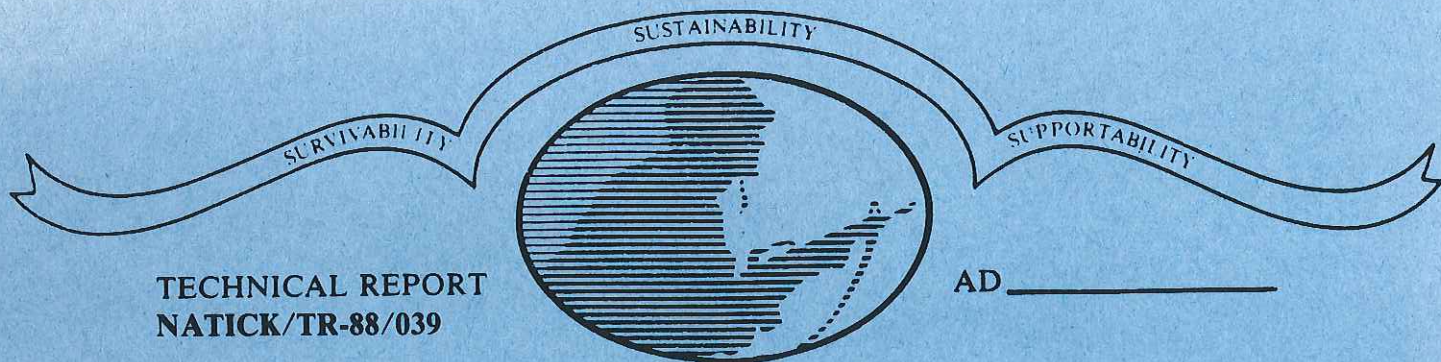




SOLDIERS', COOKS', AND COMMANDERS' ASSESSMENTS OF COLD WEATHER FEEDING PROBLEMS

**BY
DIANNE ENGELL
IRENE ABRAMS
KATHY ROCK**

FEBRUARY 1988

**FINAL REPORT
DECEMBER 1986 - SEPTEMBER 1987**

**APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.**

**UNITED STATES ARMY NATICK
RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
NATICK, MASSACHUSETTS 01760-5000**

SCIENCE AND ADVANCED TECHNOLOGY DIRECTORATE

DISCLAIMERS

The findings contained in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of trade names in this report does not constitute an official endorsement or approval of the use of such items.

DESTRUCTION NOTICE

For Classified Documents:

Follow the procedures in DoD 5200.22-M, Industrial Security Manual, Section II-19 or DoD 5200.1-R, Information Security Program Regulation, Chapter IX.

For Unclassified/Limited Distribution Documents:

Destroy by any method that prevents disclosure of contents or reconstruction of the document.

~~Unclassified~~
SECURITY CLASSIFICATION OF THIS PAGE

AD-A200 229

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0100	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NATICK/TR-88/039			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION US Army Natick Research, Development & Engineering Center		6b. OFFICE SYMBOL (If applicable) STRNC-YBH		7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Natick, MA 01760-5020		7b. ADDRESS (City, State, and ZIP Code)			
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS			
		PROGRAM ELEMENT NO. 6.2		PROJECT NO. 1L162724AH99	WORK UNIT ACCESSION NO. AH99AA179
11. TITLE (Include Security Classification) Soldiers', Cooks', and Commanders' Assessments of Cold Weather Feeding Problems					
12. PERSONAL AUTHOR(S) Dianne Engell, Irene Abrams, and Kathy Rock					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM Dec 86 TO Sep 87		14. DATE OF REPORT (Year, Month, Day) 1988 February	
15. PAGE COUNT 38					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	FEEDING FIELD KITCHENS FOOD PROCESSING		
			COLD WEATHER FOOD DISPENSING POTABLE WATER		
			KITCHEN EQUIPMENT & SUPPLIES FREEZING		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) A comprehensive survey was undertaken to examine problems associated with feeding in cold weather. Three questionnaires were designed to assess the perspectives of soldiers, cooks, and commanders. The soldiers' questionnaire addressed problems that soldiers encounter while eating in the cold. The cooks' questionnaire examined problems that cooks encounter setting up field kitchens, preparing and serving food, and sanitizing equipment. The commanders' questionnaire examined problems commanders face while coordinating field feeding during cold weather exercises. Although the soldiers, cooks, and commanders all had different perspectives, all agreed that water freezing is one of their biggest problems in the cold. Soldiers were concerned about water freezing in their canteens because it restricts fluid intake and makes preparation of dehydrated rations impossible. Water freezing presents similar problems for cooks; preparing food and sanitizing equipment is impossible when water freezes. Commanders were concerned with the individual soldiers' and cooks' concerns and with the logistics of providing potable water to troops. Other problems encountered by					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Dianne Engell			22b. TELEPHONE (Include Area Code) 617-651-5518/5520		22c. OFFICE SYMBOL STRNC-YBH

#19 ABSTRACT (Continued)

soldiers were: their hands getting cold while eating, MRE freezing, getting cold T, A, and B rations, and getting enough food and water. Cooks' major problems included: keeping food hot when serving, setting up kitchen shelters, getting enough sleep and keeping warm while preparing and serving food. Commanders concurred with the cooks and soldiers in terms of the problems mentioned above. Commanders were also very concerned about soldiers drinking enough fluids in a cold weather environment. Soldiers', cooks', and commanders' perspectives are discussed in detail in the report. Suggestions for improving conditions during cold weather feeding are included in the report.



Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Preface

The present survey was designed and analyzed by the Behavioral Sciences Division, US Army Natick Research, Development and Engineering Center, under project 1L162724AH99/AA179.

Acknowledgements

The authors would like to thank Captain Raymond Struth for his assistance in administering the surveys to the cooks. The authors would also like to express their thanks to Dr. Barbara Quigley and Ms. Joanne Edinberg for their assistance with preparing the report. Thanks also go to Ms. Jennifer Grafton for typing the manuscript.

TABLE OF CONTENTS

INTRODUCTION	1
SOLDIERS' ASSESSMENT OF COLD WEATHER FEEDING PROBLEMS	3
COOKS' ASSESSMENT OF COLD WEATHER FEEDING PROBLEMS	9
Preparing and Serving Rations	9
Kitchen Setup and Sanitation	12
Working Conditions	14
COMMANDERS' ASSESSMENT OF COLD WEATHER FEEDING PROBLEMS	15
Consolidated Field Feeding	15
Logistics of Ration and Water Supply	18
Leadership and Morale Issues	19
CONCLUSIONS	22
LIST OF REFERENCES	24
APPENDIXES	25
A. Soldiers' Questionnaire	27
B. Army Cold Weather Survey -- Cooks' Questionnaire	29
C. Cold Weather Feeding Questionnaire -- Commanders'	31

LIST OF TABLES

1. Soldiers' Demographics	1
2. Soldiers' Ratings of Cold Weather Feeding Problems	3
3. Means of Breakfast, Lunch, and Dinner Ratings	6
4. Places Where Soldiers Consume Their Meals in Cold Environments	8
5. Problems Related to Preparation and Serving of Rations . . .	10
6. Problems with Setting Up and Sanitizing Kitchen Equipment in the Cold	13
7. Problems with Cooks' Working Conditions in the Cold	14
8. Commanders' Ratings of Cold Weather Logistical Feeding Problems	16
9. Commanders' Ratings of Cold Weather Feeding Problems	18
10. Commanders' Ratings of Leadership Problems in a Cold Environment	20

SOLDIERS', COOKS', AND COMMANDERS' ASSESSMENTS OF COLD WEATHER FEEDING PROBLEMS

INTRODUCTION

A comprehensive survey was undertaken to examine problems associated with feeding in cold weather. Three questionnaires were designed to assess the perspectives of soldiers, cooks, and commanders. The soldiers' questionnaire addressed problems that soldiers encounter while eating in the cold. The cooks' questionnaire examined problems that cooks encounter setting up field kitchens, preparing and serving food, and sanitizing equipment. The commanders' questionnaire examined problems commanders face while coordinating field feeding during cold weather exercises. Copies of the soldiers', cooks', and commanders' questionnaires are attached as Appendixes A, B, and C, respectively.

A total of 355 soldiers, 61 cooks, and seven commanders participated in the survey. The soldiers had all participated in cold weather field exercises shortly before they were questioned. A summary of demographic information can be found in Table 1.

TABLE 1. Soldiers' Demographics

<u>Location of Cold Exercise</u>	<u>Avg Age</u>	<u>Rank</u>	<u>n</u>	<u>Duration (in days)</u>	<u>Avg Temp</u>	<u>Ration Cycle</u>
Ft. McCoy, WI	22.7	E-2 - E-7	82	7-8	20°F	B,MRE,B
Ft. Greely, AK	31.1	E-1 - E-9	21	12	20°F	T,MRE,T
Camp Smith, NY	22.5	E-1 - E-7	225	30	-2°F	T,MRE,T
Fulda, Germany	22.8	E-1 - E-9	27	30	30°F	A/B,MRE,A/B

The cooks who participated in this survey were from 18 home bases but were in training at Fort Lee, Virginia when asked to respond to the survey. Their average age was 34 years and their average length of service in the Army was 13 years. The cooks who responded were fairly experienced: their average field cooking experience was 8.75 years, and each participated in approximately three cold weather exercises per year.

Commanders' questionnaires were sent by mail to Army bases in Alaska. Only seven commanders responded; three of the responses were from Fort Wainwright and four were from Fort Richardson. Three commanders were first lieutenants, three were captains, and one did not report his rank. The mean age of the commanders was 28 years, and each had participated in a significant number of cold weather exercises. During the most recent exercises the average temperature was -3°F, and the average duration was 11 days.

Descriptive statistics will be reported for data from the three questionnaires. Means (X), standard deviations (SD) and sample sizes (n) will be reported for category scale questions. The sample sizes may differ by question because each respondent did not answer every question.

Open-ended questions were included in the survey to gather information not anticipated in the direct questions. These responses were tallied and will be reported with their frequencies. The response frequencies on open-ended questions are usually lower than on category scale questions because fewer subjects responded to open-ended questions.

SOLDIERS' ASSESSMENT OF COLD WEATHER FEEDING PROBLEMS

The soldiers' questionnaire focused on problems that the individual soldier encountered with eating and drinking in the cold. The questionnaire included a list of potential problems. The soldiers were asked to rate the severity of these potential problems using an 8-point category scale where 1 corresponded to extremely small problem, 4 corresponded to moderate problem, and 7 corresponded to extremely large problem. A zero was used on the scale to denote "no problem." (The zero scores were used when the means and standard deviations were computed.) Table 2 shows the list of problems and soldiers' ratings in descending order of severity.

TABLE 2. Soldiers' Ratings of Cold Weather Feeding Problems

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Water freezing in canteen	6.0	2.0	329
Keeping hands warm while eating	5.4	2.1	329
Getting enough food	4.5	2.3	334
MRE freezing	4.2	2.5	327
Preparing MRE meal	4.0	2.5	331
Getting hot meals	3.8	2.1	335
Getting hot tray pack meals	3.8	2.4	314
Getting hot A or B ration meal	3.7	2.4	290
Getting enough water	3.5	2.6	336
Using utensils to eat meals	2.6	2.5	330

* The scale used included: X = don't know; 0 = no problem, 1 = extremely small problem,... , 7 = extremely large problem.

Soldiers stated that their most severe problem eating in the cold was keeping the water in their canteens from freezing. Several soldiers also mentioned that once the Arctic Canteen froze, it was impossible to melt its contents without melting the rubber insert in

the neck of the canteen. Water freezing in soldiers' canteens presents the soldiers with a severe problem because it limits fluid consumption and it prevents soldiers from preparing dehydrated ration items for example, RCW entrees, beverages, and soups. Not only is hydration status dependent on keeping soldiers' individual water supply from freezing, nutritional status is also dependent on a good water supply. Research has shown that when water availability is low, individuals voluntarily reduce their food intake.¹

The soldiers rated getting enough to eat as more than a moderate problem. This problem may be explained by difficulties with the rations or difficulties due to the environment. This finding is consistent with results from a 10-day field study in which the Meal, Ready-to-Eat, (MRE) was compared to the Ration, Cold Weather, (RCW).² In this field study only 12% of the soldiers in the MRE group were satisfied with the amount of food in the ration. (In comparison, 50% in the RCW group were satisfied with the quantity of food.) However, results from this field study indicated that soldiers in the MRE group consumed only 56% of the available calories (2733 ± 65 kcal), while soldiers in the RCW group consumed about only 60% of the available calories (2751 ± 70 kcal). Why do soldiers perceive that there is not enough food yet eat only a portion of the available calories? Although reasons may include low acceptability of certain ration components, the major reasons probably have to do with the difficulties of ration preparation due to the special demands of a cold environment. In the study mentioned above, most of the RCW items

received very high scores on a hedonic scale but only 60% of the available food was consumed.

Soldiers rated keeping their hands warm while eating as their second most severe problem while eating in a cold weather environment. The difficulty in manipulating utensils wearing heavy cold weather gloves contribute to the soldier's problems. Although it is impossible to manipulate the plastic utensils wearing the Arctic mittens, soldiers did not rate the use of utensils as a severe problem. However, keeping one's hands warm while eating was reported to be difficult. This finding, together with independent observations of soldiers eating in cold environments, suggests that the soldiers usually remove their mittens to eat. It is quite possible that soldiers choose not to eat ration items that require a lot of preparation or require a utensil to eat in order to keep their hands warm.

The foods served for breakfast, lunch, and dinner during the cold weather exercise were rated on acceptability using a hedonic scale where 1 corresponded to dislike extremely, 4 corresponded to neither like nor dislike, and 7 corresponded to like extremely. If the soldier had never eaten a meal he responded with a zero. (Zero responses were not used when means and standard deviations were computed.) Results are reported in Table 3. The results are broken down by meal and by site, and the ration type served is listed after the rating. Average acceptability ratings indicate that most foods were liked slightly or given neutral ratings.

TABLE 3. Means of Breakfast, Lunch, and Dinner Ratings.*

<u>Site</u>	<u>Breakfast</u>	<u>Lunch</u>	<u>Dinner</u>	<u>Overall Mean</u>
Ft. McCoy	4.4 (B)	4.1 (MRE)	5.1 (B)	4.5
Ft. Greely	4.0 (T)	3.7 (MRE)	6.3 (T)	4.7
Camp Smith	3.6 (T)	4.1 (MRE)	5.4 (T)	4.4
Germany	5.0 (A/B)	5.4 (MRE)	5.3 (A/B)	5.2
Mean	3.9	4.2	5.4	

* The scale used included: 0 = never eaten, 1 = dislike extremely, ..., 4 = neutral..., 7 = dislike extremely. The ration type served is listed after the rating.

Mean scores from all four sites are in the moderate range between 4.4 and 5.2. Acceptability scores were not significantly different at the sites that served B rations and those that served T rations. Breakfast received the lowest acceptability rating, and dinner received the highest. Germany received the highest overall acceptability score, which may be due to the fact that some fresh food was served (A rations); in addition, while most of the soldiers at the other sites ate outside, only 25% of the respondents from Germany did so.

The temperature of the ration at the time the soldier eats it may be affected by: (1) environmental temperature, (2) type of ration, (3) serving temperature of rations, (4) means by which the ration is kept warm, (5) type of plates used by soldiers (either a standard army tray, cardboard, paper or styrofoam trays or styrofoam clamshell trays), and (6) the distance from the serving line to where the soldier eats.

The soldiers were asked to rate the overall temperature of their meals during the cold weather exercise, excluding the MREs, on a

category scale in which one corresponded to cold, four corresponded to neutral, and seven corresponded to hot. The majority of scores were rated around "neutral", and the mean across all four groups was 4.3. Camp Smith received the lowest score (4.1); Camp Smith had the coldest weather and the longest distance from the serving line to where the soldiers ate. Ft. Greely received the highest score (5.5) probably because the weather at Ft. Greely was considerably warmer than at the other sites, and the distance between the serving line and where the soldiers ate was considerably less than at Camp Smith. It is not surprising that the rations received less than acceptable scores on the hedonic scale; laboratory work has shown that acceptability of foods is dependent upon their serving temperature.³

Limited access to hot prepared meals (Tray Packs, A and B ration meals) may also contribute to the soldiers' perception that they are not getting enough food to eat. It is possible that the temperature of food contributes to feelings of satiety.⁴ Getting hot meals was rated by soldiers as a "moderate problem" in the cold.

Soldiers estimated that the average distance (including all sites) from the hot food serving line to the place where they ate their food was 178 yards ($\pm$ 478 yards), and the average time it took to cover this distance was 6.8 minutes ($\pm$ 8 minutes). Table 4 contains a list of places where soldiers consumed their meals at the different field exercise sites.

TABLE 4. Places Where Soldiers Consume Their Meals in Cold Environments.

	<u>Ft. McCoy</u>	<u>Ft. Greely</u>	<u>Camp Smith</u>	<u>Fulda</u>	<u>Sum</u>	<u>Percent*</u>
Outside	48	1	202	9	260	79.0
Tent	13	10	5	7	35	10.6
Vehicle	2	1	7	10	20	6.1
Mess Hall	4	1	-	5	10	3.0
Indoors	1	3	-	4	8	2.4

* Percent of those who responded (n = 329)

Soldiers were asked to describe any problems they have encountered with feeding during cold weather exercises. Responses with frequencies of at least 10 percent of total respondents (n = 355) will be reported. The most common response to this open-ended question was that the soldiers' hands got too cold (13%), which is in accord with the information elicited from the category scale question. The second most frequent response was that the food did not stay warm (11%). Other problems that were mentioned that exceeded the 10% response rate at a particular site include: non-breakfast foods in Tray Packs were served for breakfast (0.5% overall, 10% Ft. Greely), there was not enough variety in food (2% overall, 33% Ft. Greely), liquid freezes easily (6% overall, 10% Camp Smith), and there are not enough liquids to drink (0.1% overall, 11% Germany).

COOKS' ASSESSMENT OF COLD WEATHER FEEDING PROBLEMS

The cooks who participated in this survey had experience with different ration systems: 53% had used the Mobile Kitchen Trailer (MKT) for field cooking, 75% had used a tent with ranges, and 5% had used the Kitchen Company Level-Combat Field Feeding System (KCL-CFFS). The cooks had experience with the following types of rations: Tray Pack (13%), A ration (85%), and B ration (61%). (Percentage total for these questions exceeds 100 because most cooks have had experience with more than one type of field kitchen and field ration.)

The cooks' questionnaire examined problems that cooks encountered preparing and serving food and sanitizing equipment in the cold. The main section of the cooks' questionnaire consisted of a list of possible problems that cooks might encounter. The potential problems were divided into three categories: (1) preparing and serving rations, (2) setting-up and sanitization, and (3) general working conditions.

Cooks rated potential problems on 7-point category scales where one corresponded to extremely small problem, four corresponded to moderate problem, and seven corresponded to extremely large problem. Categories of "not a problem" and "don't know" were included in the scales. A discussion of means, standard deviations, and sample size for the cooks' responses follows.

Preparing and Serving Rations

Cooks ratings of preparation and serving problems are shown in Table 5 in order of decreasing severity. The preparation of all three

ration types was perceived to be a slight problem. The A ration preparation was rated as more difficult than B and T rations. As one cook wrote, "The A rations are harder to prepare because storage is difficult. Fresh fruits and vegetables spoil, the fresh meats in A rations freeze, and thawing the meats increases preparation time." Both B ration and T ration preparation were considered to be easier than the A ration but not different from each other. However, the cooks' comments indicated that they prefer T rations to B rations in the cold. B rations are harder to prepare than T rations because the dehydrated items must be reconstituted with water, while T ration preparation does not require water for reconstitution.

TABLE 5. Problems Related to Preparation and Serving of Rations

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Keeping T ration hot when serving outside	5.0	1.9	24
Water freezing	4.9	2.1	57
Providing A ration on a short notice	4.8	2.1	54
Keeping A or B ration hot while serving outside	4.6	2.0	55
Providing B ration on a short notice	4.3	1.9	52
Food freezing	4.2	2.1	54
Getting enough water for food preparation	4.0	1.9	48
A ration food preparation	3.7	1.8	51
Heating water	3.6	1.8	45
Serving A or B ration	3.6	1.8	52
Serving T ration	3.3	2.1	16
Providing T ration on a short notice	3.0	1.6	21
B ration food preparation	2.9	1.6	46
T ration heating	2.9	1.9	15

* The scale used included: X = don't know; 0 = not a problem; 1 = extremely small problem...7 = extremely large problem.

Keeping rations hot while serving was considered a difficult problem. Although the cooks preferred T rations over A and B rations in terms of ease of preparation, the cooks thought that T rations were the most difficult to keep warm in the serving line. According to the cooks, keeping T rations warm on the serving line is more difficult than keeping B rations warm. Once the Tray Pack is opened, there is a relatively wide surface area from which heat is lost. The B rations are kept in mermite cans that have a narrower exposed surface area when opened. One cook suggested adding insulation to the table tops used for serving T rations and adding sides to the tables to protect the T rations from the wind. Other suggestions were to put the Tray Packs in heated serving pans (chafing dishes) and to serve rations in a shelter.

Water freezing was a problem for cooks as well as for the soldiers. A large number of the cooks (13%) wrote that it was difficult to keep the water trailer from freezing, and that it was time-consuming and difficult to cook when starting with frozen water. Some of the cooks suggested redesigning the water trailer for extreme cold, insulating the trailer, keeping water inside a shelter, or making it possible to heat a larger quantity of water at one time. Other suggestions were reissuing the water trailer immersion heater and developing a tent with a heater for water storage.

Food freezing was rated as a moderate problem on the category scale question, and a large number of cooks (16%) mentioned that food freezing was a problem in response to the open-ended question. The severity of the problem of food freezing varied with the ration type.

Most of the problem involves the A ration: fresh fruits and vegetables freeze and spoil, while frozen meats increase the preparation time. Most B ration items are dehydrated, and therefore don't freeze. T rations are already prepared; however, freezing was not reported to be much of a problem.

Preparing rations on short notice was considered by cooks to be "difficult" with A rations, "somewhat of a problem" with B rations, and "not much of a problem" with T rations. This response corresponds to the length of time it takes to prepare each ration in the cold. According to cooks, on the average, A rations take 3.5 hours to prepare, B rations take 3.3 hours to prepare, and T rations take 1.4 hours to prepare. One cook wrote that "During cold weather training, the largest problem was trying to thaw meats (A rations) because of the increased cooking time needed due to frozen rations." In general, the cooks indicated that A rations are a poor choice for a cold weather ration. Cooks prefer T rations because of the relative ease of preparation, and the fact that ration preparation is not severely hindered by frozen water or frozen ingredients/ration components.

Kitchen Setup and Sanitation

The sanitation of kitchen equipment is difficult in the cold because the water needed to wash pots and pans freezes (see Table 6). Kitchen personnel on the wash line need to be rotated often because their hands get too cold and their clothing gets wet. Some cooks suggested building a shelter for kitchen personnel to use in order to be protected from the cold during sanitation. Some cooks were

concerned that kitchen equipment could not be sanitized properly in the cold and that the soldiers' health may be jeopardized. The need for a new sanitation system for cold weather operations was expressed by several cooks.

TABLE 6. Problems with Setting Up and Sanitizing Kitchen Equipment in the Cold

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Sanitation of pots, pans, and utensils	4.3	2.0	52
Starting M-2 burner	3.8	2.0	44
Setting up or packing up kitchen shelters	3.8	1.8	49
Setting up or packing up MKT	3.4	2.0	38

*The scale used included: X = don't know; 0 = not a problem; 1 = extremely small problem...7 = extremely large problem.

Cooks wrote that starting the M-2 burner in the cold was a large problem. The water in the gas freezes, and the pipes freeze. The generators used to preheat the burners take a long time to warm the pipes. A few cooks suggested that the M-2 burner should be modified or replaced with another burner in cold weather environments.

Cooks stated that it was quite difficult to remain warm while setting up the field kitchen and serving outside (see Table 7). Many of the cooks also commented on how cold it gets in the MKT. The floors of the MKT are made of metal and get extremely cold. One cook wrote, "The metal floor of the MKT gets so cold that anything spilled on the floor is instantly frozen. Your feet stay cold and hurt, and sometimes you even get frostbite." Many cooks suggested adding a skirt to the bottom of the MKT to keep gelid winds from blowing under

the floor. Other cooks suggested making the floor out of an insulating material.

Cooks also mentioned that the present cold weather clothing is not adequate for their mission. Cooks said that they found it difficult to function effectively when wearing enough layers of clothing to keep warm. Some cooks suggested developing waterproof, insulated gloves for cooking, serving, and cleaning.

Working Conditions

Cooks reported that it was very difficult to get enough sleep while working on field exercises (see Table 7). One cook wrote, "There is much to do. It is hard to finish setting up a new area before midnight, and we need to wake up 3 hours later to start breakfast. We never get any sleep on night moves." Cooks also reported that they have trouble operating in the dark, because it is difficult to tell if food is cooking properly.

TABLE 7. Problems with Cooks' Working Conditions in the Cold

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Getting enough sleep	5.2	1.8	58
Keeping yourself warm while serving outside	5.0	1.8	56
Keeping yourself warm while setting up the field kitchen	4.9	1.8	59
Operating in the dark	4.9	1.8	54
Keeping yourself warm while cooking	3.6	1.9	47
Getting wet while cooking	3.4	1.7	51
Getting frostbite	3.4	2.0	48

*The scale used included: X = don't know; 0 = not a problem; 1 = extremely small problem...7 = extremely large problem.

COMMANDERS' ASSESSMENT OF COLD WEATHER FEEDING PROBLEMS

The commanders' questionnaire addressed three types of potential problems encountered by commanders during cold weather feeding: (1) consolidated field feeding, (2) logistics of water and ration supply, and (3) leadership and morale issues.

Consolidated Field Feeding

Commanders are responsible for deciding how to divide up troops and mess teams for feeding during field exercises. This section addresses issues pertaining to the use of consolidated field feeding, that is, feeding in large groups. The commanders' ratings of potential consolidated field feeding problems are presented in Table 8 in decreasing order of severity. Potential problems were rated by commanders' on scales that ranged from 0 to 7 where 0 corresponded to not a problem, 1 corresponded to extremely small problem, and 7 corresponded to extremely large problem. A "don't know" category was also included in this scale. Table 8 summarizes the commanders' ratings of consolidated field feeding problems.

Commanders agreed with the cooks' assessment of ration preparation and serving problems. Keeping food warm, and keeping liquids from freezing during distribution were considered to be significant problems by the commanders. Commanders also concur with the cooks' assessment that T rations are harder to keep warm than A and B rations. In addition to these problems, commanders expressed serious concern about logistical problems. The resupply of rations

and water by airdrop and maintaining tactical posture are difficult problems (according to the commanders surveyed).

TABLE 8. Commanders' Ratings of Cold Weather Logistical Feeding Problems

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Keeping liquids from freezing during distribution	5.5	1.4	6
Resupplying water by airdrop	5.5	2.1	6
Keeping food warm in Tray Packs during distribution	5.0	2.6	6
Resupplying rations by airdrop	4.8	2.3	6
Maintaining tactical posture during feeding	4.8	1.3	6
Keeping food warm in mermite cans during distribution	4.2	2.6	6
Transporting water to this location by ground	3.4	2.1	7
Transporting equipment to this location by ground	3.1	1.6	7
Transporting rations to this location by ground	2.6	1.7	7
Finding a desirable location for consolidated field feeding	1.9	2.0	7

*The scale used included: X = don't know; 0 = not a problem, 1 = extremely small problem, ..., 7 = extremely large problem.

All of the commanders who participated in this survey were from Alaska and the distances from food preparation areas to the food serving areas were considerably longer than the distances at the sites from which the soldiers and cooks came. According to the commanders, the average distance from point of food preparation to the feeding location in the units was 8.4 miles, and the average distance from the serving location to the place the soldier consumes his meal was 328 yards. This distance is considerably longer than the soldiers from Alaska's estimate of 178 yards; however, the field exercises were not

identical. According to commanders, because of the long distance between preparation and serving locations, it is impossible with the current equipment to keep food warm.

Commanders were asked to explain how they chose a location for consolidated field feeding. The major reasons cited were tactical considerations (such as whether the company is in an offensive or defensive posture), the availability of camouflage, security, and the distance from the front line. The distance from the supply and the cooking unit was also mentioned as an important factor in deciding on a feeding location.

Commanders were also asked how they chose the ration cycle to be used in the field. The choice of ration type and ration cycle was considered to be mission dependent, given that all rations were available. The duration of the exercise, and the tactical scenario were considered when choosing which rations to use. Dynamic operations, such as deployment and repositioning, make it difficult to deliver hot meals to the soldiers because: (1) the feeding time is unpredictable; (2) the appropriate division of rations among groups is difficult; (3) soldiers must stagger themselves at the feeding unit to avoid clustering; and (4) the distance from the feeding unit to the soldier is farther than usual. MREs are often used during dynamic operations to avoid these problems. The MRE however, does have some problems in the cold.²

Logistics of Ration and Water Supply

Commanders were asked to rate the severity of potential problems related to rations and water on the seven-point category scale described previously.

Commanders reported that keeping water and rations from freezing was a severe problem (see Table 9). This is consistent with what soldiers and cooks reported to be the most difficult problem. Problems with the water buffalo freezing, storage of perishable foods, and storage of rations were rated as moderate problems. The sanitation of field kitchen facilities and equipment and trash elimination were perceived by commanders to be relatively minor problems.

TABLE 9. Commanders' Ratings of Cold Weather Feeding Problems

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Keeping water from freezing	6.0	1.2	7
Keeping rations from freezing	5.3	2.0	7
Keeping water buffalo from freezing	4.5	1.8	6
Storing perishable foods	4.5	2.9	4
Storing rations	4.3	1.9	7
Accessing unfrozen water from lakes	3.8	2.1	4
Trash elimination	3.7	2.6	7
Cleaning field kitchen facilities and equipment	3.3	2.6	4

*The scale used included: X = don't know; 0 = no problem; 1 = extremely small problem, ..., 7 = extremely large problem.

Trash elimination is also a problem in extremely cold environments. Everything brought into an arctic environment must be brought out, according to the Environmental Protection Agency. One commander mentioned that trash elimination was a problem because trash bags compound operational security, and vehicle and supply

personnel must be dedicated to trash removal. Of all the rations, T rations produce the most trash, and MREs produce the second largest amount of trash. B rations served in mermite cans create less trash for the companies, but more for the cooks. According to one commander, the wood crates used to transport artillery and tank ammunition produce more trash than ration waste; these crates are especially difficult to dispose of because they are treated with a chemical that is toxic when burned.

Keeping water from freezing was the most commonly stated problem. One commander suggested storing water in tents and shelters. Another mentioned that the arctic canteen does not work well in extreme cold and is cumbersome; he suggested that collapsible canteens, which could be kept warm underneath the outer shell of the soldier's clothes would be an improvement over the metal arctic canteen.

Leadership and Morale Issues

The commanders reported that getting troops to drink enough was their most serious leadership problem in the cold (see Table 10). Although the low availability of water due to water freezing may explain part of the problem, researchers have found that soldiers do not feel thirsty in the cold.⁵ Hypohydration has been seen in cold environments in laboratory and field studies.^{2,5-8} One commander suggested that lightweight individual or squad stoves should be available so that men can heat liquids in the field to make hot beverages. According to the commanders surveyed, the stoves used

presently are cumbersome or unreliable. Another commander suggested that each unit should dedicate a few men to serve as a water team to melt snow and ice and provide hot beverages to the soldiers in the field.

TABLE 10. Commanders' Ratings of Leadership Problems in a Cold Environment

	<u>Mean*</u>	<u>SD</u>	<u>n</u>
Getting troops to eat enough in the cold	3.3	2.1	7
Getting troops to drink enough in the cold	5.7	1.1	7
Maintaining morale during cold weather operations	3.4	2.1	7

*The scale used included: X = don't know; 0 = not a problem; 1 = extremely small problem...7 = extremely large problem.

Many commanders wrote that the Ration, Cold Weather (RCW) was an excellent product for cold weather and a great improvement over the MRE. Some commanders said that when the MRE freezes most men won't eat it unless it can be heated. According to the commanders, MREs cannot be heated easily and therefore are often not eaten. As one commander wrote, "A frozen ham and chicken loaf is practically indestructible, let alone edible!" One commander suggested that a method is required to heat the ration in which the water used to heat the MRE remains potable.

T rations received mixed ratings by commanders. T rations are considered to be a good ration when it is possible to serve them to a large group. However, when they are served to a scattered group of men, they get cold quickly when brought out to be served. In addition, commanders commented that T rations produce a lot of wasted food and trash.

A few respondents expressed that "lessons learned" during field exercises in Alaska are limited because field exercises rarely last longer than two weeks so that resupply is kept at a minimum. Problems of resupply, especially in Alaska where the road network is sparse, should be evaluated. One commander suggested examining problems that occurred during the Korean war to learn more about wartime cold-weather feeding situations.

CONCLUSIONS

Overall, the most significant problems encountered during cold weather feeding are keeping water from freezing and keeping personnel warm. Although these problems are not surprising, the extent to which water freezing and keeping warm hinders the military's mission in the field cannot be underestimated. The soldiers, cooks, and commanders all have different missions and thus different perspectives, yet all agree that water freezing is one of their biggest problems in the cold. Soldiers are concerned about water freezing in their canteens because it restricts fluid intake and makes preparation of dehydrated operational rations impossible. Water freezing presents similar problems for cooks; preparing food and sanitizing equipment is impossible when water freezes. Commanders are concerned with the individual soldiers' and cooks' concerns and with the logistics of providing potable water to troops.

Some suggestions were made to prevent water from freezing. Suggestions included storing water in a shelter or in an insulated tank, reissuing the water trailer immersion heaters, and developing a safer heater to use in a tent. In terms of the individual soldier's water supply, a collapsible canteen that can be kept underneath the soldiers' clothes in order to be warmed by body heat was suggested.

Keeping warm, an obvious problem in a cold environment, was also a problem for soldiers and cooks with the present equipment. Soldiers reported that their hands got especially cold while eating because arctic mittens need to be removed to manipulate ration packages and

utensils. Cooks mentioned that keeping warm while preparing rations and sanitizing equipment was especially difficult because getting wet exacerbates the problem. One suggestion addressing this problem was to provide waterproof, insulated gloves and aprons for cooks to wear while working. Cooks said that they were also very cold when serving B rations or T rations in unprotected areas. Some suggestions related to this problem were that a skirt be added to the bottom of the MKT and the floors be insulated so that they are more resistant to the cold.

Commanders were very concerned that soldiers do not drink enough when it is cold. Some commanders recommended distributing portable stoves to soldiers so that they could prepare hot beverages in the field. Soldiers themselves did not express as much concern about getting enough water as the commanders did. This suggests that soldiers should be educated about the dangers of hypohydration in a cold environment.

This document reports research undertaken at the US Army Natick Research, Development and Engineering Center and has been assigned No. NATICK/TR-88/039 in the series of reports approved for publication.

List of References

1. Engell, D. Interdependency of Food and Water Intake in a Cold Environment. Appetite, In Press.
2. Engell, D. B., Roberts, D. E., Askew, E. W., Rose, M. S., Buchbinder, J., Sharp, M. A. Evaluation of the Ration, Cold Weather during a 10-day Cold Weather field training exercise. Technical Report NATICK/TR-87/030, U.S. Army Natick Research, Development and Engineering Center, Natick, MA, 1987. (AD A184 568)
3. Cardello, A. and Maller, O. Acceptability of water, selected beverages and foods as a function of serving temperature. Journal of Food Science, 1982, 47(5), 1549-1552.
4. Kissileff, H.R., Gruss, L.P., Thornton, J., and Jordon, H. A. The satiating efficiency of foods. Physiology and Behavior, 1984, 32, 319-332.
5. Wyant, K.W. and Caron, P.L. Water discipline and an arctic ration prototype. Military Medicine, 1983, 148, 435-439.
6. Jacey, M., Woitowics, J.J., Tappan, D.V., Heyder, E., and Gray, P.H. Acceptance of menu items in the low-salt U.S. Marine Corps arctic ration (prototype) Nav Sub Med Rsch Lab Report No 1017, 1984.
7. Mastromarino, A.C. and Loveridge, V.A. Evaluation of the ration, cold weather, April, 1985. USANRDEC Technical Report, NATICK/TR-86/027, 1986. (AD A170 407)
8. Carson, J.L. Final report: Technical feasibility test (TFT) of the Marine Corps arctic ration. USA Cold Region Test Center (CRTC), USATECOM PROJ NO. 8-E1-925-000-004, 1986.

APPENDIXES

A. Soldiers' Questionnaire	27
B. Army Cold Weather Survey -- Cooks' Questionnaire	29
C. Cold Weather Feeding Quesionnnnaire -- Commanders	31

APPENDIX A

NAME _____ RANK _____ AGE _____
 BATTALION _____ COMPANY/UNIT _____ MOS _____

Soldiers' Questionnaire

We are here from the US Army Natick Research, Development & Engineering Center where rations and food systems for the military are developed. We would like to ask you a few questions about the food that you've been eating during this cold weather exercise. Your answers will help developers provide better food to you.

1. During this exercise, what has the temperature of your meals been? Rate the temperature of foods usually served hot (example: main course, vegetable, starch). Do not rate MREs. Please answer by circling the number that best expresses your opinion.

1	2	3	4	5	6	7
COLD	VERY COOL	COOL	NEUTRAL	WARM	VERY WARM	HOT

2. Please rate how much you like or dislike the food you've been served/issued for breakfast, lunch and the evening meal. (Circle one number per meal)

NEVER TRIED	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
0	1	2	3	4	5	6	7	8	9

a. Breakfast	0	1	2	3	4	5	6	7	8	9
b. Lunch	0	1	2	3	4	5	6	7	8	9
c. Evening Meal	0	1	2	3	4	5	6	7	8	9

3. Are any of the following a problem? Please use this scale to rate each item. (The larger the number, the bigger the problem.) Place the number that best expresses your opinion on the line to the right. If you don't know, mark an "X" on the line.

0	1	2	3	4	5	6	7
NOT A PROBLEM	EXTREMELY SMALL PROBLEM			MODERATE PROBLEM			EXTREMELY LARGE PROBLEM

- a. keeping hands warm while eating _____
- b. water freezing in canteen _____
- c. MRE freezing _____
- d. getting hot meals _____
- e. getting enough food _____
- f. getting enough water _____
- g. getting hot tray pack meals _____
- h. getting hot A or B ration meals _____
- i. preparing MRE meal _____
- j. using utensils to eat meals _____

- 4a. How far is the hot meal serving line from where you eat? _____ yards
- b. How long does it take you to get from the serving line to where you eat? _____ minutes
- c. Where do you usually eat (example: in your tent, outside, in a vehicle)?

5. Please explain in detail all the major problems that you have encountered in the field during cold weather exercises. Describe any problem that has to do with rations or eating in the cold.

APPENDIX B

ARMY COLD WEATHER SURVEY

NAME _____ RANK _____ AGE _____
 UNIT _____ MOS _____ YEARS IN SERVICE _____
 YEARS OF FIELD COOKING EXPERIENCE _____
 NUMBER OF COLD WEATHER EXERCISES PER YEAR _____
 CHECK TYPE OF EQUIPMENT USED IN COLD WEATHER ENVIRONMENTS:
 MKT _____ TENT WITH RANGES _____ KCL (CFFS) _____
 CHECK TYPE OF RATIONS PROVIDED IN COLD WEATHER:
 T-RATIONS _____ A-RATIONS _____ B-RATIONS _____
 PRESENT INSTALLATION _____

This questionnaire has been designed to identify the major problems that military cooks have in the field in cold weather. The results will be used by researchers at the U.S. Army Natick Research, Development and Engineering Center where food systems for the military are developed. Your answers and comments will help scientists and engineers provide a better cold weather system for you.

1. Have any of the following been a problem for you in cold weather? Please use this scale to rate each item. (The larger the number, the bigger the problem.) Write the number that best expresses your opinion on the line to the right. If you don't know, mark an "X" on the line.

0	1	2	3	4	5	6	7
NOT	EXTREMELY			MODERATE			EXTREMELY
A	SMALL			PROBLEM			LARGE
PROBLEM	PROBLEM						PROBLEM

- a. A ration food preparation _____
- b. B ration food preparation _____
- c. T ration heating _____
- d. serving A or B rations _____
- e. serving T rations _____
- f. keeping yourself warm while cooking _____
- g. keeping yourself warm while serving outside _____
- h. keeping yourself warm while setting up
the field kitchen _____
- i. getting enough sleep _____
- j. getting wet while cooking _____
- k. getting frostbite _____
- l. water freezing _____
- m. food freezing _____
- n. keeping A or B rations hot when
serving outside _____

2. Please comment on the major problems listed in Question 1. Explain why each is a problem.
3. Do any equipment failures occur because of extreme cold weather? Please explain.
4. Are there any other problems that occur because of the extreme cold?
5. Can you think of ways to solve any of these problems?
6. How much time does it take from the start of setup until you are ready to serve A rations? _____ B rations? _____ T rations? _____
7. Can you suggest any equipment, clothing, procedure or ration changes that would improve cold weather feeding operations?

30

APPENDIX C COLD WEATHER FEEDING QUESTIONNAIRE - COMMANDERS

The Army is currently investigating problems related to feeding in extremely cold weather. This questionnaire addresses problems that commanders may encounter. Other questionnaires have been distributed to soldiers and cooks. The results of this survey will be used to help researchers at the US Army Natick Research, Development and Engineering Center to provide a better cold weather system. Thank you for your help.

Background Information:

NAME _____	AGE _____	RANK _____	PRESENT INSTALLATION _____
NUMBER OF COLD WEATHER EXERCISES YOU HAVE COMMANDED _____			
MOST RECENT COLD WEATHER EXERCISES:			
	I	II	III
LOCATION	_____	_____	_____
YEAR	_____	_____	_____
DURATION	_____	_____	_____
POSITION SERVED	_____	_____	_____
AVERAGE TEMPERATURE	_____	_____	_____
WEATHER CONDITIONS	_____	_____	_____

Please use the scale below to indicate if the following activities are problems and if so, the extent of the problem. If you have not had experience with an activity, fill in an X on the line next to that activity. Space has been left after each group of problems for comments, solutions and suggestions for improvement.

SCALE

X	0	1	2	3	4	5	6	7
NO	NOT A	EXTREMELY			MODERATE			EXTREMELY
EXPERIENCE	PROBLEM	SMALL			PROBLEM			LARGE
		PROBLEM						PROBLEM

1. Have you had difficulty:
 - a. finding a desirable location for consolidated field feeding _____
 - b. transporting rations to this location by ground _____
 - c. transporting equipment to this location by ground _____
 - d. transporting water to this location by ground _____
 - e. resupplying rations by airdrop _____
 - f. resupplying water by airdrop _____
 - g. How do you choose a location for consolidated field feeding?
 - h. How do you choose whether or not to utilize a consolidated field kitchen?

PLEASE TURN OVER

i. How do you choose which type of ration and which ration cycle to use (i.e., B/MRE/B, B/MRE/MRE, T-Rations, other).

j. How much time does it take to set up for:

1. B-rations _____

2. T-rations _____

k. Explain how dynamic operations (deployment, repositioning) affect field feeding in the cold. Please list specific problems.

Please add any comments or suggestions you may have regarding the topics covered in question 1.

2. If you have operated a consolidated field kitchen have you had problems with the following:

X NO EXPERIENCE	0 NOT A PROBLEM	1 EXTREMELY SMALL PROBLEM	2	3	4 MODERATE PROBLEM	5	6	7 EXTREMELY LARGE PROBLEM
-----------------------	-----------------------	------------------------------------	---	---	--------------------------	---	---	------------------------------------

a. keeping food warm in tray packs during distribution _____

b. keeping food warm in mermite cans during distribution _____

c. maintaining tactical posture during feeding _____

d. keeping liquids from freezing during distribution _____

e. What is the average distance from point of food preparation to the feeding location in your unit?

f. What is the average distance from feeding location to where the soldier consumes his meal?

g. What containers (standard army tray, other) does the individual soldier use to carry his food from the feeding location to where he consumed his meal?

Please add any comments or suggestions you may have regarding the topics covered in question 2.

3. How much of a problem have the following been?

X NO EXPERIENCE	0 NOT A PROBLEM	1 EXTREMELY SMALL PROBLEM	2	3	4 MODERATE PROBLEM	5	6	7 EXTREMELY LARGE PROBLEM

i. How do you manage trash elimination?

Please add any comments or suggestions you may have regarding the topics covered in question 3.

4. Have you had problems with the following?

X NO EXPERIENCE	0 NOT A PROBLEM	1 EXTREMELY SMALL PROBLEM	2	3	4 MODERATE PROBLEM	5	6	7 EXTREMELY LARGE PROBLEM

Please add any comments or suggestions you may have regarding the topics covered question 4.

5. Please list any other problems or comments you have regarding cold weather feeding which have not been addressed above.