear thick hand protection so that the heat of the handgrip heaters was much less useful. In the evening, after the wind had gone down, one of drivers was able to reduce his hand protection to the fabric shell of the mitts. The handgrip heat was then very noticeable, in fact almost too hot at times. This driver had the impression that he was gaining a significant amount of heat through the hands although the heaters only produce about 15 W.

Day 9, February 5

The next morning we were awake at 0600 h. At breakfast, we were visited by yet another north-bound traveller whom we welcomed in. We were nevertheless away at 0945 h.

The trail was badly drifted and cut up by two cat-trains which we met headed in the opposite direction. The south wind, at over 30 km/h, filled in the trail in the open sections with drifts. In the forest it was relatively calm. There were holes in the trail every few kilometers where travellers had stopped and built fires. Most of these were big enough to have been dangerous if hit at speed.

The polyethylene tow bars stood up to real torture. They had been bent and twisted and run over by the sleds. Two holes had been inadvisedly made in them as a means to secure them when the long ropes were being used. The bars were weakened by the holes and always bent in those spots. One of the bars eventually fatigued and broke through at the hole causing the sled to

jackknife. The sled was lashed to the snow machine using the remaining side of the tow bar and a length of rope. After this, the sled was harder to control. Had the tow bars been somewhat more rigid they would not have been run over or twisted to such an extent.

All stops were out this day. We travelled at full throttle, at a speed of 40 km/h for much of the distance and arrived in Moosonee at 1515 h having travelled 112 km in 5.5 hours, an average speed of just over 20 km/h. It had been a good day for travelling, particularly in the forested sections. One driver, using the grip heaters, drove bare-handed for much of the distance. The temperature had been about -20°C.

Moosonee

On arrival in Moosonee, the sleds were stored at James Bay Travel. After the fourth Elan had been reassembled we drove to the hotel, checked in, cleaned up and went to the dining room. When we returned to the rooms after eating, the whole floor of the hotel smelled strongly of the exhaust fumes, gasoline and naphtha which had clung to our clothing.

The next day the details of redeployment were seen to. A boxcar was requested since the train was due in; arrangements were made to be met in Cochrane by the truck and a van; the OPP were notified of our return and the Ministry of Natural Resources office was visited.

The 1986 Elan, now a veteran of both of the James Bay trials, was taken out of town to a long, straight road covered with icy hard packed snow for performance tests.

In the evening, the boxcar was loaded with the sleds and snowmobiles. When the door was closed it was discovered that the padlock would not fit the hole in the latch. Some nails were twisted through the hole, and the padlock applied in another location to give the appearance that the door was secured.

The next day we left on the train for Cochrane. It was one of the first few runs to use the new rail cars which proved to be very pleasant. On arrival in Cochrane, the load was shifted onto the tractor-trailer which left immediately for Ottawa. We left for Ottawa the next morning and arrived in the early evening.

PERFORMANCE OF EQUIPMENT

Clothing

In the 1986 trial, the last five days in particular had been cold for the drivers of the snowmobiles when wearing the full protective clothing then being tested. Winds had been light to moderate, ranging up to 35 km/h on one day. The mean temperature during the period had been -17°C. On TRIAL RUN II, the mean temperature during the last five days had been -27.5°C and the winds had been in the range of 25 to 40 km/h during the hours of travel. Nevertheless, time spent on the trail was the same in both

cases. Despite the greater severity of the weather conditions, the two participants who had taken part in both of the treks to Ekwan Point on James Bay agree that the climatic stress had been much greater in 1986. The concept of adding a well-insulated layer over top of the inner layer worked well in these circumstances. Even the addition or removal of outer trousers was possible and relatively convenient, particularly if they were worn outside of the outer parka. This configuration looks a little strange but it is effective, particularly when sitting on the seat of a moving snowmobile.

As previously noted, the inner parka and trousers alone were sometimes insufficient for camp activities lasting up to an hour. This problem can be solved, as it was on the trial, by wearing the outer parka instead of the inner parka shell when going out for a short period. If it is available, it is just as convenient to wear the outer parka, except for its lack of pockets. Pockets had been omitted by design since the outer parka is often removed and packed away. Anything left in the pockets would then be inaccessible.

Snowmobile helmets were worn as an experiment to simulate a soldier's combat helmet. No problems were noted with respect to perspiration accumulation during long term wear in a subfreezing environment. The hoods of one or both parkas could be worn over the helmet. This resulted in a significant restriction on head movement. With the parka hood over the helmet, the neck closure tended to leak cold air in the wind. Some redesign may be indicated, however, a neck scarf proved to be a useful short-term solution.

Pullover facemasks were worn beneath the helmets. These masks have a vapour barrier nose piece which directs the breath out of the area behind the transparent visor on the helmet. These masks will be modified to seal better across the bridge of the nose and under the eyes. The two drivers who wore glasses with corrective lenses removed the nose cover and replaced it with a yashmak from the Wilson hood (15). This made a much better seal, usually preventing frosting of their glasses. The combination was comfortable, except in high cross-winds when the visor let in the breeze. Sometimes these facemasks were supplemented by thick, knitted ski masks. It was possible to perform almost any task without having the glasses frost up, even during desperate struggles with drowning snowmobiles, when work rates and sweat rates were high.

When not being worn, the helmets were usually left outside on the snowmachines or in the sledge bag. If brought into the tent, condensation formed on the helmet until it warmed up to the dew point of the air in the tent. It would then take a long time for it to dry.

Snowmobiles

The return trip of 340 km had taken 20.4 hours so that the average speed on this leg was 17 km/h compared to 13 km/h on the outward leg. The odometer of one machine registered a total trip

distance of 723 km. Its engine hourmeter recorded 49.5 hours. The machine which had done the reconnaissance, the heating, and had returned to Ft. Albany from Kashechewan for the throttle cable registered 766 km. The third machine, which had broken its speedometer cable when it was towed, would have registered about 720 km. In total, the three machines travelled 2200 km on 430 litres of fuel for an average of 5.1 km/litre (20 litres per 100 kilometres).

In performance trials on the bare icy surface of the road south of Moosonee, the 1986 Elan travelled at a speed of 18 km/h at 4000 RPM, 51 km/h at 4900 RPM, 58 km/h at 5500 RPM and had a top speed of 68 km/h at an engine speed of 6300 RPM. This was without a sled or load other than the driver. During the trip to Ekwan Point, on the best part of the trail, this machine had had a top speed of 38 km/h. The maximum engine speed had been only 5200 RPM. Fuel economy under load might be improved by changing the chaincase sprockets to increase the gear ratio. This would allow the engine to run at a higher rate, which might be more efficient (11).

The PTO-side engine mounting bolts fail during an operation of this kind. A brute force solution is to use bigger bolts. This might simply transfer the damage to another part of the mounting. Another possible solution is to reduce the shock loading of the bolt by adding a small spring to each bolt.

The Elan is a simple, rugged, well-proven machine which is widely used in the Canadian North, especially south of the tree-line. It is not the optimum machine for military use in the North. Many modern snowmobiles are faster and more powerful, yet still reliable. In recent years the Transportation Development Centre of Transport Canada has funded the development of snowmobiles specifically designed to be arctic work machines (12). The design of one of these models evolved through cooperative efforts of engineers and Inuit hunters.

A different project resulted in a smaller and lighter snowmobile prototype which was able to float and to swim with two men onboard if open water were encountered. This machine, which had a more powerful engine than the Elan and a longer track, was constructed mainly of plastic to reduce its weight. The large amounts of cellular plastic built into the machine for floatation resulted in a large reduction in engine noise. The infra-red and radar signatures of this machine would also have been greatly reduced by the use of these materials and by the design. It incorporated features for arctic use stemming from the development of the larger model. Unfortunately, funding for this "stealth" snowmobile ceased at an early stage of its development. There appear to be no plans for further development by Transport Canada.

Radio Equipment

The DE1000 survived the treatment it received. Before taking it into the field internal connections which might shake loose were marked so that they could be correctly replaced. None of these connections loosened. The problems encountered were ascribed to the coaxial cable, to the antenna and to the batteries. The cable coupling may have been in intermittent contact with the aluminum

support on one occasion. On others, the cable may have been broken. The NiCad battery packs failed to produce sufficient voltage at low temperatures to ensure its operation. A higher voltage NiCad is one solution. Each battery pack weighed over 11 kg. A small portable generator supplying 100 W at 12 VDC weighing less than two of the NiCad battery packs is a possible replacement.

The SBX-11A was used successfully on one occasion to speak to a radio-telephone operator 800 kilometers distant in Alma, Quebec. It has good range, is rugged and lightweight, and runs on nine D-cells. The clarifier failed because a set screw loosened. Any equipment carried on a snowmobile or a sled towed by one for several hundred kilometers is subjected to severe vibration.

The helmet radios for communication between the members of the party were a failure. VOX operation suffers from the high noise level of the machines. The range was also too short. A potential solution is to mount a radio and antenna on the cowling of the snowmobile, isolated from vibration, and near the engine where it would be warm. A handset speaker-microphone could then be mounted on the dash. A light mounted on the dash would tell the driver when another unit is transmitting.

Stoves and Tent

The MSR Whisperlite stoves burned cleanly and produced no noticeable fumes when used with the grill. Prior to the trial, it had been discovered that the O-rings on the fuel bottles leaked when cold. This problem was solved by replacing the O-rings with ones made from nitrile rubber. The pump handles, which are made of plastic, split longitudinally into two pieces. This was only an inconvenience, however. It did not effect the operation of the pump.

Approximately 14 litres of naphtha were used during the seven nights spent in the tent. In 1986, 11 litres had been used in the same time period. Since there had been one fewer person in 1986, the consumption had been approximately the same: half of a litre per person per night.

The insulated tent was a warm shelter, a fact noted by more than one of our visitors. However, at the end of the trial it was found to have gained 10 kg of ice. While this greatly increased its packed volume, it had not noticeably effected the shelter it provided. Near the end of the trial, it was packed into an empty ration unit box, having "outgrown" its original container. Either the integrity of the vapour barrier had been breached or the material was inherently more permeable than expected.

Sleeping Bags

The sleeping bags were of a DREO design (13). They have continuous-filament polyester insulation and an integral pad. Three of the four had been used inside of vapour permeable, coated bivy sacks (Dermoflex). Two of these, weighed in the bivy sacks, picked up 570 grams and 450 grams. The third, which had had a chance to dry in the cabin on the second night, had gained 370 grams. The fourth sleeping bag which had been used without a cover

gained only 290 g. It had been left unpacked on the floor of the tent at Ekwan Point during the non-travel day.

Assuming a ventilation rate of 20 g/s for the tent in a light breeze (14) and a water vapour input from the stoves, people and drying clothing of 600 g/s, the mean dewpoint of the air in the tent should have been about 10°C. Since the inner regions of an unoccupied sleeping bag are insulated from the heat of the tent and therefore colder than the outer regions, water vapour will diffuse from the outer regions of the insulation of the sleeping bag where it had accumulated during the night, to the inner region. The redistributed water will diffuse back into the outer region of the bag when the temperature gradient is reversed the next time it is used. This will take extra heat away from the body making the bag feel colder. If the surface temperature of the unoccupied sleeping bag left unpacked in the tent at Ekwan Point had been near 10°C, it is possible that it picked up water from the air in the tent rather than dried. It would appear that the bivy sacs increased the amount of water retained by the sleeping bags which were equipped with them, though the statistics are weak. Of course, the intended use of a bivy sack is mainly for outside conditions.

CONCLUSIONS

The trial proved that a large improvement in the protection provided by the clothing system had been achieved since the last trial in 1986. In addition, it showed that it is possible for two people to travel on one snowmobile/sled combination for long distances even when the smallest snowmobile in production is used. Except for communications and maintenance, the passenger sled had been completely self-contained. The SBX-11A and trail radio mast could have been easily included in its load. It would have been necessary to reduce the number of fuel units and thereby the range, to include tools and spares, but even with one less fuel unit, the range would still have been more than 750 kilometres.

The addition of a vapour permeable bivy sack did not provide any net benefit in keeping the sleeping bag dry inside an insulated tent in very cold weather. It may have resulted in an increase in the moisture retained in the sleeping bag. Its use outside was not tested.

Moisture build up in the insulation of the tent was a minor, but significant, problem. A different vapour barrier material might have to be found.

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This report describes the conduct of a nine-day trial of cold weather clothing and equipment carried out by four DREO personnel along the west coast of James Bay. The equipment used, i.e., cold weather clothing, sleeping bags, stoves, tent, radios, snowmobiles and sleds, is described and its performance is discussed.

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