

Understanding Our First Enemies in the Cold

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Throughout history, the essential ingredient to the quality of any fighting force is the individual war-fighter. It is in how we train these Soldiers and the knowledge and discipline they carry within them. As we have found in increasing heat, we also find in increasing cold —not a single challenge but a spectrum of increasing potential threats for warfighters which needs to be understood and individually countered for survival and success. Any environment is a whole integrated complex that cannot be thought of and treated as just one consistent threatening factor. As it gets colder, Soldiers face more and harder challenges.

We can be physically fit and optimally trained and supported for the tasks that we face, but our bodies cannot fully adapt to the new situation and attain maximal performance without first a whole body, full time exposure and the days spent taken to physiologically respond to the environment's demands. Our bodies always adapt to meet the environment that it is in at that present moment. Our bodies will have to acclimate to any change in our environment, and sometimes that means, in the worst case, that it may be literally weeks before new stability may be reached and supported by our new behaviors. This can be very complex with changing seasons, the ascents to altitude, and the arrival of storms. The first enemy we must always consider is the environment. The current changing global strategic environment is requiring that we, once again, regain our aptitude to operate safely in cold climates at all altitudes.

The basic challenge in the cold is to understand and reduce or prevent the body's loss of moisture and heat to the environment. Cold air is dry air which dehydrates the body. The steaming breath we see is the visible evidence of the water and warmth leaving our bodies. The cold environment is constantly leaching the energy and moisture



Soldiers from 2nd Battalion, 87th Infantry Regiment, 2nd Brigade Combat Team, 10th Mountain Division, cross-country ski at the Chilean Army Mountain School in Portillo, Chile, on 21 August 2021. (Photo by SGT Gregory Muenchow)

from our bodies that we need to live. If we are climbing to altitude, the situation becomes more complex as the oxygen we need for energy diminishes.

Cold temperatures can quickly drop to levels that our bodies simply cannot acclimatize to. What we do is habituate by adding deliberate behaviors that supplement and support our bodies' abilities to survive the challenge of the cold. To do this we need food and water; shelter; clean, dry clothes; adequate rest; and sources of warmth. We also need to understand how to continually be aware and act in the environment to safely sustain ourselves. Simply put, our bodies in the cold become engines that we need to constantly observe and sustain on top of all our other requirements for resources and concerns so that we can survive and pursue our goals.

Cold and Mountainous Regions

Army Techniques Publication 3-90.97, *Mountain Warfare and Cold Weather Operations*, defines cold regions as "where cold temperatures, unique terrain, and snowfall have a significant effect on military operations for one month or more each year."¹ It describes regions that are either moderately cold or severely cold, each comprising about approximately one quarter of the Earth's land mass.²

- **Moderately cold** — Where the mean temperatures during the coldest month of the year are below freezing.
- **Severely cold** — Where mean annual air temperatures stay below freezing, maximum snow depths exceed 60 centimeters (24 in), and ice covers lakes and rivers for more than 180 days each year.

Weather Conditions That Create Hazards

Temperature, wind, snow, and freeze/thaw cycles are the primary environmental conditions that affect the winter and mountain battlefield and challenge the physiology of the warfighter. The lack of stability in these factors can stress our body by forcing it to frequently try to adapt and can possibly magnify our fatigue, distress, and distraction.

Cold Weather Characteristics

The Army categorizes cold temperatures into the following operational groups:³

Wet cold — +39° Fahrenheit (F) to +20° F (4° Celsius [C] to -7° C).

Dry cold — +19° F to -4° F (-7° C to -20° C).

Intense cold — -5° F to -25° F (-20° C to -32° C).

Extreme cold — -25° F to -40° F (-32° C to -40° C).

Hazardous cold — -40° F (-40° C) and below.

Wet Cold

*Wet cold conditions occur when wet snow and rain often accompany wet cold conditions. This type of environment is more dangerous to troops and equipment than the colder, dry cold environments because the ground becomes slushy and muddy and clothing and equipment becomes perpetually wet and damp. Because water conducts heat 25 times faster than air, core body temperatures drop if troops are wet and the wind is blowing. Troops become casualties due to weather if not properly equipped, trained, and led. Wet cold environments combined with wind is dangerous because of the wind's effect on the body's perceived temperature. Wet cold leads to hypothermia, frost bite, and trench foot. Wet cold conditions are not only found in mountain environments but in many other environments during seasonal transition periods. Under wet cold conditions, the ground alternates between freezing and thawing because the temperatures fluctuate above and below the freezing point. This makes planning problematic. For example, areas that are trafficable when frozen could become severely restricted if the ground thaws.*⁴

When reading the broad spectrum of physiology sources, we encounter a different definition of "wet cold" and find many arguments from Midwesterners and Canadians about the subject. The climatic conditions that bring it on are ill-defined, and there are those who deny that it exists. What is to be remembered is that the U.S. Army is creating an operational category while the civilian sources are attempting to define a subjective description. However, once one has experienced it, you become wary of it. It seems that under certain climatic conditions as the temperature drops moisture appears to be trapped in the air rather than dissipated and the air becomes a very clammy cold. One report indicates this seems to happen down to about 15° F (-8.5 C). The basic problem is that moisture in the air sucks the warmth right out of our bodies, chilling us very quickly. When experiencing this, you find yourself



A Soldier with the 4th Infantry Brigade Combat Team (Airborne), 25th Infantry Division awaits transportation after a successful airborne operation in Deadhorse, AK, on 22 February 2017. The Soldiers completed the operation in -30 degrees temperatures, with a wind chill factor of -56 degrees. (Photo by SSG Daniel Love)

hoping the temperature will drop to dehydrating levels so you can be dry and cold instead of miserably wet and cold. The only apparent counter to this condition is enough dry clothes and food for heat production.

Leaders must know and follow the guidance provided by Table C-1 of ATP 3-90.97 for required training, specialized uniforms and equipment, support requirements, and the ration types and amounts for operations in wet cold.

Dry Cold

Dry cold conditions are easier to live in than wet cold conditions. Like in wet cold conditions, proper equipment, training and leadership are critical to successful operations. Wind chill is a complicating factor in this type of cold. The dry cold environment is the easiest of the cold weather categories to survive in because of low humidity and the ground remains frozen. As a result, people and equipment are not subject to the effects of the thawing and freezing cycle, and precipitation is generally in the form of dry snow.⁵

Associated with this is the decline of manual dexterity as our skin temperature drops below 55° F (13° C).⁶

Leaders must know and follow the guidance provided by Tables C-2 and C-3 of ATP 3-90.97 for required training, specialized uniforms and equipment, support requirements, and the ration types and amounts for operations in dry cold.

Intense Cold

Intense cold exists from -5° F to -25° F (-20° C to -32° C) and can affect the mind as much as the body. Simple tasks take longer and require more effort than in warmer temperatures, and the quality of work degrades as attention-to-detail diminishes. Clothing becomes more bulky to compensate for the cold so troops lose dexterity. Commanders must consider these factors when planning operations and assigning tasks.⁷

It must be remembered that the diminishment of our thought processes starts at about 40° F and continues with the drop in temperature if we do not protect ourselves against it. Leaders must know and follow the guidance provided by Tables C-3 and C-4 of ATP 3-90.97 for required training, specialized uniforms and equipment, support requirements, and the ration types and amounts for operations in intense cold.

Extreme Cold

Extreme cold occurs from -25° F to -40° F (-32° C to -40° C) and the challenge of survival becomes paramount. During extreme cold conditions, it is easy for individuals to prioritize their physical comfort above all else. Personnel withdraw into themselves and adopt a cocoon-like existence. Leaders expect and plan for weapons, vehicles, and munitions failures in this environment. As in other categories, leadership, training, and specialized equipment are critical to the ability to operate successfully.⁸

Leaders must know and follow the guidance provided by Table C-4 of ATP 3-90.97 for required training, specialized uniforms and equipment, support requirements, and the ration types and amounts for operations in extreme cold.

Hazardous Cold

In hazardous cold conditions, commanders and planners assume greater risk if they engage in operations when the temperature falls below -40° F (-40° C). Units are extensively trained before undertaking an operation in these temperature extremes.⁹

Experience has shown that consistent leadership by veteran warfighters who carefully keep troops clothed, fed, warmed, rested, and supplied with hot liquids will allow all needed tasks to be accomplished, although requiring up to about four times the amount of time scheduled for those tasks in a temperate environment.

Leaders must know and follow the guidance provided by Table C-5 of ATP 3-90.97 for required training, specialized uniforms and equipment, support requirements, and the ration types and amounts for operations in hazardous cold.

Altitude and its Effects

The effects of altitude are pervasive and potentially lethal, so they must be considered whenever changes in altitude are involved in operations. Warfighters live and work in a whole integrated environment, and it is a mistake to focus on one aspect without considering its interaction with all the other environmental factors.

In mountainous areas, the general rule is for every 1,000 feet of elevation gained, the temperature decreases 3° F to 5° F. At high elevations, there may be differences of 40° to 50° F between the temperature in the sun and that in the shade, which is similar in magnitude to the day-to-night temperature fluctuations experienced in some deserts.

At higher elevations, air is considerably dryer than air at sea level. Due to this increased dryness, Soldiers must increase their fluid intake by approximately a third.

For most warfighters between elevations of 2,438 meters (8,000 feet) and 5,486 meters (18,000 feet), 70 to 80 percent of the respiratory component of acclimatization occurs in seven to 10 days, and 80 to 90 percent of overall acclimatization is generally accomplished within two to four weeks. All of this depends on the amount of physical stress then being experienced by the warfighter. Maximum acclimatization may take months to years. Acclimatization cannot be accelerated as some people acclimate more rapidly than others, and a few may not acclimate at all. There is no reliable way to identify those who cannot acclimate except by their experience during previous altitude exposures. When brought to lower altitudes, all Soldiers will lose their acclimatization in perhaps as little as 10 days.¹⁰

Altitude exposure may result in changes in vision, taste, mood, and personality. These effects are directly related to altitude and are common above 3,048 meters (10,000 feet). Some effects occur early and are temporary, while others may persist after acclimatization or even for a period of time after descent.

Hypoxia, the lowering level in the oxygen reaching the body's tissues, and cold can impair judgment and physical performance, resulting in a greater risk of injury while operating in rugged terrain. Because hypoxia-induced psychological effects can result in poor judgment and decision making, a higher incidence of cold injuries must be anticipated.

Heat Injury in the Cold

A hazard we virtually never think of is heat injury in the cold. All the standard heat injuries, such as heat cramps, heat exhaustion, and heat stroke, can occur in the mountains and at altitude. For Soldiers this may "occur during

movements, especially upslope with heavy loads or at high altitude with heavy loads. Personal protection equipment can restrict evaporation of sweat (body cooling) and also cause heat injuries. Commanders need to balance the load, personal protection equipment, and pace with the altitude and degree of slope.”¹¹ This is a double-edged sword in that the overheating that threatens warfighters causes sweat which in the cold can freeze into ice inside their clothing and then threaten lethal cooling. A balance needs to be obtained in effort and mode of dress that allows Soldiers to heat up while working without injury and avoid the soaking sweats which take away the insulative protection of their clothes.

Summary

As cold increases with the fall in temperature, “more is just not more of the same” but new combinations of potentially lethal challenges. We need to understand the differing level of challenges in the different categories. Much of the increasing challenge is in our body’s growing struggle to prevent or offset the increasing loss of body heat and moisture and the additional energy this demands as an offset. This includes choices of clothing, choosing the right work/rest schedule, supply of food and water, support requirements, and perhaps, special equipment.

Whenever we humans move over the general range of 4,900 feet in altitude, we must always consider that the environment is always reducing air pressure as we climb and diminishing our energy supply. As the temperature drops below 40° F (5° C), the cold begins to suck the energy out of our bodies and take with it the moisture we need to stay alive. These two separate forces begin to undermine our physical abilities to function and survive no matter how fit we may be to begin with.

Time is also a planning consideration. A rule of thumb is that it generally takes two to four weeks to acclimatize to a stable cold environment. It takes approximately two weeks to adapt to the changes associated with the hypobaric conditions at 2,268 meters (7,500 feet). For every 610 meters (2,000 feet) above that requires an additional week of acclimatization to altitude. It must be remembered that a single day’s ascension of over 8,000 feet predisposes Soldiers to potentially lethal Acute Mountain Sickness.

A warfighter’s body is not a machine but a biological organism that always attempts to adjust to its current environment. It has real limits and needs help in the form of disciplined behaviors to survive and succeed in cold environments. A thorough understanding of Appendix A, Altitude and Environmental Hazards, of ATP 3-90.97 is essential for all leaders and medical personnel prior to deployment. Recognizing the differences in the threats posed by the cold categories will help us understand and prepare ourselves and our Soldiers for those challenges.

Notes

¹ ATP 3-90.97, *Mountain Warfare and Cold Weather Operations*, April 2016, 1-3.

² Ibid.

³ Ibid, 1-8.

⁴ Ibid.

⁵ Ibid.

⁶ Lawrence E. Armstrong, PhD, *Performing in Extreme Environments* (Human Kinetics, 2000).

⁷ ATP 3-90.97, 1-9.

⁸ Ibid.

⁹ Ibid.

¹⁰ Armstrong, *Performing in Extreme Environments*.

¹¹ ATP 3-90.97, A-4.

Other References

TB Med 508, *Prevention and Management of Cold - Weather Injuries*, 2005

Training Circular (TC) 3-97.61, *Military Mountaineering*, 2012

TC 4-02.3, *Field Hygiene and Sanitation*, 2015

Field Manual (FM) 3-05.70, *Survival*, 2012

FM 4-25.11, *First Aid*, 2002

FM 31-70, *Basic Cold Weather Manual*, 1968

FM 31-71, *Northern Operations*, 1971

FM 90-6, *Mountain Operations*, 2000

GTA 5-8-12, *Individual Safety Card*, 2005 (this is a good pocket guide for Soldiers)

Technical Note No. 92-2, *Sustaining Health and Performance in the Cold: Environmental Medicine Guidance for Cold-Weather Operations*, USARIEM, 1992

LTC (Retired) Charles D. Henry's career has allowed him to earn both the Expert Infantryman Badge and the Expert Field Medical Badge. His service included operations in the Andes, the Alaska Range, the Huachucas, the Rockies, and the Sierras — all over 5,000 feet. He was inducted into the "Below 50 Club" at the Northern Warfare Training Center for training in the field at temperatures measured below -50 F. His service included winter operations in Korea, Alaska, Europe, and the eastern and northern United States. He also experienced operations in South and Central America and the southwestern and southeastern United States. LTC Henry earned a Master of Science in Physiology.