



Land Domain Combat Capability in the High North

Operational Environment, Requirements, and Unit Capability Analysis

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Summary

This report presents the unique conditions and resultant military requirements for conducting conventional large-scale operations in the Scandinavian High North. By using three derived heuristics, a set of distinct military units from five Western states was then assessed for their ability to operate effectively in that environment. The report is based on an open-source literature review that has collated material primarily regarding patterns of military exercises in the region in the last five years. The conclusions feature a list of Western military units that are assessed as capable of operating in the High North. These units are primarily Norwegian, Finnish, and American.

Keywords: Scandinavian High North, subarctic capability, cold-weather capability, empty battlefield, low-density battlefield

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Contents

1	Introduction	7
1.1	Purpose and research questions.....	8
1.2	Method	8
1.3	Concepts and assumptions	9
1.4	Delimitations	11
1.5	Reader's guide.....	12
2	The High North as an area of operations	13
2.1	Background and strategic significance.....	13
2.2	Climate and terrain	14
2.3	Infrastructure.....	17
2.4	Summary of the operational area from a military perspective ..	21
3	Capability requirements for operating in the High North.....	22
3.1	Cold-weather capability	22
3.1.1	Operations and tactics	22
3.1.2	Equipment.....	24
3.2	Ability to operate in wilderness conditions	26
3.2.1	Low-density battlefield and large areas	26
3.2.2	Wilderness as a channelling environment.....	29
3.3	Analysis of capability development for High North units	30
3.3.1	Training	30
3.3.2	Logistics	31
3.3.3	Particularly suitable capabilities.....	32
4	Units capable of operating in the High North	34
4.1	Finland	34
4.2	Norway.....	38
4.3	United States	40
4.3.1	US Army	40
4.3.2	US Marine Corps	45
4.4	Canada	47
4.5	United Kingdom	49

4.6 The Netherlands 52

5 Conclusions..... 54

5.1 Summary and results..... 54

5.2 Discussion and further research..... 55

6 References 59

7 Annex 1: Estimate of the Finnish wartime order of battle..... 75

7.1 Assumptions and calculations 75

8 References..... 78

1 Introduction

Sweden's accession to NATO has fundamentally altered the conditions shaping its defence policy. For the Swedish Armed Forces, this geopolitical shift entails major adaptations. From now on, the Armed Forces will need not only to defend Sweden on its own territory, but also contribute to the Alliance's collective defence beyond its borders.¹ Moreover, Finland's accession has likewise shifted the centre of gravity for Sweden's defence eastward. One area especially affected by these geopolitical changes is the Scandinavian High North (hereafter, the High North), whose remoteness and demanding climate pose significant challenges for units operating there.

Within the framework of the OASIS project,² the Swedish Defence Research Agency (FOI) has been tasked by the Swedish Defence Staff with analysing the consequences of NATO accession on the Swedish Armed Forces' capability needs. Earlier memoranda in the project have examined the implications of the Swedish Armed Forces' changing tasks in both the maritime and land domains.³ The project has also produced material for wargaming activities focused on the High North.⁴ These memoranda have highlighted the region's significance as a militarily strategic area in which Swedish forces may need to carry out tasks in a NATO-led operation.

The study presented here was conducted to deepen the project's understanding of the military problem in the High North, under the presumption that the Swedish Armed Forces will henceforth need to be able to participate in allied operations in the region. An important aspect of this problem, though relatively unexplored in open sources, is how many, and which, allied units, together with their Swedish counterparts, could constitute NATO's ground combat forces in the region in the event of war. For the Swedish Armed Forces, it is relevant to understand not only the tasks that the Army may need to perform, but also which allied units could support it during operations there.

¹ Henningsson, Jan, *FOI Memo 8203 Ändrade uppgifter för försvaret vid ett Nato-medlemskap? Ett diskussionsunderlag inför fortsatt förmågeutveckling*, Stockholm, FOI, 2023; Försvarsmakten, *FM2022–13205:10 Nästa armé—Koncept, krav och lösning, Iteration Q2*, 2023.

² OASIS: Operativ Analys och Strategisk Inriktning av Stridskrafter (*Operational Analysis and Strategic Planning*).

³ Henningsson, Jan and Welsh, John, *FOI Memo 8446 Natomedlemskapets konsekvenser för sjödomänen—Ett diskussionsunderlag inför fortsatt förmågeutveckling*, Stockholm, FOI, 2024; Henningsson, Jan, *FOI Memo 8520 Natomedlemskapets konsekvenser för markdomänen—Ett diskussionsunderlag inför fortsatt förmågeutveckling*, Stockholm, FOI, 2024.

⁴ Henningsson, Jan, Ardenfors, Oscar, Brodin, Filip and Gräns, Carl Michael, *FOI D-rapport 1207 Underlag för spel Nordkalotten vid ett Nato-medlemskap*, Stockholm, FOI, 2023.

1.1 Purpose and research questions

This study was originally produced to support further analysis within the OASIS project's work in the land domain by updating the assessments that underpin earlier work, and by extension to support the project's continuing analysis and wargaming. The report was also created as an open resource for external readers, both in other Swedish governmental agencies and elsewhere, to generate knowledge and stimulate discussion about the military context in the High North.

Accordingly, the study analyses the requirements that the High North imposes on military operations, and, on that basis, lists the non-Swedish Western units assessed, as of July 2024, as capable of operating in the region. The research questions formulated to match these aims were:

- What requirements does the High North, as an area of operations, impose on military activity?
- What capabilities are necessary to meet them?
- Which Western ground combat units can reasonably be considered to possess these capabilities?

1.2 Method

The report is based on a literature review conducted in spring 2024, concluded in July that year. Initially, we collected material relevant to Western military capabilities in the area from open sources: government publications, doctrinal documents, and academic secondary literature (e.g., FOI publications).⁵ From this, we compiled (i) a description of the requirements on military units operating in the High North and (ii) criteria to assess, from available material, whether a given unit meets those requirements and can therefore operate in the area. The criteria were that:

- the unit is stationed in peacetime in the High North or a comparable area; or
- the unit has repeatedly taken part in exercises in the area; and
- no specific information indicates the unit lacks the capability to operate there.

Finally, we applied these criteria to a set of Western armed forces in order to analyse their ability to operate in the region with specific units. A unit's fulfilment of the criteria was considered on the basis of its documented activities over the last five years. The material used for this assessment was drawn primarily from the units' publicity materials, news reporting, and social media.

⁵ An important source for this work was the FOI report, FOI-R--5527--SE, *Western Military Capability in Northern Europe 2023—Part 1: National Capabilities*; it is frequently cited in what follows.

As a note to external, possibly international readers, this report was originally written on a grant from the Swedish Defence Staff, which has had an impact on how some assessments were conducted. The report is firmly based on a Swedish perspective, occasionally using historical Swedish experience as sufficient evidence of a unit's fulfilment of the criteria above.

Most notably, more thorough assessments of the performance of a particular unit's major vehicle systems in severe winter conditions were omitted as superfluous when the Swedish Armed Forces themselves have operated such vehicle systems. These omissions are essentially equivalent to a presumption that any vehicle that the Swedish Armed Forces have operated in the area under consideration have been found reliably sufficient for such operations – and therefore that that vehicle would not in and of itself be cause for that unit failing to meet the third criterion above.

1.3 Concepts and assumptions

Unless otherwise stated, “unit” refers to a wartime unit in a country's war organisation, its order of battle (ORBAT). In some armed forces, for example Sweden's, there is a large difference between wartime units and the units that constitute a country's peacetime establishment. A country's ORBAT is sometimes classified; in that case, we estimate the number of its constituent units and their types from open sources and note this in the text.

Entire units rarely deploy to exercises, especially in demanding environments like the High North. More often, only smaller sub-elements of a given unit take part. Accordingly, we assess how regularly a unit participates and the scope of that participation, assuming the experience gained by participating sub-units is retained by the unit as a whole. The resulting list of units capable of operating in the High North is therefore an estimate based on these assumptions and on open sources.



Map 1: The extent of the Scandinavian High North as defined in this study, with Norway's Troms and Finnmark counties, Sweden's Norrbotten County, Finland's Lapland (Lappi), and Russia's Murmansk Oblast highlighted. Nordland County is hatched to indicate that it is often included in definitions of the High North.

Source: Per Wikström.

The Scandinavian High North has no clearly fixed boundaries, and definitions of its geographic extent vary. Some definitions are based on the region's historic Sámi culture; others use the Arctic Circle, which crosses Russia and the Nordic countries. The definition used in this study follows administrative divisions and includes Norrbotten County (Sweden), Finnmark and Troms counties (Norway), Lapland (Finland), and Murmansk Oblast (Russia).

Definitions based on administrative divisions often also include Nordland County in Norway. It is not included here because, from a military perspective, it differs from the rest of the area; for example, population density is higher and infrastructure more developed in Nordland than in Troms and Finnmark. To address a coherent military problem set, the county is therefore generally

excluded. In a few instances, circumstances relating to Nordland are noted where they may affect the military problem in adjacent counties.

1.4 Delimitations

This report focuses on a small number of countries: Finland, Norway, the United States, Canada, the United Kingdom, and the Netherlands. These either border Russia in the Scandinavian High North or have other territories with similar arctic/subarctic conditions, or, alternatively, they have ground forces with potentially relevant capabilities and have signalled an intention to deploy them to the region in the event of war. Germany and France are assessed as focusing primarily on other theatres and have not clearly expressed interest in substantial reinforcement operations in this region; they are therefore not considered here. The same applies to Poland and the Baltic states, which are omitted because their exposed position means that, under any reasonable conditions, they are unlikely to detach forces to fronts other than their own. More distant Member States without large territories with a subarctic climate are assumed to be less likely to possess relevant capabilities and have therefore not been included in the study underpinning this report.

The report lists regular, operationally mobile ground units intended to perform combat tasks in direct contact with the adversary, such as mechanised or motorised units. However, the criteria applied for which units were included in that list, or how such units were listed, are not entirely straightforward. Units providing indirect effects, such as conventional tube artillery and particularly ground-based long-range fires, are discussed, but units of these types are not listed individually; they are instead treated as abstracted capabilities belonging to the land forces. Ground units whose main combat tasks lie in other domains, such as air defence and cyber units, were not considered. Air and naval forces have been omitted from the analysis, but because helicopter support is often organised within an army and can constitute a significant part of a ground unit's overall capability, discussion of such support has been included. As with artillery support, it is treated here as a generalised capability belonging to the land forces; individual helicopter units are not listed. Fighter aviation and air-launched long-range strike assets are not included. Naval infantry units have been considered, even though such forces generally do not belong to a country's army. Western special operations forces—for example Green Berets, US and UK Rangers, and others—often have strong ability to operate in the area and train regularly in Arctic and subarctic environments.⁶ However, they are deemed to be unsuitable

⁶ Ida Folkesson, “Norrlandsjägare och UK Rangers sida vid sida” [Norrland's Rangers and UK Rangers side by side], Swedish Armed Forces, 7 October 2022.

for direct combat and difficult to assess using open sources, and were therefore excluded from the study.

This report addresses only the ability to operate in the region. It does not, therefore, take a position on how likely it is that a given unit would be deployed to the area and conduct operations there in the event of conflict. In some cases there is reason to assume a significant discrepancy between these two questions. A country such as Finland, for example, may possess large forces with the required capability but, for strategic reasons, may need to prioritise operations elsewhere. Moreover, a list of units with the requisite capability should not be mistaken for an estimate of the total contemporary force presence in the area. Available logistics resources may limit the size of any deployment.

1.5 Reader's guide

The report is divided into five main sections. Following this introduction, Section 2 describes the High North as an operational area. The region's significance within the broader West–Russia relationship is briefly addressed, and its geography and infrastructure are described. Section 3 analyses the capability requirements for military forces that arise from these conditions. These requirements are grouped into the thematic categories of *cold-weather capability* and the *ability to operate in wilderness conditions*. Section 4 provides an analysis and list of Western units assessed as having these capabilities. Finally, Section 5 summarises the report and discusses certain implications.

2 The High North as an area of operations

2.1 Background and strategic significance

The High North straddles NATO's northern border with Russia and has long figured in military-strategic discussions and planning. During the Cold War, it was widely assumed in the West that the High North would be a main theatre in any armed conflict between NATO and the Warsaw Pact. It was further assumed that a forward Soviet defence of the naval bases in the Murmansk area on the Kola Peninsula, home to most of the USSR's strategic submarines and hence its nuclear second-strike capability, would require offensive operations deep into Finnish and Norwegian territory.⁷ Plans to reinforce this "northern flank" accordingly featured for many years in, among other things, US planning for the defence of the Alliance.⁸

Some elements of this strategic context have outlived the Soviet Union, while others have emerged since. Large parts of Russia's nuclear-armed submarine fleet remain based on the Kola Peninsula. In wartime, neither side can ignore these bases, whether or not they are now the hub of operations.⁹ The region's growing economic importance may also provoke disputes with Russia. Global warming has partly opened the Northern Sea Route to commercial traffic, which may in time divert substantial volumes of shipping now transiting Suez to routes north of Russia. Significant mineral and oil deposits are thought to be extractable in Arctic waters off the High North.¹⁰ If Russia feels threatened, or believes its interests or rights have been set aside, it may choose to respond to perceived infringements in the area with military means.

⁷ Mikkola, Harri, *The Geostrategic Arctic: Hard Security in the High North*, Helsinki, Finnish Institute of International Affairs, 2019.

⁸ Vanhanen, Henri, *Northern Europe in NATO: From the Fringes to the Forefront of Euro-Atlantic Security*, in Linnainmäki, Joel and Pesu, Matti (ed.), *NATO's New Northern Direction—The Evolving Role of the Alliance in Europe's North*, Helsinki, Finnish Institute of International Affairs, 2024; Wegge, Njord, "The Strategic Role of Land Power on NATO's Northern Flank," *Arctic Review on Law and Politics*, vol. 5, 2022: 94–113.

⁹ There is an academic debate about whether a Russian forward defence of its nuclear second-strike capability would realistically require (or has ever required) the occupation of Western territory; see, e.g., Ina Holst-Pedersen Kvam, "Bastionforsvaret og Russlands militærmakt—Et udatert trusselbilde?", NUPI Policy Brief, vol. 2, 2021. The question warrants further study, but this report proceeds on the assumption that a threat to the Nordic parts of the High North cannot be ruled out, whether or not forward defence of the submarine force is regarded as a Russian priority.

¹⁰ Gustafsson, Pär, FOI Memo 7624 *Russia's Ambitions in the Arctic Towards 2035*, Stockholm, FOI, 2021.

Russia has long invested heavily in military forces and installations in the Arctic and the High North. This growth has recently slowed in the land domain as units have been drawn into the war in Ukraine. Activity in the other domains has continued much as before the war, however, so there is reason to assume that the build-up on land will resume when the situation in Ukraine allows.

As in the Cold War, NATO and its members must deter and, if necessary, repel such attacks to protect their territory and military infrastructure. This latter task has grown in importance since the war in Ukraine and the Russian massacres in Bucha and elsewhere. Earlier planning that tacitly assumed ceding allied territory initially and recovering it only much later has become even more politically untenable as evidence of Russian abuses against civilians in occupied areas has emerged.¹¹

2.2 Climate and terrain

The High North has a subarctic climate marked by year-round humidity, long, very severe winters, and large seasonal temperature differences.¹² Summer is short, roughly three months, and cool. In winter, temperatures rarely rise above freezing even briefly, producing snow cover often exceeding 60 cm.¹³ In addition to latitude, temperatures depend on topography and distance from warmer bodies of water, which means the average temperature varies across the region. Table 1 summarises mean temperatures for October–April in selected towns in the High North.

¹¹ Kepe, Marta, *From Forward Presence to Forward Defense: NATO's Defense of the Baltics*, RAND, 14 February 2024, accessed 14 October 2024; Wall, Colin and Wegge, Njord, *The Russian Arctic Threat: Consequences of the Ukraine War*, Washington, D.C., Center for Strategic & International Studies, 2023.

¹² Peel, M.C., Finlayson, B.L., and McMahon, T.A., "Updated world map of the Köppen-Geiger climate classification," *Hydrology and Earth System Sciences*, vol. 11, no. 5, 2007:1633–1644, McClatchey, John, "Global climate and weather," in *An Introduction to Physical Geography and the Environment*, Holden, Joseph (ed.), 195–228, Harlow: Pearson Education Limited, 2017; the classification is based on the Köppen-Geiger system, which assigns standardised designations to geographic areas by overall climate group, precipitation, and temperature.

¹³ Försvarsmakten, FM2019-3480:4 Bilaga 1 till Systemutvecklingsplan för Försvarsmaktens Vinterförmåga 2019–25, Stockholm, Försvarsmakten, 2019.

Table 1. Mean temperatures in degrees Celsius for selected towns and months in the High North.

Month	Tromsø	Boden	Rovaniemi	Murmansk	Average/month
October	0.4	2.6	0.9	1.0	1.2
November	-5.2	-2.7	-4.3	-4.6	-4.2
December	-8.7	-6.8	-7.9	-8.0	-7.9
January	-11.0	-9.5	-10.7	-11.6	-10.7
February	-10.1	-8.9	-10.6	-10.9	-10.1
March	-6.8	-4.6	-5.8	-6.4	-5.9
April	-1.4	1.1	0.2	-0.8	-0.2
Average/town	-6.1	-4.1	-5.5	-5.9	

Source: climate-data.org. Tromsø, Boden, Rovaniemi, Murmansk Climate (2024).

For shorter periods, temperatures in the High North can fall far below the mean. The Swedish Armed Forces assumes that temperatures in parts of the area can at times¹⁴ reach -35°C and, in isolated cases, as low as -46°C .¹⁵ It is noteworthy that English-language doctrine often describes operations in such severe cold as focused solely on surviving rather than achieving any operational goals in regards to the adversary.¹⁶

Because of the High North's high latitude, the number of daylight hours per day varies greatly over the year. Parts of the area experience very long days and the midnight sun in summer and around-the-clock darkness in winter. Variations in day length over the year are summarised in Figure 1.

¹⁴ In 1998, approximately 20% of the days were colder than -15 degrees C in Norrland; in the same year, approximately 2% of the days were colder than -30 degrees; see Andersson, Henrik, FOA-R--99-01064-201 Modellering av markstrid under vinterförhållanden, Stockholm, FOA, 1998; however, climate change has probably meant that this proportion has declined since then.

¹⁵ Försvarsmakten, FM2019-3480:4 Bilaga 1.

¹⁶ NATO, NATO Standard AJP-3.2: Allied Joint Doctrine for Land Operations, 2022; Department of the Army, ATP 3-90.97 Mountain Warfare and Cold Weather Operations, 2016.

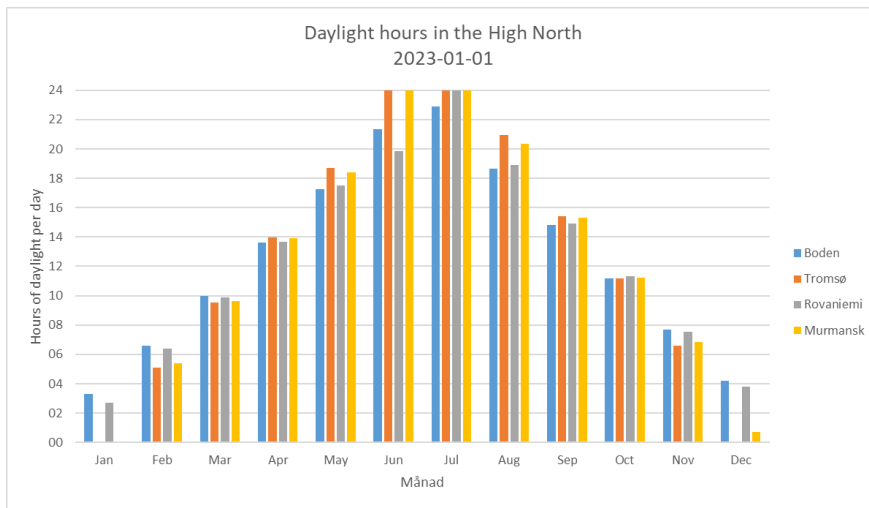


Figure 1: Daylight hours in the High North.

Source: Global Monitoring Laboratory, NOAA Solar Calculator (2024).

The High North is dominated by several natural environments that are either difficult to traverse or otherwise challenging for military forces. Large parts of the area are forested. In Sweden's Norrbotten County and Finland's Lapland (Lappi), there are extensive stands of both conifer and birch. The proportion of conifer decreases at higher latitudes, and along the region's northern coasts, in Troms and Finnmark, birch predominates.¹⁷ The Norwegian and Swedish Mountains (or Scandes) run along the northern and western coasts of the High North. Elevation varies greatly. The height and latitude of the mountains mean that very large areas lie above the treeline and therefore lack substantial vegetation that could obstruct lines of sight. Several large rivers and streams flow from these mountains, especially across Norrbotten County.¹⁸ Rivers freeze in winter and run high during the spring thaw. Owing to high precipitation, low mean temperatures, and runoff from the mountains, Upper Norrland and Finnish Lapland are also characterised by extensive bogs and other wetlands, which exhibit poor ground bearing capacity.¹⁹ Along the northern coast and in parts of

¹⁷ Crowther, T, et al., "Mapping tree density at a global scale," *Nature*, vol., 525, 2015: 201–205; European Environment Agency, Land cover and change accounts 2000–2018 [Dataset], European Environment Agency, 22 August 2023.

¹⁸ Försvarsmakten, FM2021-7366:18: I19 MARK 2021S Markstridskoncept Övre Norrland, Stockholm, Försvarsmakten, 2022.

¹⁹ Olefeldt, David et al., "The Boreal-Arctic Wetland and Lake Dataset (BAWLD)," *Earth System Science Data*, vol. 13, no., 11, 2021: 5127–5149; Cizkova, Hana et al., "Actual state of European wetlands and their possible future in the context of global climate change," *Aquatic Sciences*, vol. 75, 2011: 3–26.

the Kola Peninsula, low-lying plains with tundra and permafrost are common.²⁰ The region’s principal natural environments are summarised in Table 2.

Table 2. Selected natural environments (non-exhaustive) and their coverage in the European High North.

Natural environment	Finnmark/ Tromsø	Norrbotten	Lappi
Forest (coniferous)	1.7%	36.1%	42.7%
Forest (other/transition)	23.7%	20.0%	27.2%
Mountain terrain/block fields	47.6%	8.3%	1.7%
Wetlands/heathland	21.8%	26.3%	21.8%
Watercourses	2.8%	6.6%	5.4%

Note: Reliable data on the natural environments in Murmansk Oblast are lacking. “Finnmark/Troms” shows a calculated average.

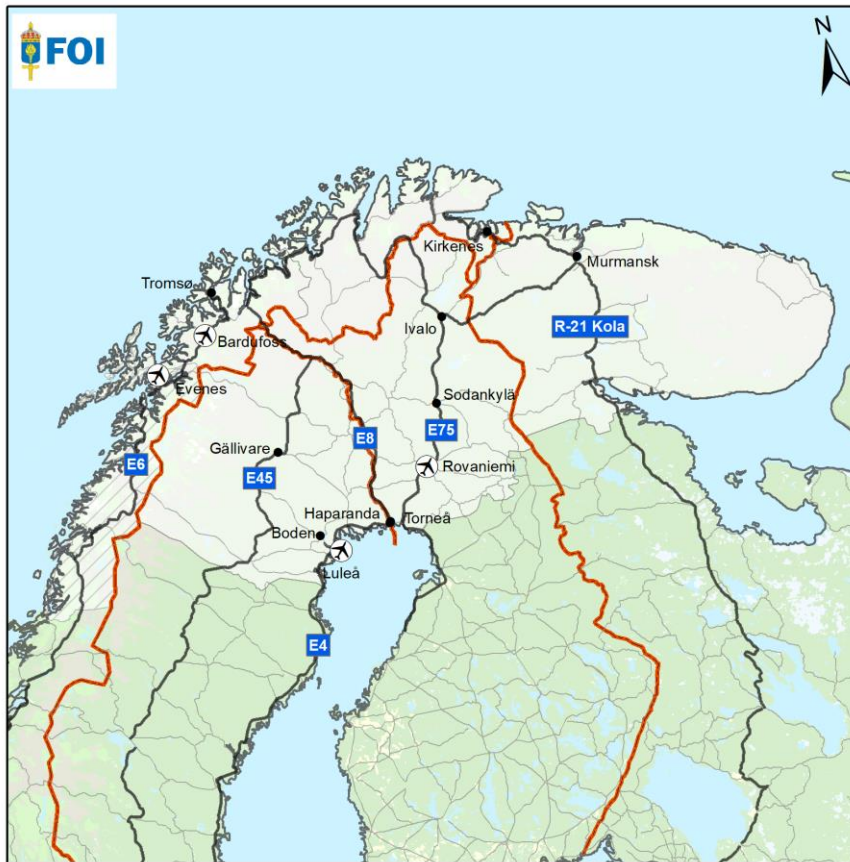
Source: European Environment Agency. Land cover and change accounts 2000–2008 (2019).

2.3 Infrastructure

The High North covers just over 400,000 km² and has a total population of about 1.3 million.²¹ The average population density is therefore roughly 3.2 inhabitants per km². The figure is somewhat misleading, however, because a significant share of the population is concentrated in a few towns, above all Murmansk. If the largest town in each country in the area is excluded, the population falls by about 35% and the density drops below 2 inhabitants per km².

²⁰ Department of the Army, ATP 3-90.97.

²¹ Statistics Finland, Population data by region, Population and Society, 26 April 2024; Statistiska Centralbyrån, Folkmängden efter region, civilstånd, ålder och kön, år 1968–2023 [Dataset], Statistikdatabasen; Statistisk sentralbyrå, Population [Dataset], Statistikkbanken; Rosstat, Chisleynnost i razmeshchenye nacelenya [Population size and distribution; dataset], volumes of the official publication of the results of the All-Russian Population Census of 2010; Lantmäteriverket, Arealer Kommunvis [Dataset], Statistik, 1 January 2023; Länsstyrelsen Norrbotten, Om länet; Regjeringen, Fylkesinndelingen fra 2024, 1 January 2024; Zonn, Igor, Kostianoy, Andrey and Semenov, Aleksandr (ed.), “Murmansk Oblast,” in The Western Arctic Seas Encyclopedia, 2017.



Map 2: Selected larger settlements, roads, and air bases in the area.

Source: Per Wikström.

This low population density is reflected in the region's level of infrastructure. With the exception of Murmansk, the region lacks major urban areas and settlements are widely dispersed. The region's 14 hospitals are scattered along the northern and southern coasts.²² Only three, Kiruna, Gällivare, and Rovaniemi, are located inland. In the Nordic countries, only Kirkenes Hospital provides emergency care within 100 km of the Russian border. The power-transmission grid is also unevenly distributed. In the interior and along the Baltic Sea coast, around Gällivare, Tornio, and Rovaniemi, the grid is dense, with several redundant, parallel high-voltage lines. Only two major high-voltage lines

²² Does not include other healthcare facilities such as primary care centres and clinics. The number of beds per hospital is unknown, but almost certainly varies widely.

stretch north of these towns: one runs along the Norwegian coast to Skaidi, and another runs north from Sodankylä to Varangerbotn.

The region’s land-transport infrastructure is very limited compared with other parts of the countries concerned. The following table shows the approximate density of motorways, railways, and other roads in the High North areas of the three Nordic countries.

Table 3. Transport infrastructure in the European High North.

Measure	Upper Norrland	Sweden	Northern Norway	Norway	Northern & Eastern Finland*	Finland
Km of motorway per 1000 km2	0	5	0	2	1	3
Km of railway per 1000 km2	13	27	4	12	14	19
Km of other road per 1000 km2	164	1206	164	842	171	344

***Note:** The regional breakdown underlying these tables does not perfectly match the geographic boundaries used for the High North elsewhere in this report. In particular, the Finnish figures are based on an area considerably larger than Finnish Lapland. This may help explain the smaller discrepancy between Finland’s High North area and Finland as a whole, compared with the corresponding relationships in the other Nordic countries.

Source: Eurostat. Road, rail and navigable inland waterways networks by NUTS 2 regions [Dataset].

Russian statistics are hard to compare with Western equivalents because they do not distinguish between motorways and other roads, but only between railways and public hard-surfaced roads. Even so, official Russian figures indicate that railway density in Murmansk Oblast is 6 km per 1000 km², while the density of what are termed public hard-surfaced roads is 24 km per 1000 km². The length of the R-21 “Kola” (the only motorway that crosses Murmansk Oblast) is reported as 561 km. Murmansk Oblast covers roughly 145,000 km², which implies a motorway density of about 4 km per 1000 km².²³

There are therefore few major roads that allow access to, and movement within, the region. In Northern Norway, the only major road is the E6, which runs north–south through Finnmark. In Finnmark, it turns north-west and links Tromsø with Kirkenes on the Russian border. In Sweden, the E45 and E4 are the principal approaches from the south of the country. They run broadly in parallel: the E45 from Malung to Gällivare in the interior, and the E4 from Gävle to Haparanda along the coast. Within the region these roads connect with major east–west

²³ Rosstat, Statistical Publications, Regioni Rossii, Sotsialno-ekonomicheskije pokazateli [Regions of Russia, Socio-economic indicators; dataset], 21 March 2024; Serova, Natalia, “Peculiarities of Financing Road Activities in the Arctic Region: The Experience of the Murmansk Oblast,” Arctic and North, vol. 45, 2021:36–47.

European routes at only two points. In the High North, the E4 and E45 branch into two main roads eastwards to the Finnish border and one main road northwards to Norway via Abisko. The two more important Finnish roads in the High North also run mainly north–south: the E8 follows the Swedish border northwards, while the E75 runs north-east from Kemi and Rovaniemi to Sodankylä and then straight north to the Norwegian border. Only a few minor roads link these routes and connect them to the Russian border. The R-21 “Kola” also runs north–south, linking Murmansk and St Petersburg. In the east–west direction there is only one major road from Murmansk to Kirkenes in Norway, in addition to a few minor roads towards the Finnish border. On the Kola Peninsula there is virtually no road network to speak of. The main transport routes in the High North described here are predominantly two-lane. Sweden’s E4 and Russia’s R-21 have some 2+1 sections (three lanes).

Sea transport capacity is relatively good for such a sparsely populated region. The annual tonnage handled by a port gives a rough indication of its relative importance. The busiest port in Norway’s Troms and Finnmark is Hammerfest, handling about 5 million tonnes of cargo per year, roughly ten times more than Tromsø, the next busiest port in the area. If Narvik (in Nordland County but close to the Troms border) is included, the tonnage rises to almost 27 million tonnes per year. The Swedish ports of Piteå and Luleå handle about 9 million tonnes per year combined. The corresponding figure for the Finnish ports of Tornio and Kemi is 4.5 million tonnes. Safe winter access to Swedish and Finnish ports requires icebreaker support. In Norway, by contrast, ice formation is mainly a problem in the country’s southern ports.²⁴

The High North also has a relatively large number of airports with both commercial and military traffic. Table 4 below lists a number of airports in the region. Airports with a permanent military presence, or that have been used for military purposes in peacetime, are shown separately. Both Sweden and Finland employ a road-base and dispersal concept, which means that civilian airports can also be used for military purposes.

²⁴ Trafikanalys, Gör ditt eget statistikurval—Sjötrafik, Trafikanalys; Statistisk sentralbyrå, “Maritime transport,” Statistikkbanken; Kystverket, “Istjenesten i Norge,” Kystverket, 16 April 2024; Kemin Satama, Vuosikertomus 2023 [Annual Report 2023]; Rauanheimo, Röyttä port in Tornio, Rauanheimo.

Table 4. Airports in the High North.

Country	Norway	Sweden	Finland
Total number of airports	14	6	7
Military airports (permanent presence)	3 (Bardufoss, Evenes, Andøya)	3 (Luleå, Vidsel, Jokkmokk)	1 (Rovaniemi)
Airports with possible or sporadic military activity	—	2 (Pajala, Arvidsjaur)	4 (Enontekiö, Ivalo, Kemi-Tornio, Kittilä)

Source: Lundberg, T., All airports in the Nordic region. Nordregio website (2023).

2.4 Summary of the operational area from a military perspective

Units operating in the High North must overcome several geographic challenges. For many months each year, troops and equipment have to cope with very low temperatures and deep snow, which demands significant adaptations in routines, tactics, and techniques. Without technical or doctrinal solutions for night operations, activity across large parts of the area in winter would be limited to only a few hours per day. The large temperature contrast between summer and winter also creates distinct problems: troops must handle markedly different climates over time and the physically taxing thaw period with wet, slushy conditions. The terrain further complicates operations. Extensive forest interspersed with bogs and other wetlands, rugged mountain areas, large lakes, and broad rivers produces a wide set of tactical and technical problems. While the prospects for achieving sustainment, protection, and mobility can differ markedly between these different terrain types, between different types of units, and from season to season, local terrain nevertheless generally tends to impede military activity. The limited road infrastructure in the High North means that both access to, and movement within, the area are highly constrained. Few roads are large enough for major troop movements, and those that exist are generally oriented north–south, making it easier to reach the area than to move laterally once there. In addition, large expanses lack built roads entirely, limiting rapid dispersal. Civilian settlement is limited and unevenly spread, leaving little scope to rely on local resources for sustainment.

3 Capability requirements for operating in the High North

The area of operations places particular strains on units, which means that forces operating there must meet a set of distinct capability requirements to carry out their tasks. This section describes those capabilities. The requirements are summarised and divided into two broad themes: cold-weather capability and the ability to operate in wilderness conditions. If a unit is to field these capabilities in operations, it must first receive training and logistical support tailored to the environment. The section concludes with a synthesis of these capability-development aspects and, in the analysis, highlights capabilities and unit profiles that are especially well suited to the environment.

3.1 Cold-weather capability

Cold-weather capability is the most significant difference between a unit that can operate year-round in the High North and one that cannot. The Swedish Armed Forces define the capability as follows:

“Winter capability is possessed by the individual, system or wartime unit that can still perform its primary task anywhere in Sweden despite cold, snow or ice.”²⁵

Every basic military function, mobility, fires, protection, and others, is affected by winter. A lack of cold-weather capability not only undermines mission execution; it is, in a literal sense, a matter of survival. Incorrect behaviour in winter conditions can—and has—led to failed operations, serious injury, and loss of life.

In this report, the requirements related to cold-weather capability are grouped into two categories: operations and tactics, and equipment.

3.1.1 Operations and tactics

To operate in winter conditions, units must adapt how they execute their tasks.

Movement, both at the levels of combat technique and tactics, can be severely hampered by winter. Snow affects the mobility of all systems, especially wheeled vehicles and dismounted troops without skiing equipment. At snow depths over 30 cm, wheeled vehicles require snow chains to move off-road, and sustained traffic by such systems presupposes prior ploughing. Extensive

²⁵ Försvarsmakten, FM2019-3480:4 Bilaga 1; going forward, the definition, established before Sweden’s accession to NATO, should also encompass the execution of tasks on allied territory.

ploughing is also necessary for capabilities that require open staging areas, such as command posts and artillery. Even well-executed snow clearance creates problems, since snowbanks can prevent wheeled vehicles from pulling off the road quickly during, for example, an air attack. Driving time, even when all necessary preparations have been made, increases by roughly 20–70% compared with travel on snow-free roads. Advance by dismounted infantry is likewise degraded by snow. Snow deeper than 50 cm prevents extended foot movement by infantry without skis. Ice may also need to be broken, since existing ice cover on rivers can be too thin for heavy equipment and, in some cases, bridging requires open water. Snow also complicates mine-clearing operations, making movements even more time-consuming.²⁶ It may be necessary to assign personnel to start vehicles regularly in freezing temperatures to prevent engines from becoming too cold, which in turn has a significant impact on fuel consumption and the unit's logistics requirements. In general, commanders should expect that all tasks (not only those related to movement and mobility) that troops must perform outdoors in winter conditions will take much longer than they otherwise would. The combination of numb hands during manual work, bulky clothing, and greater caution means that activities which in warmer climates could be done in minutes may take hours in severe cold.²⁷

Snow clearance and movement through snow leave clear tracks that readily reveal movements to an observing adversary. Efforts to conceal a unit's exact location, such as laying decoy tracks and clearing snow from roads that are not intended for use, are very time-consuming. Higher thermal contrast between vehicles or troops and the surroundings, the formation of fog and snow plumes as units move and equipment generates heat,²⁸ and the prevalence of sparse and bare trees all make concealment more difficult for the defender.²⁹

Units operating in winter likewise need to adapt tactics and combat techniques for eventual engagements. Indirect fire is strongly affected by snow conditions: thick snow cover absorbs fragments from surface-burst shells, by some estimates 40–80% with as little as 10 cm of snow.³⁰ The use of proximity-fused projectiles³¹ is therefore necessary, but even the effect of such ammunition is assessed to be up to 30% lower in snow-laden forests. Snow cover can also make adjustment of such fire ineffective. At the same time, snow and cold can in some

²⁶ Mines still appear to be effective against troops and equipment in snow, provided the snow cover does not become too deep or freeze solid. How thick that cover can be remains uncertain.

²⁷ Andersson, *Modellering av markstrid*; Försvarsmakten, FM2019-3480:4 Bilaga 1; Department of the Army, ATP 3-90.97.

²⁸ This also occurs when small arms are fired, which heats the barrel. The small plumes of vapour produced when firing can reveal the shooter's position.

²⁹ Andersson, *Modellering av markstrid*; Försvarsmakten, FM2019-3480:4 Bilaga 1.

³⁰ Andersson, *Modellering av markstrid*; Department of the Army, ATP 3-90.97.

³¹ Proximity-fused shells detonate at a preset height above the ground, which markedly alters the dispersion pattern of the resulting fragments.

respects improve survivability. Frozen ground means that conventional fieldworks must be dug with bulldozers, but fresh snow in sufficient depth offers some protection against small-arms fire, and dismounted troops can establish simple snow works relatively quickly.³² If a foxhole consists only of shovelled snow, a thickness of 4 m is required to stop small-arms fire. This falls to about 2.5 m if the walls are reinforced by hard packing and freezing. In addition, armoured vehicles can be protected from shaped-charge projectiles by a snow berm only 75 cm thick.³³

It is important to note, however, that winter conditions do not consistently hinder all activities. Units with winter capability can exploit a difficult environment to achieve results otherwise impossible. Under certain conditions, manoeuvre is actually easier in winter. Rivers and streams whose ice has reached sufficient thickness provide excellent axes of advance. Bogs and other wetlands whose bearing capacity is very low in summer can, under some winter conditions, freeze and become frost hardened. Tracked vehicles and ski-trained troops can therefore achieve greater freedom of movement on these snow-covered, frozen areas than would otherwise be the case.³⁴ Evergreen coniferous forest covered with thick layers of snow can also provide excellent visual concealment for a camouflaged unit, with the exception of thermal signatures.³⁵ Provided a unit has the training and the equipment, it can also exploit the long winter nights to gain an advantage in night fighting.

3.1.2 Equipment

Military operations in winter environments place heavy demands on many aspects of a unit's materiel and materiel handling. Chief among these is the use of consumables, which rises sharply in winter operations. Cold weather means individual soldiers burn more calories per unit of time, both through shivering and through the extra effort required to move in snow while wearing bulky outer clothing. The difference in caloric intake between soldiers in cold versus warm climates can approach 30%.³⁶ Troops require heated tents, which increases thermal signatures and creates a requirement for the supply of firewood or other fuels.³⁷ Because snow worsens road conditions and makes driving rougher, fuel consumption also rises, typically by 25% to more than 100% compared with

³² NATO, NATO Standard AJP-3.2.

³³ Andersson, *Modellering av markstrid*; Försvarsmakten, *Handbok Markstrid—Vintersoldat*, Stockholm, Försvarsmakten, 2024.

³⁴ Försvarsmakten, FM2019-3480:4 Bilaga 1.

³⁵ Tuunainen, Pasi, "New approaches to the study of Arctic warfare," *Nordia Geographical Publications*, vol. 43, no. 1, 2014: 87–99.

³⁶ Tharion, William et al., "Energy requirements of military personnel," *Appetite*, vol. 44, no. 1, 2005: 47–65.

³⁷ Försvarsmakten, FM2019-3480:4 Bilaga 1; Department of the Army, ATP 3-90.97.

operation in higher temperatures. Batteries are likewise depleted more quickly in severe cold. The logistics of a unit with cold-weather capability must therefore be scaled to meet all of these increased needs.³⁸

Beyond consumables, units need equipment specifically designed for winter conditions. A unit operating in severe cold without winter-adapted clothing will almost immediately be rendered unfit for combat. In addition, dismounted troops require extra equipment for virtually all longer movements. Besides skis and poles, this includes snowshoes and pulks (sleds). Small arms, engines, and other critical machine components also need regular lubrication with cleaning oils and other lubricants to function and to avoid damage. Many common lubricants clump or solidify in extreme cold, so units must be supplied with oils that remains liquid even at very low temperatures.³⁹

In many cases, specialised winter camouflage is also required. Without white winter uniforms, dismounted troops have poor prospects of advancing undetected over snow-covered ground. Small arms should likewise be camouflaged with white tape. Vehicles of various kinds should be protected from enemy reconnaissance by repainting with appropriate paints and by using camouflage nets.⁴⁰

Cold-weather capability requires a steady supply of large quantities of relatively light, simple items and consumables, but it should also be noted that any units' larger, decisive materiel systems, such as artillery, trucks, armoured fighting vehicles, and tanks, are equally affected by the cold and require support. In addition to the fact that cold and snow can be expected to increase wear on all vehicles (raising logistical demands for spares and replacements), vehicles that were not designed for subarctic use risk becoming almost unusable very quickly. Mobility in deep snow, even for tracked vehicles, which normally have far better cross-country performance than wheeled equivalents, requires either low ground pressure to ride over the snow or very high engine power to push it aside. A fighting vehicle that is too heavy, has tracks that are too narrow, or an engine that is too weak will bog down and may have to be abandoned if recovery is not possible in time. Rubber and metals also become stiffer and more brittle at very low temperatures. This means that in every vehicle, internal components, especially hoses, pistons, and other parts that contact fluids or face heavy wear, are at risk of failure in cold climates. The risk is particularly acute if regular maintenance is not carried out on the vehicle fleet, or if vehicles are not kept warm between uses. Weapons systems are likewise affected by severe cold. Propellant burns more slowly at low temperatures, reducing projectile muzzle

³⁸ Department of the Army, ATP 3-90.97; Försvarmakten, FM2021-7366:18.

³⁹ NATO, NATO Standard AJP-3.2; Försvarmakten, Handbok Markstrid—Vintersoldat; Department of the Army, ATP 3-90.97.

⁴⁰ Försvarmakten, Handbok Markstrid—Vintersoldat.

velocity. Cold air also has higher density than warm air, so projectiles experience greater drag than they would in warmer conditions. It follows that the accuracy of barrelled systems, principally indirect-fire weapons, will be markedly degraded in cold climates unless they are fitted with compensating firing tables or range settings.⁴¹

3.2 Ability to operate in wilderness conditions

Beyond severe winter conditions, the High North is characterised by sparse infrastructure and low population density. Swedish guidance describes this environment (also called Norrland terrain) as marked by:

- a limited road network;
- limited access to civilian infrastructure;
- great distances;
- dominant high ground;
- numerous obstructive watercourses (rivers); and
- extensive delaying or obstructive bog systems.⁴²

A unit operating in this area therefore needs what is here termed *wilderness capability* if it is to accomplish its tasks satisfactorily.⁴³ Unlike winter conditions, there is no specific doctrine for wilderness operations in the Swedish Armed Forces, NATO, or the US Army. Accordingly, wilderness capability is used here in a way that mirrors the definition of cold-weather capability above: the ability of the individual, system, or wartime unit to perform its primary task anywhere in Sweden (and adjacent operational areas) despite the effects of wilderness terrain.

3.2.1 Low-density battlefield and large areas

A particularly distinctive feature of the High North wilderness is its scale. The relationship between the area's size and the number of units available to the states concerned results in low force density; the wilderness can therefore be viewed as a low-density battlefield. The term low-density battlefield is defined as "a situation in which formations of ground forces operate over vast geographic

⁴¹ Försvarsmakten, FM2019-3480:4 Bilaga 1; Department of the Army, ATP 3-90.97.

⁴² Försvarsmakten, Handbok Armé—Brigad: AH Brig, Stockholm, Försvarsmakten, 2016.

⁴³ Some literature calls this subarctic capability; see Försvarsmakten, FM 2022-19979:19 Försvarsmaktens analys avseende militär förmåga i övre Norrland—Fördjupat underlag, Stockholm, Försvarsmakten, 2022.

areas, unable to form contiguous fronts and with vulnerable lines of communication.”⁴⁴

The underlying military problem is easily illustrated by the mismatch between available forces and the kilometres of frontage those forces are expected to protect. Swedish doctrine indicates that a force of four fully manned brigades, a very substantial concentration of units for a region like the High North, deployed side by side could defend at most 80 km of frontage.⁴⁵ That distance corresponds to just over 6% of the Russia–Finland border and about 11% of the distance from the northernmost point to a point level with Rovaniemi along that same border. If the same number of units were spread along that stretch, each battalion would be nearly 40 km from the nearest supporting manoeuvre unit. The problem becomes more pressing when one considers that defence must be conducted not only in width but also in depth. The same battle group would cover an area of 2400 km², roughly 2% of Finland’s land area north of Tornio.

The High North’s low-density battlefield places heavy demands on forces, chiefly because of the large distances between both friendly and enemy units. Where the defender cannot form a continuous front, an attacker can bypass defending units entirely. Such incursions deep into allied territory lack endurance, since they must eventually be reinforced and supplied, but a risk-taking adversary can still use them to seize key terrain in the High North and shape the battlefield early in a conflict. To counter such incursions, defending units in the area need the ability to prevent them quickly, or at least to respond rapidly to enemy penetration.⁴⁶

This implies that units in the High North must first be able to detect and track potential incursions. The area’s size demands a robust technical intelligence and command (C2) solution. Intelligence must be shareable with units that may be very far apart, which places high demands on communications for forces operating in wilderness conditions. This capability is also crucial to prevent a unit from being cut off from support in the event of a rapid enemy thrust.

To limit an adversary’s expansion on the High North’s low-density battlefield, units must also be able to disrupt the advance so that the attacker can be stopped before achieving operational objectives. Such action should occur as early as possible to restrict the depth of penetration. For ground forces, tempo and mobility are decisive. The most obvious method is to move between the adversary and its objective and thereby force it to engage in direct combat. The adversary can also be impeded in its advance if it comes under indirect fire while

⁴⁴ Hörnedal, Andreas, FOI-R--5573--SE Rare Birds: A Look at the Low-density Battlefield and Armed Drones, Stockholm, FOI, 2024, s, 11.

⁴⁵ Försvarsmakten, Handbok Armé—Brigad.

⁴⁶ Dalsjö, Robert, “Det glea slagfältet och försvaret av Sverige,” Kungliga Krigsvetenskapsakademiens Tidskrift, no. 3, 2019: 24–26.

manoeuvring, which means that various forms of long-range fires can be particularly effective in the High North.⁴⁷

A battlefield with great distances between units and their bases imposes major strains on logistics, which in turn limit the size of combat units that can participate in an operation. The greater the distance between forward units and the depots that supply them, the lower the throughput of supplies. For a given set of transport resources and a given road network, there is a maximum distance beyond which a unit of a certain size cannot be supplied with the ammunition, fuel, and rations it needs to maintain its capability. The transport resources required to sustain a unit at a minimum level therefore increase with the geographic distance between depot and unit.⁴⁸

In the High North, the distances between major bases are so great that logistical constraints arise early. The route from Boden to Rovaniemi, following the most suitable main highways (E4, E8, and E75), is almost 300 km. From Rovaniemi to the road junctions at Ivalo and Joutsijärvi is about 270 km and 110 km further, respectively. If a light infantry brigade, which requires roughly 300 tonnes of supplies per day⁴⁹ is 50 km from its supply depot, about 4 lorries can cover its daily delivery needs. If, however, the brigade operates at a distance from its base area comparable to the stretch between Boden and Ivalo, the number rises to 24.⁵⁰ Without these additional transport assets, delivered supplies would fall by about 84%. If one assumes that a unit's supply demand is proportional to its size, that volume would correspond to roughly a company. Without extra transport resources, pre-positioning, or local supply, the effective size of forward combat units will therefore drop sharply when operating on large, low-density battlefields.⁵¹

⁴⁷ Neretnieks, Karlis, "Det glesa slagfältet—Ett bidrag till debatten," Kungliga Krigsvetenskapsakademien, 27 January 2020.

⁴⁸ Skoglund, Per, Listou, Tore and Ekström, Thomas, "Russian Logistics in the Ukrainian War: Can Operational Failures be Attributed to logistics?," *Scandinavian Journal of Military Studies*, vol. 5, no. 1, 2022: 99–110; Prebilic, Vladimir, "Theoretical Aspects of Military Logistics," *Defense & Security Analysis*, vol. 22, no. 2, 2006: 159–177.

⁴⁹ O'Hanlon, Michael, *The Science of War: Defense Budgeting, Military Technology, Logistics, and Combat Outcomes*, Princeton, Princeton University Press, 2009. The brigade referred to here is a US airborne infantry brigade. There is no publicly available information on the sustainment requirements for a Swedish mechanised brigade.

⁵⁰ Assuming a flatbed truck's maximum payload is about 13 tonnes, meeting a brigade's daily requirement of 300 tonnes would take a little over 23 trips per day. If the brigade is 50 km from its depot, then—at 50 km/h and allowing one hour to load and unload—just under four trucks working around the clock could cover that demand. The round trip between Boden and Ivalo can be driven, at the same speed, in roughly 25 hours including loading and unloading. At that distance, a single brigade would therefore need nearly 24 trucks in continuous use to meet its needs. In practice the number is much higher, since the logistics vehicles themselves must be resupplied, which increases transit time and reduces payload. Degraded road conditions will slow the pace further, especially if two-way traffic cannot be maintained; on minor forest roads, throughput is likely minimal.

⁵¹ The author received support from Joen Dahlberg in analysing the logistics problem.

3.2.2 Wilderness as a channelling environment

The low-density battlefield is a useful concept for discussing wilderness capability, yet it does not fully capture the wider problem of fighting in wilderness terrain. A key difference is that wilderness is not only devoid of military units; its terrain is inherently channelling.⁵² Several factors in the High North channel units into specific locations and axes of advance, creating significant vulnerabilities that an adversary can exploit under the right conditions.

A first factor is the terrain and geography of the High North itself. The significant gaps between roads are, to a great extent, occupied by forest, wetlands, lakes, and broad watercourses, and in places by tundra or blockfields. Such terrain often prevents off-road movement, especially for wheeled vehicles. Winter and snow affect military operations in many ways, but from a mobility perspective bogs are a greater problem, as wetlands have extremely poor bearing capacity. Minor forest roads are often built for forestry and therefore are rarely through routes and, instead, end in turning areas. The bearing capacity of small roads also varies greatly by season: in spring, unpaved roads deteriorate markedly, especially under heavy traffic. This reduces road capacity and increases the time units must spend on them. Even if limited movement is possible along simple forest tracks or in roadless terrain with tracked vehicles, sustaining a continuous supply of critical consumables and evacuating casualties and damaged equipment still require continuous two-way traffic on supply routes, which sharply limits the number of usable roads.⁵³

All high-intensity combat in the area will therefore tend to be channelled onto the best available roads. For combat units, this creates constraints on several fronts. Units cannot as easily deploy on a wide frontage or disperse in the terrain, which reduces their ability to bring the full weight of their firepower to bear. Personnel and equipment on or near roads are far more visible from the air and the ground, and the high concentration of vehicles in road convoys makes the formation vulnerable to engagement along its entire depth.⁵⁴ If a road is blocked by an accident or by vehicles destroyed by enemy action, the unit as a whole could be delayed until the obstacle is cleared. Channelling onto a few roads thus

⁵² It may seem contradictory that the High North as an area of operations is both sparse and channelling, since channelling by its nature can concentrate forces in a small area. It is worth recalling, however, that the “density” of forces per unit area that arises from channelling occurs chiefly at the tactical level—for example, when two units meet along a single road in wilderness terrain. At the broader, operational level, the concepts are less at odds: here, sparseness refers to the relationship between the total force available and the expanse of the entire area of operations.

⁵³ Försvarsmakten, FM2021-7366:18.

⁵⁴ The US 11th airborne division, stationed in Alaska, reportedly uses the following standing rule for mobility in such areas: “Roads, trails, and cutlines are the enemy’s engagement areas; if it is easy, you are walking into a trap; if it is hard, you are winning,” quoted in Bost, Joshua, Knox, Elizabeth and Perez, Jomar, “Assured Mobility in the Arctic,” *Military Review*, vol. 1, 2024: 141–148,

limits a unit's ability to conceal its position, protect itself from enemy fire, manoeuvre to the desired point of attack, and sustain itself in the area over time. The sparse road network, combined with the difficult terrain, therefore poses a major challenge for forces operating in the High North. Dependence on through-routes also makes major junctions and intersections, which often coincide with the region's more built-up areas, key terrain to control.

The area's limited civilian infrastructure and settlement further channel forces. Distances between the larger, more developed urban areas mean a given unit can realistically count on civilian support—medical care, power, supplies—from only a very small number of places. If resources at one location are saturated, for example if the hospital in Kirkenes fills with casualties, the nearest equivalent facility may be hundreds of kilometres away. The scarcity of major population centres also changes the likelihood of a unit being detected. An empty forested landscape can provide visual cover, but it is an unfavourable electromagnetic background: emitters that a city's electromagnetic background noise would otherwise mask are easier for electronic-warfare sensors to detect. Any advantage that wooded terrain might otherwise give for concealing an operational unit's movement is therefore lost unless strict emission control is maintained. There is thus a clear incentive to control the few urban areas in the sparsely populated region in order to better conceal and protect one's own personnel and emitting equipment.⁵⁵

3.3 Analysis of capability development for High North units

Conditions in the High North affect almost every type of military activity and generate a distinct set of requirements, centred on cold-weather capability and wilderness conditions, that all fighting units must meet. For units to meet these requirements in practice, and thus achieve the necessary capability, they must first undergo important adaptations. The analysis below therefore considers several prerequisites for developing units that can operate in the area. This is followed by a discussion of the unit profiles that may be particularly well suited to the area's requirement set and are therefore prime candidates for capability development.

3.3.1 Training

It is hard to overstate the importance of training and preparation tailored to the High North, ideally through exercises in winter and in wilderness terrain, before a unit's deployment under these conditions.

⁵⁵ Försvarsmakten, FM2021-7366:18.

The knowledge and experience required in winter conditions relate not only to methods for mobility, protection, and fires in demanding circumstances, but also to individual well-being and the cohesion of the formation.⁵⁶ Soldiers who lack experience of operating in subarctic cold are at very high risk not only of underperforming but also of rapidly becoming subject to medical evacuation. The Swedish Armed Forces regard cold-weather training as a prerequisite for developing the necessary capability in Swedish units.⁵⁷ According to Arctic doctrinal publications from the United States, personnel who are not specifically trained for the challenge simply “will not survive.”⁵⁸ The time required for the necessary training and education before a unit is used in operations may vary with factors such as ambition, intended tasks, and training intensity. This question is not examined further here, but as a historical reference point it may be noted that, during the Second World War, Sweden assessed that units deployed in the High North for winter training became operationally effective only after roughly three months.⁵⁹

Training is also required for operations in wilderness areas even in warmer conditions. Commanders who are not familiar with the constraints imposed by the wilderness risk making incorrect decisions. Typical pitfalls include assessing incorrectly the feasibility of travel in roadless terrain, assuming that the use of emitting equipment is feasible in an otherwise empty electromagnetic background, and misjudging the distance a unit can move from its base area without degrading its supply situation.

3.3.2 Logistics

All military activity in the High North requires that associated logistics are scaled to the area’s challenges. Almost every condition that characterises the region as an operational area—cold and snow, long distances between strategically important locations, few and narrow roads, and the lack of support from surrounding communities—has a negative effect on the logistics problem. Transport runs become both longer and slower, while consumption of rations, ammunition, spare parts, and above all fuel increases during operations in this region. Increasing assigned transport assets per combat unit can compensate, restoring the total volume of supplies to levels that might be expected in more

⁵⁶ Collins, John M., *Military Geography for Professionals and the Public*, Washington, D.C., National Defense University Press, 1998.

⁵⁷ Försvarsmakten, FM2019-3480:4 Bilaga 1.

⁵⁸ Clark, J, “The Arctic Dilemma: Force Generation Considerations for Land Forces,” in Lynch, Michael and Coombs, Howard (ed.), *International Competition in the High North: 2022, Conference Volume*, Carlisle, Strategic Studies Institute, US Army War College, 2024.

⁵⁹ Palmstierna, Nils, “Beredskapsminnen från Övre Norrland 1939–1944,” cited in Arildsson, Sarah and Lidberg, Mikael, “Vår beredskap är god”: En studie över den militära beredskapen i Övre Norrland 1939–1944, Luleå University of Technology, 2005,

permissive theatres, but at the cost of creating other problems such as traffic congestion, reduced flexibility, and poorer combat efficiency. Manoeuvre units require supply solutions that work off-road as well as on-road; this means tracked vehicles able to move across deep snow, bogs, and blockfields. Such transport is essential for larger operations in the area, but it has limited payload and speed. Airlift is likewise volume-limited and vulnerable and can complement but not replace ground transport.

3.3.3 Particularly suitable capabilities

Beyond the attributes required of units in the High North, certain special capabilities are not strictly necessary for, or necessarily integrated into, an average manoeuvre unit, but, given the conditions, may be and have been identified as especially useful for a force operating there. Capabilities of this kind are better viewed as optional enablers rather than mandatory requirements, and they do not need to be organic to the combat unit; they can be held at a higher level of command. What these capabilities have in common is that their value and necessity stand out clearly because of the severely limited military logistics in the region.

Units operating in winter and wilderness benefit from a reduced need for logistical support and resupply. Although the use of heavier formations, especially tank units, cannot be ruled out in the High North, lighter, more mobile units have clear advantages in an environment where logistical support is severely constrained in both volume and speed.⁶⁰ The difference in requirements is substantial: only the weight of daily fuel consumption of a heavy tank brigade is equivalent to the combined total daily weight of all supplies consumed by a light infantry brigade, including other supply categories such as food, water, and ammunition.⁶¹ A reduced need for supplies increases a unit's endurance and its independent off-road mobility in the wilderness. Lower dependence on heavy, bulky maintenance also makes air resupply more feasible, which further improves operational mobility. Infantry and lighter tracked vehicles that can disperse into the terrain reduce vulnerable concentrations on the road network and enable attacks throughout the depth of the adversary's units. In Sweden, *jägarbataljoner*, ranger battalions, provide this light capability, but more conventional ground combat units can also benefit from lighter vehicles: on contact, the side that can spread laterally in the terrain, and thus outflank, has a significant advantage.

The prominent constraints on mobility and endurance in the High North also mean that systems able to disrupt and halt an adversary at long range can have disproportionately large effects. If a combat unit is struck early while still

⁶⁰ Clark, "The Arctic Dilemma."

⁶¹ O'Hanlon, *The Science of War*.

dispersing, or if its logistics are broken up by ambush, the unit's operational reach drops sharply. Forces in the High North therefore benefit from a rapid long-range strike capability. In the land domain, long-range fires (LRF) usually refers to rocket-artillery systems. With the necessary intelligence and command arrangements, missiles fired from these systems can currently engage stationary targets at roughly 150–400 km with high precision. At those ranges, targets across significant parts of the operational area can be struck from Swedish territory, so the systems require neither long transport times to reach the adversary nor substantial logistics to support firing positions deep in the wilderness. Other forms of land-based LRF, such as loitering missions and armed UAVs, or drones, can meet the same need and enjoy similar advantages. These airborne weapons can also reliably destroy mobile targets. Both heavier UAVs and attack helicopters have likewise been identified as useful in this context.⁶²

⁶² Neretnieks, "Det glesa slagfältet."

4 Units capable of operating in the High North

The climate, terrain, and limited infrastructure in the High North impose different, and generally tougher, requirements on units than those in other theatres. Units stationed elsewhere in the Alliance cannot simply be deployed for defence operations in the High North without more adaptation and training. In this context, it is more appropriate to apply a reverse burden of proof: a given unit must be regarded as unable to operate in the area unless there is strong reason to believe otherwise.

A major part of the requirement set is familiarity with, knowledge of, and experience in winter conditions and wilderness environments. A unit stationed in a subarctic and wilderness setting can be assumed to have accumulated such familiarity through training and exercises in its day-to-day activity. It can also be assumed that the unit's decisive materiel is sufficiently adapted to those conditions. Likewise, extensive or repeated participation in exercises in the area should be taken as a sign that at least a core of such experience has been established within the unit. Accordingly, a unit is assessed as capable of operating in the High North if:

- in peacetime, it is stationed in the High North or in a comparable area; or
- it has repeatedly taken part in exercises in the High North or a comparable area; and
- there is no specific information indicating that the unit lacks the capability to operate in the area.

In the overview that follows, these three criteria are applied to judge whether a unit can be considered capable of operating in the High North. The countries whose land combat units are considered are Finland, Norway, the United States, Canada, the United Kingdom, and the Netherlands.

These assessments were originally based on Swedish operational experience in the High North. As such, Swedish Armed Force experience with operating a vehicle in the area was considered sufficient to conclude that that vehicle would not fail criterion 3 above.

4.1 Finland

Finland's geography and exposed security situation give the country strong incentives to develop units capable of operating in the High North. The country has a clear focus on national, or territorial, defence, and the Finnish Defence Forces have therefore been sized to withstand an armed attack: on mobilisation,

their forces, including called-up reservists, are expected to reach 285,000 personnel.⁶³ The Finnish defence establishment is highly secretive concerning its ORBAT, which has complicated the estimates of its structure and capabilities set out below.

The basic unit in the Finnish peacetime organisation is called a brigade, which can be a source of some confusion. Because the army is built on mobilisation, these standing brigades should not be interpreted as being identical to the wartime order of battle.⁶⁴ The peacetime brigades are primarily administrative units and are chiefly responsible for training and mobilisation. Conscripts complete their basic training at these formations. The brigades that the country would field on mobilisation are almost certainly more numerous than the brigades in the peacetime establishment. Since peacetime formations do not map cleanly to wartime units, there is some difficulty in assessing the winter and wilderness capability of individual Finnish wartime formations.

The Finnish Army's peacetime organisation consists of five brigades distributed across the country.⁶⁵ In addition to their geographic spread, several brigades are clearly focused on providing conscript training in particular capabilities or arms. In this context, the Jaeger Brigade in Sodankylä is of particular interest, as it has positioned itself as the country's leading centre of expertise for winter warfare. It is also the northernmost brigade; its stationing in Sodankylä, well north of Rovaniemi, means daily activity deep in the High North.⁶⁶ The Kainuu Brigade, based in Kajaani, likewise experiences winter and wilderness conditions comparable to those in the High North, with a population density of about 3.5 inhabitants per km² and the same average winter temperature as Boden.⁶⁷ It can therefore be assumed that combat units whose core consists of personnel and reservists from the Jaeger Brigade and the Kainuu Brigade should be regarded as capable of operating in the High North.

The number of units in the wartime ORBAT originating from these brigades must be estimated from open sources. Calculations indicate, excluding various support units, a wartime force of roughly two brigades derived from the Jaeger Brigade. The corresponding figure for the Kainuu Brigade is two brigades and just over three battalions (see Appendix 1 for calculations on units in the ORBAT). Earlier analyses suggest that, within this wartime force, one brigade,

⁶³ IISS, "Chapter Three: Europe"; Jonsson, "Finland."

⁶⁴ IISS, "Chapter Three: Europe"; Jonsson, "Finland."

⁶⁵ Jääkariprikaati (Jaeger Brigade), Kainuun Prikaati (Kainuu Brigade), Karjalan Prikaati (Karelia Brigade), Panssariprikaati (Armoured Brigade) and Porin Prikaati (Pori Brigade). In addition, there are two regiments: Kaartin Jääkäriyrykmentii (Guard Jaeger Regiment) and Utin Jääkäriyrykmentii (Utti Jaeger Regiment).

⁶⁶ Maavoimat, "Jägarbrigaden—Om oss."

⁶⁷ Kainuun Liitto, Kainuu in Figures, Statistics, 28 November 2023; Finnish Meteorological Institute, Temperature and precipitation statistics from 1961 onwards [Dataset].

specifically linked to the Kainuu Brigade in the peacetime structure, would be a relatively high-quality, readily available manoeuvre brigade suited to operations in the country's northern areas. The remaining units would consist of regional formations with lower capability and mobility.⁶⁸

The other peacetime brigades cannot be regarded, on the basis of location alone, as capable of operating in the High North. They should instead be evaluated based on their participation in exercises in the area. In this regard, the Pori Brigade appears to be something of an outlier, as elements of its personnel have taken part in every major Finnish and international exercise in the area in recent years.⁶⁹ It is therefore possible that this brigade has some capability to operate in the High North. Open sources do not allow an estimate of the number of wartime units that might be generated from this brigade. However, it has been assessed that the Pori Brigade would also field a manoeuvre brigade of similar quality and mobility to the one associated with the Kainuu Brigade.⁷⁰ A cautious judgement, given that the Kainuu and Pori brigades are roughly the same size in the peacetime structure, therefore indicates that at least this mobilised manoeuvre brigade can be added to the list of formations capable of operating in the High North. In total, the number of Finnish wartime units with sufficiently strong capability to operate in the High North would thus amount to about six to seven brigades, of which two are estimated to be high-quality manoeuvre formations.

The unit types that comprise this wartime force is not public. Most mobilised army brigades are light infantry.⁷¹ It is reasonable to assume a relationship between the type of training conducted by a Finnish brigade in peacetime and the type of unit that the same brigade fields in wartime. Since all three relevant peacetime formations train jaeger (ranger) infantry, it is likely that a large share of the forces able to operate in the High North will be light infantry brigades. The Kainuu Brigade also trains conscripts in armoured warfare. In exercises, tank companies have moreover been attached to the Jaeger Brigade.⁷² The training and exercise activity in the relevant peacetime brigades therefore indicates that heavier formations in the Finnish Army also have the capability to operate in the High North. These heavier formations would probably be

⁶⁸ Häggblom, Robin, "The Finnish wartime Army," Corporal Frisk, 26 May 2018. This assessment is probably still reliable, since the Finnish Army has not undergone any major organisational reforms since it was written.

⁶⁹ Maavoimat, "Exercise Northern Wind 2019 in Northern Sweden," Maavoimat; Maavoimat, "Cold Response 2022," Maavoimat; Porin Prikaati—Pori Brigade, Facebook post, 19 March 2024; Maavoimat, "Finnish Defence Forces to exercise defending NATO northern region together with allies," Maavoimat, 6 February 2024.

⁷⁰ Häggblom, "The Finnish wartime Army."

⁷¹ IISS, "Chapter Three: Europe"; Jonsson, "Finland."

⁷² Maavoimat, Kainuun prikaati Alokasinfo [Kainuu Brigade Rookie Info], Maavoimat; Häggblom, Robin, "6. Division to the Defence of the common North," Corporal Frisk, 27 May 2022.

subordinated to the two manoeuvre brigades mentioned above, associated with the Kainuu and Pori brigades, respectively.⁷³

Finnish transport-helicopter assets belong to the Army, and the light infantry trains regularly in heliborne movement.⁷⁴ In the peacetime establishment, the country's helicopters form a battalion under the Utti Jaeger Regiment. Given the size of the transport-helicopter fleet—20 NH90s (the same type as Sweden's Helicopter 14)—it is not unreasonable to think that they are also organised as a battalion in the wartime order of battle.⁷⁵ The helicopters have taken part in exercises in the northern parts of Finnish Lapland and should be considered acceptable for operations in the area.⁷⁶

The major materiel systems in Finnish units capable of operating in the High North are, on the whole, familiar to the Swedish Armed Forces. This applies in particular to the Leopard 2 tanks,⁷⁷ CV9030 infantry fighting vehicles, BV 206 all-terrain carriers, and Helicopter 14 (NH90)—all of which were either developed in Sweden or have long been used there in Arctic or subarctic conditions. These systems are therefore regarded as acceptable for operations in the High North and are not discussed further. On the other hand, the Finnish Army's principal tracked self-propelled howitzer, the K9, is not used in Sweden. Assessing its exact performance under High North conditions would require material not available to this study, but several other countries with Arctic and subarctic climates—notably Norway—have chosen to procure the system. It has also been trialled and used extensively in military exercises in the High North.⁷⁸ Finland has recently decided to procure additional guns, which may indicate that any technical issues are negligible or at least considered manageable.⁷⁹ A reasonable inference from the available sources is that the system has sufficient cold-weather capability in this context. Finland also employs a recently updated version of the US M270 MLRS for land-based long-range fires. The system is tracked and therefore has some off-road mobility, but its specific suitability for snow and wilderness terrain is unknown. Finland has, however, recently chosen to procure a large number of ER GMLRS rockets, with a range of about 150

⁷³ Häggblom, "The Finnish wartime Army."

⁷⁴ Häggblom, Robin, "A Northern Heavy-lift," Corporal Frisk, 11 December 2018.

⁷⁵ Also see IISS, "Chapter Three: Europe."

⁷⁶ Puolustusvoimat, "Utti Jaeger Regiment's main winter exercise to develop international joint operating capability," Puolustusvoimat, 8 February 2024.

⁷⁷ The Finnish Army operates the Leopard 2A4, which is somewhat older than the Swedish main battle tank Stridsvagn 122/Leopard 2A5.

⁷⁸ Edvardsen, Astri, "Large Army and Navy Exercises in the Nordic Region This Late Fall," High North News, 1 December 2022; Maavoimat, Maavoimille lisää K9-panssarihaupitseja [More K9 howitzers for the Finnish Army], Maavoimat, 18 November 2022.

⁷⁹ Manuel, Rojoef, "Finnish Army to Receive New Batch of K9 Howitzers," The Defense Post, 22 November 2022.

km.⁸⁰ These systems can therefore engage targets across large parts of the operational area without necessarily needing to meet the same winter and wilderness requirements.

Table 5. Summary—Norwegian units with assessed capability to operate in the Scandinavian High North.

Unit: see Appendix 1 for calculations	Assessed capability for High North operations
Jaeger Brigade: 2 light infantry brigades	Good
Kainuu Brigade: 1 mechanised brigade; 1 light infantry brigade; 3 light infantry battalions	Good
Pori Brigade: 1 mechanised brigade; 1 light infantry brigade; 3 light infantry battalions	Good

4.2 Norway

Norway’s geography makes an attack from the north, from the Kola Peninsula, the most likely threat axis. The Norwegian Army has therefore traditionally prepared for defensive operations in the High North, in the northernmost counties of Finnmark and Troms, to buy time until reinforcements from the United States and other NATO countries can arrive.⁸¹ This posture is reflected in the peacetime basing of Norway’s ground forces, which are concentrated in the north. The core of the army is the manoeuvre force in Brigade North, at the time of writing the country’s only brigade.⁸² Of its eight battalions, six are stationed at Bardufoss, Setermoen, and Skjold in Troms. Of the brigade’s three mechanised units, two— Armoured Battalion (*Pansarbataljonen*) and 2nd Battalion—are based in the region, as is the brigade artillery battalion.⁸³ Since 2020, additional units have been raised under the newly established Finnmark Land Defence. This headquarters includes Porsanger Battalion (*Porsangerbataljonen*), based in northern Finnmark, described as a mechanised reconnaissance battalion under formation.⁸⁴ Beyond the manoeuvre forces, two Home Guard districts (*Heimevernet*)—HV-16 in Narvik and HV-17 in Porsangmoen—are located in or near the High North.⁸⁵ To these can be added

⁸⁰ IISS, “Chapter Three: Europe”; Kettunen, Alexei, “Suomesta GMLRS-ohjussuurvalta?” [Finland to become a GMLRS missile superpower?], Soumen Sotilas, 7 November 2022.

⁸¹ Försvarmakten, “FM2022-19979:19—Försvarmaktens analys avseende militär förmåga i övre Norrland—Fördjupat underlag”; Wegge, “The Strategic Role.”

⁸² Gustafsson, Jakob, “Norway,” in Ottosson, Björn and Pallin, Krister (ed.), FOI-R--5527--SE, Western Military Capability in Northern Europe 2023—Part I: National Capabilities, Stockholm, FOI, 2024.

⁸³ Forsvaret, “Setermoen,” Forsvaret, 24 June 2024, accessed 12 September 2024; Forsvaret, Bardufoss, Forsvaret, 18 July 2023.

⁸⁴ Gustafsson, “Norway”; IISS, “Chapter Three: Europe.”

⁸⁵ Forsvaret, “Om Heimevernet,” Forsvaret, 2024.

the Garrison of Sør-Varanger (GSV), which corresponds to a reconnaissance and ranger battalion.⁸⁶

These units—the Armoured Battalion, 2nd Battalion, artillery battalion, Porsanger Battalion (once complete), HV-16/17, and the GSV—can be presumed to have the capability to operate in the High North. That leaves Telemark Battalion among Brigade North’s fighting units. An assessment of a battalion’s winter and wilderness capability is based on its exercise record: Telemark Battalion has taken part in almost all major international winter exercises to which the Norwegian Army has contributed in the last five to six years.⁸⁷ This is unsurprising, as the battalion forms the core of Norway’s continuously available readiness force and is the only unit in the army fully manned by professional soldiers.⁸⁸ In sum, the battalion—and therefore Brigade North as a whole—can be regarded as capable of operating in the High North.

Apart from Brigade North and the units in Finnmark Land Defence, Norway has no larger manoeuvre formations. Reservists who do not man Brigade North are assigned to other parts of the Home Guard, whose units mainly have territorial duties and areas of responsibility. The Home Guard does have around ten more capable rapid-reaction forces, together numbering roughly 3000 personnel, deployable nationwide, but these appear to be intended primarily to protect critical infrastructure and to support the civilian sector.⁸⁹

Many of Norway’s major systems are also similar to those used by the Swedish Armed Forces. The heavy mechanised units, Telemark Battalion and Armoured Battalion, operate Leopard 2A4 tanks,⁹⁰ an older variant of Sweden’s Strv 122. The army also fields the CV9030N, an updated counterpart to Sweden’s current Strf 9040.⁹¹ Like Finland, Norway equips its artillery with the tracked K9 self-propelled howitzer, discussed above.

Norway’s transport-helicopter assets are organised under the special forces and are intended primarily to support special operations rather than conventional combat.⁹² These helicopter resources can be assigned to the army, but, realistically, that is a secondary task. Norway operates the Bell 412 platform. This type previously served in Sweden under the designation HKP 11. Since it

⁸⁶ Forsvaret, “Finnmark landforsvar,” Forsvaret; IISS, “Chapter Three: Europe.”

⁸⁷ Edvardsen, Astri, “Kick-Off in the North for the Norwegian Army’s Biggest Exercise This Fall,” High North News, 18 November 2022; Forsvaret, “En demonstrasjon av styrke og samhold i nord,” Forsvaret, 21 March 2024; Forsvaret, “Mediebank,” Forsvaret, 21 March 2019; Forsvaret, “Mediebank.”

⁸⁸ Gustafsson, “Norway.”

⁸⁹ Forsvaret, “Innsatsstyrker,” Forsvaret; Gustafsson, “Norway.”

⁹⁰ These will soon be replaced, however, by the more modern Leopard 2A8.

⁹¹ Hägglöf, “6. Division to the Defence.”

⁹² Forsvaret, “339 Special Operations Aviation Squadron (SOAS),” Forsvaret.

operated from Boden while in Swedish service, and several Norwegian aircraft are based at Bardufoss air base in the High North, the platform can be assumed to have the required capability.⁹³ Taken together, the army’s decisive materiel systems are assessed as capable of operating in the High North.

Norway currently lacks a long-range strike system, but it has recently received approval from the US administration to procure M142 HIMARS with ATACMS missiles.⁹⁴ If the purchase goes ahead, Norway will be able to engage targets at ranges of up to 300 km, giving considerable flexibility in planning operations in the High North.

Table 6. Summary—Norwegian units with assessed capability to operate in the Scandinavian High North.

Unit	Assessed capability for High North operations
Brigade North: 1 mechanised brigade	Good
Finnmark Land Defence: 1 light infantry battalion (GSV)	Good

4.3 United States

Despite the country’s increasingly explicit focus on the Indo-Pacific, the leadership of several major services has expressed strong interest in developing the ability to operate in Arctic and subarctic climates. Since 2021, both land-combat services, the Army and the Marine Corps,⁹⁵ have published Arctic strategies.⁹⁶ At the time of writing, the services were also jointly developing the first doctrine for operations in Arctic climates in fifty years.⁹⁷ These conceptual measures have been complemented by practical steps to strengthen the armed forces’ winter capability. The Army and Marine Corps are discussed separately below.

4.3.1 US Army

The Army, historically not associated with fighting in Arctic climates, has recently reorganised its Alaska-based army corps (USARAK) specifically to

⁹³ Forsvaret, “Utstyr og materiell,” Forsvaret; Gralén, Lars, “Ett helikoptersystem avvecklas,” Helikopter Flottilj Nytt, no. 4:2004.

⁹⁴ Defense Security Cooperation Agency, “Norway—M142 Hight Mobility Artillery Rocket Systems,” 9 August 2024.

⁹⁵ What is referred to here as the Marine Corps’ strategy is in fact the entire US Department of the Navy’s Arctic strategy, which therefore also encompasses the Navy and the Coast Guard.

⁹⁶ Department of the Army, Regaining Arctic Dominance—The U.S. Army in the Arctic, Washington D.C., Headquarters, Department of the Army, 2021; Department of the Navy, A Blue Arctic—A Strategic Blueprint for the Arctic, Washington, D.C., Headquarters, Department of the Navy, 2021.

⁹⁷ Malyasov, Dylan, “US Army develops Arctic doctrine for extreme cold weather operations,” Defense blog, 30 January 2024; see Department of the Army, ATP 3-90.96, C1: Arctic and Extreme Cold Weather Operations, 2025

highlight its Arctic identity and increase its capability.⁹⁸ The corps has been redesignated as the reactivated 11th Airborne Division. The division consists primarily of its 1st and 2nd brigades, a light motorised infantry brigade, and an airborne infantry brigade, respectively. Because the US Army integrates helicopter support closely and extensively with ground units, the division also includes two aviation battalions (one attack/reconnaissance and one general-support battalion). The division further encompasses the Army's centre of expertise and training for Arctic operations, the Northern Warfare Training Center.⁹⁹ The division was formed from existing units already stationed in Alaska; it is therefore not an entirely new capability. However, the brigades' Arctic identity, role, and capabilities were clearly emphasised during the reorganisation.¹⁰⁰ New personal equipment for operations in Arctic conditions is being trialled.¹⁰¹ The scale of the division's exercises in winter and wilderness conditions has increased markedly since the reorganisation and, in spring 2024, involved a record number of participants.¹⁰²

An assessment of a unit's potential winter and wilderness capability should primarily consider where it is based. The 1st and 2nd brigades are stationed at Fort Wainwright in Fairbanks and Fort Richardson in Anchorage, Alaska, respectively.¹⁰³ Like the Scandinavian High North, both coastal Anchorage and inland Fairbanks have, broadly speaking, a subarctic climate. In Fairbanks, the average temperature for December–February is -18.7°C , which is significantly colder than the same months in the High North (see Table 1). Anchorage's winter average of about -6.4°C is comparable to temperatures in Tromsø or Murmansk.¹⁰⁴ The state's population density is about 0.5 persons/km², lower than that of the High North.¹⁰⁵ From an operational perspective, Alaska can therefore, with confidence, be regarded as sufficiently comparable from an operational perspective to the High North.

The division's light infantry brigades are designed to operate with a relatively small logistic footprint; their primary ground transport is the utility vehicle, most

⁹⁸ Dennis, Christopher, "Why 11th Airborne Division?" US Army, 16 May 2022.

⁹⁹ Sword, Michael, "Arctic Warfare Heats Up: Unique Division Specializes in Cold-Weather Operations," AUSA, 24 January 2023; 11th Airborne Division, "Units," 11th Airborne Division.

¹⁰⁰ Lacdan, Joe, "Soldiers prepare for combat operations in the Arctic," *US Army*, 1 March 2024.

¹⁰¹ Schauer, Mark, "Arctic Mobility Sustainment System tested at Army's Cold Regions Test Center," *U.S. Army*, 15 April 2024.

¹⁰² South, Todd, "8,000+ soldiers tested in large-scale combat in the Arctic," *Army Times*, 27 February 2024.

¹⁰³ 11th Airborne Division, "Units."

¹⁰⁴ Climate-Data, "Fairbanks climate," *Climate-Data*.

¹⁰⁵ U.S. Census Bureau, "Historical Population Density Data (1910–2020)," *US Census Bureau*.

likely the HMMWV.¹⁰⁶ Given that vehicle's participation in numerous Arctic exercises, there is no reason to question its suitability for High North operations, although, like all wheeled vehicles, it has severely limited mobility in deep snow. The 1st Brigade is therefore replacing its wheeled Stryker fleet with CATVs (the US designation for the BvS10), whose ability to operate in the High North, like its predecessor, the Bv206, is well known to the Swedish Armed Forces.¹⁰⁷ The division's aviation battalions, closely tied to the infantry brigades, operate the UH-60 Black Hawk, familiar to the Swedish Armed Forces, as well as the CH-47 Chinook transport helicopter and the AH-64 Apache attack helicopter. Despite the fact that the latter two required modifications for cold-weather operations and, even then, normally fly only at temperatures above -40 °C because of the fuel's freezing point, they feature prominently in the division's exercises. They should therefore be considered acceptable for High North operations, provided they receive sufficient maintenance and temperatures do not fall to extreme lows.¹⁰⁸

As infantry formations, the brigades do not field tanks, tracked infantry fighting vehicles, or self-propelled howitzers. Instead, their firepower is provided by air-delivered towed artillery. This arrangement limits mobility after airlanding, since moving the guns requires either helicopter lift or towing by a tracked carrier.¹⁰⁹ Endurance is likewise constrained, as these systems require continuous heating, and thus substantial fuel, to remain operable.¹¹⁰ In sum, the 11th Airborne Division can be assumed to have good capability to operate in the High North, but its firepower and staying power after the initial phase are limited unless air superiority can be maintained.

The U.S. Army's 10th Mountain Division may also display the winter and wilderness capabilities required for operations in the High North. In addition to various support and aviation units, the division consists of three light infantry brigades, the 1st through 3rd. The 1st and 2nd Brigades are stationed at Fort Drum in Watertown, northern New York, while the 3rd Brigade is based at Fort

¹⁰⁶ Congressional Budget Office, *The U.S. Military's Force Structure: A Primer, 2021 Update*, Washington D.C., Congressional Budget Office, 2021; Feickert, Andrew, *Infantry Brigade Combat Team (IBCT) Mobility, Reconnaissance, and Firepower Programs*, Washington D.C., Congressional Research Service, 2017; Department of the Army, *FM 3-96 Brigade Combat Team*, Washington D.C., Headquarters, Department of the Army, 2021; Warner, Gary, "2 Army soldiers killed and a dozen injured when truck skids off road in Alaska," *Stars and Stripes*, 3 October 2023.

¹⁰⁷ Judson, Jen, "BAE Systems wins US Army deal for Cold Weather All-Terrain Vehicle," *DefenseNews*, 23 August 2022; Roaten, Meredith, "AUSA 2023: Cold Weather All-Terrain Vehicles delivered to US Army," *Jane's*, 12 October 2023.

¹⁰⁸ Lacdan, "Soldiers prepare"; Army Technology, "British Army's Apache helicopters deploy to Arctic," *Army Technology*, 16 January 2019.

¹⁰⁹ Fitzgerald, Chad, Graw, Dan and Kuegler, Hannah, "From Heaven to Hell: Fires Employment for the 11th Airborne Division 'Arctic Angels,'" *Military Review*, vol. 1, 2024: 130–140.

¹¹⁰ Shouse, Michael, et al., "Airborne Joint Forcible Entry Operations in an Extreme Cold Weather Environment," *Infantry Magazine*, 2023, vol. 112, no. 1, 2023: 10–18.

Johnson, Louisiana. The High North differs markedly from Louisiana, but it has certain similarities with northern New York. The US Army uses a climate-zone system to ensure that stationed brigades are equipped for local weather. Under this system, Fort Drum—because of periodically recurring spells of very severe cold—has the same classification as Fort Wainwright in Alaska.¹¹¹ Despite this classification, the areas should not be regarded as equivalent in this context: Watertown/Fort Drum’s average winter temperature is just under 1 °C, well above the High North, and the county’s population density, about 35 per km², is likewise not comparable with High North conditions.¹¹² On the basis of their location, the 1st and 2nd Brigades may therefore be expected to have winter familiarity, but it is doubtful that this, per se, amounts to capability for operations in the High North.

Two of the division’s brigades, the 1st and 3rd, have recently taken part in some exercises relevant to winter and wilderness capability, such as Arctic Forge 2023 and Defender 2024 in Europe.¹¹³ However, it has not been possible to confirm, based on open sources, whether personnel from any of the division’s brigades have taken part in winter exercises held in Alaska. As such, it cannot be determined here whether this suggests that local exercises are regarded as comparable to those in the High North or Alaska, or that the Army does not intend for the division be specialised for Arctic operations to the same degree as the 11th Airborne Division, if at all.

The Army’s 10th Mountain Division appears to have basic cold-weather capability but seeing as the evidence is limited, it is a matter of judgement to what extent this corresponds to the ability to operate in the High North, given the additional demands of wilderness terrain. In view of the geographical and infrastructural conditions at the brigades’ home bases, and their more sporadic participation in exercises in the area, these formations are probably less well adapted to High North operations than the brigades of the 11th Airborne Division. It cannot be ruled out that the 10th Mountain Division is intended to be developed further for higher capability in the area, but until then it is likely to have more limited capability for operations in the High North and may, if so, require refresher training before any such deployment.

¹¹¹ Simon, Kelly, “‘Arctic’ zone classification at Fort Drum means Soldiers will receive new cold-weather equipment,” *U.S. Army*, 26 January 2017.

¹¹² National Oceanic and Atmospheric Administration, “NOAA Online Weather Data” [Dataset], *National Weather Service*; United States Census Bureau, “County Population Totals and Components of Change: 2020–2023” [Dataset], *U.S. Census Bureau*.

¹¹³ Barry, Gregory, “How the 10th Mountain Division Is Going Back to Its Alpine and Mountain Roots,” *Military Review*, no. 4, 2024: 105–112; Nieberg, Patty, “10th Mountain Division rolls more than 500 miles across Finland, Sweden and Norway,” *Task & Purpose*, 13 May 2024; Baker, Austin, “Multinational Soldiers conduct winter warfare training during Defense Exercise North 2023,” *divids*, 7 March 2023.

Because both divisions are fundamentally infantry formations, their organic fire support consists only of towed field howitzers in attached artillery support battalions. The Army's long-range fires function is instead provided by field artillery brigades, which deliver fire support at division level. A field artillery brigade usually comprises four fire support battalions. The types of battalion assigned to the brigade depend on the specific mission. Some are equipped with towed howitzers; others field rocket-artillery systems (M270 MLRS or M142 HIMARS) for long-range strike. These brigades can be assigned to a division or to a joint task force as required.¹¹⁴ None of the country's four field artillery brigades is stationed in Alaska. However, contingents from these brigades are often attached to units from both divisions during exercises, including in Alaska.¹¹⁵ The Army fields both ER GMLRS and ATACMS, which give the rocket-artillery systems the ability to engage targets at operational ranges.

The Army National Guard also falls under the Army. It has some characteristics of a reserve and therefore largely lies outside the scope of this study. Since National Guard units have been deployed outside the United States in support of the regular army, including in combat roles, and since Guard units have taken part to a considerable extent in exercises relevant to this study, it is nevertheless appropriate to address the force briefly here. Since the Army released its new Arctic strategy in 2021, which assigns the National Guard a clear role in developing partnerships and participating in joint exercises with other Arctic partner countries, several Guard units appear to have been adapted for, or at least exposed to, operations in winter and wilderness conditions. For example, manoeuvre elements from the 86th Infantry Brigade Combat Team (Vermont) and the 183rd Cavalry Regiment (Virginia) have taken part in cold-weather exercises in both Europe and North America.¹¹⁶ Of particular interest is the local National Guard presence in Alaska. Apart from support elements, the Guard has an infantry battalion in and around Fort Wainwright which, given local conditions, should in principle be regarded as fully capable of operating in the High North.¹¹⁷

That some National Guard units have experience of exercises in the relevant areas does not mean they can automatically be treated as fully comparable with the other formations discussed here. Although Guard units may receive combat tasks similar to those of the regular Army, they often require additional

¹¹⁴ Department of the Army, *ATP 3-09.24 The Field Artillery Brigade*, Washington, D.C., Headquarters, Department of the Army, 2024.

¹¹⁵ Wiley De Moura, Nadine, "Chilean armies set stage for inaugural exercise Southern Fenix 2024," *U.S. Army*, 11 April 2024; Welch, Jason, "The Joint Fight: Arctic paratroopers and HIMARS build combat power during Northern Edge 21," *U.S. Army*, 12 May 2021; Reinsch, Michael, "10th Mountain Division's service members train with HIMARS," *U.S. Army*, 11 April 2019.

¹¹⁶ Arcovitch, Mikel, "National Guard Conducts Arctic Training with Canada," *National Guard*, 4 March 2024; Baker, "Multinational Soldiers."

¹¹⁷ Alaska National Guard, "38th Troop Command," *Alaska Army National Guard*.

preparatory training if the tasks are more demanding. In this context, they can be viewed as reinforcing units which, after an initial phase, could be deployed to the High North to augment Army forces there.

4.3.2 US Marine Corps

The Marine Corps prepared a brigade for deployment to northern Norway from the 1970s to the 1990s in the event of open conflict in the area.¹¹⁸ To reduce the logistic burden of moving a brigade's heavy equipment under wartime conditions, the Corps chose to pre-position large quantities of materiel and supplies in depots in Trondheim. Those stocks remain in place even though the brigade for which they were intended has been disbanded. In addition, a small Marine Corps unit is always present in Europe under Marine Rotational Force—Europe (MRF-E), which can deploy around the continent to take part in various exercises.¹¹⁹

Responsibility for Marine units in Europe, and for reinforcement in the event of war, lies with II Marine Expeditionary Force (II MEF), which is based centrally along the U.S. Atlantic coast.¹²⁰ II MEF's ground combat forces are drawn mainly from the 2nd Marine Division, which comprises nine infantry battalions organised into three infantry regiments,¹²¹ plus four specialised battalions for tasks including amphibious operations. The division has an artillery regiment with two towed-howitzer battalions for organic fire support, while long-range fires in the form of HIMARS battalions from other Marine divisions can be transferred if needed.¹²² In total, these are substantial forces, but at any given time II MEF appears to provide only a little over one infantry battalion to MRF-E. Although II MEF personnel numbers in Europe seem to rise during major Arctic exercises (reportedly up to 2500 from the usual 1300), open sources have not confirmed that this increase consists of additional manoeuvre units.¹²³ It appears instead to be mainly extra logistics and support assets, and at times

¹¹⁸ Qviller, Jörn, *Det amerikanske marinekorpset—Den nölande arktiske krigeren*, in Wegge, Nord (ed.), *Sikkerhetspolitikk og miliärmakt i Arktis*, Cappelen Damm Akademisk, 2023.

¹¹⁹ Ottosson, Björn, "USA," in Ottosson, Björn and Pallin, Krister (ed.), *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm, FOI, 2024.

¹²⁰ Department of the Navy, *MCRP 1-10.1: Organization of the United States Marine Corps*, Washington D.C., Headquarters, Department of the Navy, 2020.

¹²¹ In Swedish usage, these "regiments" are roughly equivalent to brigades.

¹²² Department of the Navy, *MCRP 1-10.1*; U.S. Marine Corps, "2nd Marine Division," *Marines*, <https://www.2ndmardiv.marines.mil/>, accessed 7 May 2024.

¹²³ Nieberg, Patty, "Army activates Arctic Aviation Command for extreme cold flying," *Task & Purpose*, 20 August 2024; Vandiver, John, "US Marine contingent to join huge NATO Nordic drill, show 'we'll be here when needed,'" *Stars and Stripes*, 1 March 2024; U.S. Marine Corps, "U.S. Marines Deploy for Months-Long Training During Marine Rotational Force—Europe," *Marines*.

HIMARS batteries.¹²⁴ It is worth noting that II MEF's basing in North Carolina has meant that much of the current MRF-E (1st Battalion, 2nd Marines), as late as March 2024, had never previously been on skis.¹²⁵ It should also be noted that up to 75% of Marine infantry leave the Corps after their first enlistment, which means a very large share of a given unit's experience and competence from a specific exercise will have disappeared within three years.¹²⁶

Discussion of the US Marine Corps' capabilities relevant to operations in the High North should also address the controversial reorganisation the service is undergoing. In line with Force Design 2030, the Corps has decided, among other things, to cut the number of infantry units and to divest all tanks and heavy bridging equipment. These reductions are intended to allow a focus on lighter, more mobile edge capabilities suitable for littoral combat and for supporting the maritime and air domains.¹²⁷ The aim is to increase the Corps' relevance in the Indo-Pacific by transforming Marine units in the region into "stand-in forces": small, light units that, by being initially positioned inside an adversary's A2/AD envelope and by maintaining a low signature together with an enhanced long-range fires function, can prevent an enemy from denying theatre access to friendly reinforcements. It is not yet clear whether these reforms are suitable for the subarctic environment, and the question is actively debated in Norwegian publications.¹²⁸ Some aspects of the reform, such as greater capacity for long-range fires and improved situational awareness, have also been identified in Swedish contexts as a potential answer to the problems of a low-density battlefield.¹²⁹ At the same time, the doctrine (to say nothing of the very concept of stand-in forces) assumes that Marine units will already be stationed in the theatre at the outbreak of conflict and that they will possess significant long-range fires. Given that Norwegian basing policy does not permit such stationing, that II MEF, at the time of writing, lacks organic HIMARS battalions, and that the Corps has divested the heavier systems needed to break through an enemy's lines, it is unclear how Marine Corps units could successfully apply the same doctrine in northern Norway as in the South China Sea.

On balance, the Corps' ability to provide substantial reinforcement to northern Norway and the High North in an open conflict appears difficult to reconcile with both its exercise pattern and doctrinal choices. This conclusion runs counter to the Corps' stated ambition to expand its Arctic capability. Continuous

¹²⁴ Austin, Akeel, "U.S. Marines of 2nd Battalion, 10th Marine Regiment train with HIMARS in Norway in preparation for Exercise Nordic Response 2024," *dvids*, 27 February 2024.

¹²⁵ NATO, "There's no business like snow business—US Marines build their skills in the Norwegian Arctic," *NATO*, 12 March 2024.

¹²⁶ Qviller, "*Det amerikanske marinekorpset*."

¹²⁷ Ottosson, "USA."

¹²⁸ Qviller, "*Det amerikanske marinekorpset*."

¹²⁹ Dalsjö, "*Det glesla slagfältet*"; Neretnieks, "*Det glesla slagfältet*."

rotations make any estimate of the size of the force package that could be judged capable of operating in the High North highly uncertain given continuous rotations. Given the generally sporadic and limited presence in Arctic climates, the assessment here is that, at any given time, the Marine Corps could field one manoeuvre battalion from II MEF with subarctic capability.

Table 7. Summary—US units with assessed capability to operate in the Scandinavian High North.

Unit	Assessed capability
11th Airborne Division: 1 light infantry brigade 1 airborne infantry brigade	Good capability
10th Mountain Division: 3 light infantry brigades	Uncertain capability
II Marine Expeditionary Force: 1 light infantry battalion	Good capability

4.4 Canada

Canada’s northern geography is, on the whole, comparable to that of the High North. Where they differ, conditions in northern Canada tend to pose the greater obstacles to military activity: for example, the country’s Arctic and subarctic regions cover larger areas and have even lower population density than their counterparts in the High North.¹³⁰

Of the country’s three major manoeuvre formations—1, 2 and 5 Canadian Mechanized Brigade Group (CMBG)—none is stationed in such regions during peacetime. The most northerly based of these is 1 CMBG in Edmonton, Alberta, which lies at roughly the same latitude as Hamburg. Winter temperatures in Edmonton are indeed comparable to Boden, but average snow depth and the prevalence of wetlands are markedly lower around Edmonton than in the High North.¹³¹ Population density in Alberta in general, and around Edmonton in particular, is also significantly higher than in the High North. The continuous military presence in Arctic and subarctic regions instead consists of units from the Canadian Rangers, Task Force Group—North, and the brigades’ Arctic Response Company Groups (ARCG). All of these are manned by reservists or part-time volunteers, and none is larger than a company. They are intended to show presence across the area rather than to conduct high-intensity operations and can therefore be set aside for present purposes.

Participation by the larger manoeuvre formations in international Arctic or subarctic exercises appears relatively sporadic and is focused on joint exercises with US units in Alaska. In these cases, battalion-level forces have taken part,

¹³⁰ Clark, “The Arctic Dilemma.”

¹³¹ Alberta Biodiversity Monitoring Institute, “Wetlands in the Prairie Region,” *ABMI*.

predominantly from 1 CMBG. From what can be confirmed in open sources, only one light infantry battalion among the regular units, 3 Princess Patricia's Canadian Light Infantry, has participated more regularly in exercises in the area.¹³² The Army also conducts annually recurring national exercise operations in northern Canada. Although these are intended to develop the ability to operate in an environment similar to the High North, most are oriented towards territorial units such as ARCG or towards Army Reserve units.¹³³

Certain statements by senior Canadian officers complement this picture. The head of the Army's training system has asserted that every Canadian soldier is to receive individual winter training during annual brigade- and battalion-level exercises. It is unclear whether these exercises are in fact conducted under Arctic or subarctic conditions, or whether they relate only to winter conditions in general. The evidence points to the latter, since the Canadian concept for short-notice deployment in Arctic areas is not based on designated standing units, but rather on composite company-sized formations comprising both regular personnel and reservists. It has also been assessed that the Army would only with some effort be able to assemble enough of these companies to field a formation on the order of a battalion or larger, which indicates that no single larger unit in the Canadian ORBAT has the capability sought here.¹³⁴

It is not known how many such companies the Army has organised or what preparations would be required to convert them into a larger "Arctic" formation. Assuming such a reorganisation had been prepared in advance, which has not been substantiated in open sources, the country might be able to field a little over a battalion capable of operating in the High North. This estimate should be treated as an upper bound for what the country could generate for an operation in a High North-like area without major effort. The possibility that a large share of Army personnel may have relatively good winter skills should not justify a different assessment.

Canadian light infantry uses the wheeled LAV 6.0 and has also procured the Bv 206 for Arctic operations.¹³⁵ The Army employs Bell 412 and CH-47 Chinook in the transport-helicopter role;¹³⁶ at least the latter has taken part in Canadian

¹³² Government of Canada, "Over 600 Canadian Armed Forces members training with Allies and partners in Alaska on Exercise GLOBAL RESOLVE 24," *Government of Canada*, 13 February 2024; Rehman, Mishall, "Numerous Exercises and Operations have CAF and American military personnel hone arctic skills," *Canadian Military Family Magazine*, 18 March 2022.

¹³³ Government of Canada, "Operations and Exercises," *Government of Canada*, 16 August 2021.

¹³⁴ Pelletier, Roch, "Canadian Land Forces in the High North and Arctic—A Collective Effort," in Lynch, Michael and Coombs, Howard (ed.), *International Competition in the High North: 2022 Conference Volume*, Carlisle, Strategic Studies Institute, U.S. Army War College, 2024.

¹³⁵ Government of Canada, "Vehicles," *Government of Canada*, 14 April 2021.

¹³⁶ IISS, "Chapter Two: North America," *The Military Balance*, vol. 124, no. 1, 2024: 16–53;

exercises in Arctic areas.¹³⁷ Materiel should therefore not be regarded as a limitation for the capability under discussion. On the other hand, the Canadian Army currently lacks a long-range fires capability.

Table 8. Summary—Canadian units with assessed capability to operate in the Scandinavian High North.

Unit	Assessed winter and wilderness capability
3 Princess Patricia's Canadian Light Infantry: 1 light infantry battalion	Good capability

4.5 United Kingdom

The United Kingdom is not an Arctic state and has no territory in the High North or similar regions.¹³⁸ It has nevertheless long expressed a strong interest in contributing to the region's security. In addition to observer status in the Arctic Council, the UK initiated and acts as framework nation for the Joint Expeditionary Force (JEF), which is clearly oriented towards Nordic and Baltic operations. The country has long published policy for the Arctic, and in 2022 the Ministry of Defence issued a dedicated paper explaining the UK's military role in the High North.¹³⁹

Because the UK lacks its own bases in the High North, the Arctic, or comparable areas, only units that can be shown to have taken part in relevant exercises should be considered, regardless of home station. The British units most closely associated with winter warfare and training in High North-like conditions are those of the UK Commando Force. The force draws on the Navy, Army and Air Force, but its core is three light Royal Marines commando battalions, 40, 42, and 45 Royal Marines Commando,¹⁴⁰ organised under the Navy.¹⁴¹ Although these battalions are not formally designated for winter warfare or High North operations, 45 Commando occupies a special position: it forms the backbone of the UK's northern Littoral Response Group, an amphibious task group for

¹³⁷ Government of Canada, "Operation NANOOK 2023 successfully concluded in Canada's Arctic," *Government of Canada*, 13 September 2023.

¹³⁸ The UK's overseas territories with somewhat similar climates, such as South Georgia and its Antarctic territories, are uninhabited. Given their location and strategic profile, we assume there is no reason to develop forces dedicated solely to operations in those areas.

¹³⁹ Ministry of Defence, "The UK's Defence Contribution in the High North," *Ministry of Defence*, 2022.

¹⁴⁰ These light marine infantry units have recently undergone a major reform to make them more useful beyond conventional amphibious warfare. Their numbers have been cut, while the troops who remain are expected to work in smaller teams. The force is now described as "akin to special forces." Although they verge on being special-operations units, we include them here since they are still meant to undertake their traditional amphibious missions; see Navy Lookout, "Strike from the sea—Developing the UK Commando Force," *Navy Lookout*, 24 June 2024.

¹⁴¹ Aronsson, Albin, "UK," in Ottosson, Björn and Pallin, Krister (ed.), *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm, FOI, 2024.

northern Europe and the Baltic.¹⁴² The UK also has a multi-year cooperation agreement with Norway under which personnel from this force (about 1000 troops, roughly a Royal Marines battalion) spend two months each year in northern Norway for winter training.¹⁴³ It is not clear which manoeuvre units are formally covered by this agreement, or whether the agreement even specifies individual units, while open sources only confirm regular participation by 45 Commando.¹⁴⁴ In the run-up to and during major international exercises over the past four years, however, both 40 and 42 Commando have also been present in Norway. The Royal Marines have no heavy armoured fighting vehicles or tanks. Instead, alongside various light wheeled vehicles, they field the BvS10 articulated tracked vehicle, which, as noted above, should be regarded as suitable for High North operations.¹⁴⁵ For fire support, they employ light towed howitzers.¹⁴⁶

Units from the British Army have also taken part in a number of exercises in the area, but this participation appears to have been spread evenly across several formations. The airborne 16 Air Assault Brigade Combat Team is the Army's principal contribution to the national Global Response Force and has therefore trained in a range of demanding environments, including the High North.¹⁴⁷ For several years, two of its battalions have exercised in northern Norway and Finland.¹⁴⁸ The battalions, 2 PARA and 1st Battalion, Royal Irish Regiment, are light infantry and have no tracked vehicles. The brigade has aviation transport assets for dismounted troops and for moving heavier fire support, but this presupposes a degree of air control and cannot replace ground transport during extended operations. Nor has it been possible to confirm that either battalion has taken part in more than one exercise in the area. Elements of the light mechanised Royal Anglian Regiment have also exercised in the region.¹⁴⁹ This unit does have tracked vehicles for greater off-road mobility, but it has not conducted recurring training there either. The Army's long-range fires capability consists

¹⁴² Navy Lookout, "Understanding the Royal Navy's littoral response group concept," *Navy Lookout*, 17 August 2021.

¹⁴³ Foreign, Commonwealth & Development Office, *Looking North: The UK and the Arctic, The United Kingdom's Arctic Policy Framework*, 2023, London.

¹⁴⁴ ForcesNet, "Royal Marines Undergo Reconnaissance Exercises In Arctic Circle," *ForcesNet*, 2 March 2021; Royal Navy, "Commandos master the art of moving through Arctic battlefield," *Royal Navy*, 24 January 2020.

¹⁴⁵ Royal Navy, "Royal Marines head 'behind enemy lines' on fjord raids," *Royal Marines*, 22 February 2022; Royal Navy, "Royal Marines at the tip of the NATO spear on major Arctic exercise," *Royal Marines*, 14 March 2024; Royal Navy, "Equipment Commando: By Land," *Royal Navy*.

¹⁴⁶ British Army, "29th Commando Regiment Royal Artillery," *British Army*.

¹⁴⁷ Aronsson, "UK."

¹⁴⁸ Army MOD Press Office, "Paratroopers 'Break the Ice' with JEF and NATO Allies March 2023," cited in *ParaData*; Ministry of Defence, "UK Forces return home after successful NATO exercise," *GOV.UK*, 12 November 2018.

¹⁴⁹ The Royal Anglian Regiment, Facebook post, 10 May 2022.

of the M270 MLRS, fielded in two regiments in 3rd (UK) Division. The UK currently only employs GMLRS rockets, but plans to procure a broader set of munitions with ranges beyond 100 km.¹⁵⁰

The helicopter support formation for UK Commando Force, the Commando Helicopter Force, operates Merlin and Wildcat helicopters for transport and attack roles.¹⁵¹ These have been used regularly in High North exercises and should be regarded as suitable for operations in the area.¹⁵² The UK also employs Chinook and Apache helicopters; both have been discussed above. It is unknown whether the UK's Chinooks have been configured for Arctic and subarctic operations, but British Apache platforms have frequently taken part in exercises in the High North.¹⁵³ These should be considered to have the capability being assessed here.

Aggregate estimates of the total number of British units capable of operating in the High North are highly uncertain, given the sporadic nature of reported Arctic participation. At least one marine battalion, 45 Royal Marines Commando, appears to have such capability. Individual companies from the other Royal Marines battalions probably have some capability and could together amount to roughly one additional battalion. The same probably holds for an unknown number of units in the British Army.

Personnel from three Army battalions have taken part in at least one relevant exercise, and two of those battalions have been tasked to be available at high readiness for operations anywhere in the world. With refresher training, perhaps half of this force could have at least basic winter and wilderness capability. In sum, the United Kingdom could field two to four infantry battalions, that is, at most a brigade-sized force, capable of conducting operations in the High North after certain preparations.

Table 9. Summary—British units with assessed capability to operate in the Scandinavian High North.

Unit	Assessed winter and wilderness capability
UK Commando Force: 1–2 marine infantry battalions	One with good capability, possibly one more with uncertain capability
British Army: 0–3 light infantry battalions	Uncertain capability

¹⁵⁰ British Army, “Guided Multiple Launch Rocket System (GMLRS),” *British Army*.

¹⁵¹ Royal Navy, “Commando Helicopter Force,” *Royal Navy*.

¹⁵² Defence Industry Europe, “Royal Navy Commandos deploy to Arctic Circle for NATO defence drills,” *Defence Industry Europe*, 11 January 2025; Pereira, Julian, “UK Commando Helicopter Force completes Arctic warfare operations in Norway,” *Forces News*, 20 April 2023.

¹⁵³ Army Technology, “British Army’s Apache helicopters.”

4.6 The Netherlands

The Netherlands, like the United Kingdom, has no territory in the High North or the Arctic. Dutch interests in the Arctic region should also be regarded as relatively modest in this context. The Korps Mariniers (Netherlands Marine Corps) does, however, have a historical connection to the region.¹⁵⁴ During the Cold War, one of the Corps' principal tasks was to contribute to the allied defence of northern Norway. The Corps was developed in parallel with, and partly integrated into, its British counterpart, the Royal Marines Commando, to be able to conduct operations there.¹⁵⁵ The country has maintained this traditional capability, not least by continuing to provide Marine Corps units to the joint United Kingdom/Netherlands Amphibious Force (UKNLAf).¹⁵⁶

The Netherlands has no peacetime basing locations with conditions similar to those in the High North. The Corps' exercise record should therefore be the focus here. Its principal conventional land-combat capability consists of two Marine Combat Groups (1MCG and 2MCG), which are, in essence, light marine infantry battalions. Both 1MCG and 2MCG appear to have trained frequently in the High North and in similar environments. In all major allied exercises in northern Norway in recent years, at least one of the groups has been present.¹⁵⁷ Such exercises also seem to be complemented by extensive annual training in the same area.¹⁵⁸ Those annual training periods typically involve a force just under battalion strength, around 600 personnel. The experience from this training can be assumed to be well embedded across the force as a whole, and both 1MCG and 2MCG can therefore be regarded as suitable for High North operations.

The Dutch Army's main land formations are comprised of three brigades: 11 Luchtmobiele Brigade (Airmobile Brigade), 13 Lichte Brigade (Light Infantry Brigade), and 43 Gemechaniseerde Brigade (Mechanised Brigade).¹⁵⁹ Elements

¹⁵⁴ Like the UK Royal Marines, the Netherlands Marine Corps is sometimes regarded as a special operations force. The Netherlands Ministry of Defence describes the Corps as "special-operations-capable." In practice, this label appears to mean only that the 1st and 2nd Marine Combat Groups can support special operations forces. The Corps also fields its own special operations unit, separate from the combat groups, which indicates that the combat groups themselves should not be considered special forces per se; see Ministry of Defence, "Special forces en combat groups," *Defensie*.

¹⁵⁵ de Wit, Rob, "Uitdelen en incasseren" [Hand out and Cash in], *Marineblad*, 9 May 2023.

¹⁵⁶ Ministry of Defence, "British–Dutch cooperation between marine units," *Defensie*.

¹⁵⁷ Chockey, William, "Korps Mariniers and U.S. Marines conduct amphibious landing," *dvids*, 21 March 2022; Ministry of Defence, "A look at the Defence news 11–17 March," *Defensie*, 20 March 2024; van Duin, Joris, "Duidelijk signaal boven de Poolcirkel" [Clear signal above the Arctic Circle], *Alle Hens*, vol. 77, no. 2, 15 March 2024; van den Bulk, Saminna, "Afschrikken in de arctic" [Deterrence in the Arctic], *Alle Hens*, vol. 76, no. 2, 15 March 2023.

¹⁵⁸ Korps Mariniers, Facebook post, 25 January 2024; Korps Mariniers, Facebook post, 13 February 2024; Korps Mariniers, Facebook post, 6 March 2023; Korps Mariniers, Facebook post, 10 March 2022; Korps Mariniers, Facebook post, 8 March 2021; Margés, Joost, "Actueler dan ooit" [More topical than ever], *Alle Hens*, vol. 75, 2, 10 March 2022.

¹⁵⁹ IISS, "Chapter Three: Europe."

of these units have received some winter training, but this has been conducted in the Tyrolean Alps. It has not been possible to confirm that any of them has taken part in major exercises in the High North. They may have some winter familiarity, but they should not be regarded as capable of operating in the High North.

Like the British commando battalions, the Marine Combat Groups are equipped with the BvS10 articulated all-terrain vehicle for mobility over snow, a system already noted as suitable for High North operations. As light infantry, the battalions lack heavier fires systems, including artillery support. The Netherlands has recently chosen to procure the PULS rocket artillery system.¹⁶⁰ The system can fire munitions with ranges of up to 300 km, but it is not yet known which munition types the country has acquired. The Dutch long-range fires capability is therefore, for the time being, unknown.

The Netherlands fields a transport helicopter squadron operating the AS532U2 Cougar Mk II and CH-47F Chinook, and an attack helicopter squadron with the AH-64 Apache.¹⁶¹ The Air Force also operates several NH90 helicopters primarily for anti-submarine warfare; these will in due course replace the Cougar in the amphibious transport role.¹⁶² The transport helicopter squadron primarily supports the Airmobile Brigade but it is reasonable to assume that it should also be able to undertake lift tasks for the Korps Mariniers, albeit as a secondary task. The NH90 and Cougar have participated in Arctic exercises; these platforms can be considered to be suitable for High North operations, subject to potential limitations at the very lowest temperatures.¹⁶³ It is not known whether the Dutch Chinook and Apache fleets have received the same adaptations that enable their US counterparts to operate in Arctic conditions.

Table 10. Summary—Dutch units with assessed capability to operate in the Scandinavian High North.

Unit	Assessed winter and wilderness capability
Korps Mariniers: 2 marine infantry battalions	Good capability

¹⁶⁰ Wolting, Jaap, “Versterking vuursteun krijgt vorm” [Strengthening fire support takes shape], *Koninklijke Landmacht*, vol. 74, no. 5, 4 June 2024.

¹⁶¹ Royal Netherlands Air Force, “Vliegbas Gilze-Rijen,” *Koninklijke Luchtmacht*.

¹⁶² Twigt, André, “NH90 werkt op voor amfibische taak” [NH90 reworked for amphibious task], *Vliegende hollander*, vol. 78, no. 1–2, 22 February 2022.

¹⁶³ Van Duin, Joris, “Helikoptergeweld boven de poolcirkel” [Helicopter force above the Arctic Circle] *Vliegende hollander*, 25 March 2024; Marchand, Arno, “Arctische luchtmachtlessen” [Arctic Air Force Lessons] *Vliegende hollander*, vol. 80, no. 3, 30 March 2023.

5 Conclusions

5.1 Summary and results

The High North as a geographic theatre is characterised by severe winter conditions, low population density, and significant constraints on mobility and sustainment. These circumstances impose specific requirements on units expected to operate in the region. Units must possess both cold-weather capability and the ability to operate in wilderness. Units that are to conduct high-intensity combat in the area should be specifically trained and equipped for the task and be able to operate over very long distances without relying on surrounding infrastructure or supporting capabilities. A low requirement for logistic support and a credible long-range fires capability can confer significant advantages on a force in the area.

Assessing a given unit's ability to operate under these conditions in detail requires classified or otherwise non-public information and data. In this study, however, it is assumed that units routinely based in the High North, or in areas that are comparable to it, have developed the required capability. Another reasonable indicator of such capability is a unit's exercise history in these areas, on the premise that one "trains where one expects to fight."¹⁶⁴ It is often clear in open sources which units have participated in exercises intended to develop or validate cold-weather and wilderness capability. This provides a basis that makes it possible to compile the set of units with the requisite capabilities available to the land forces of Finland, Norway, the US, Canada, the United Kingdom, and the Netherlands. The results are summarised in Table 11.

¹⁶⁴ Depledge, Duncan. "Train Where You Expect to Fight: Why Military Exercises Have Increased in the High North." *Scandinavian Journal of Military Studies*. Vol. 3, no. 1, 2020: 288–301.

Table 11. Unit numbers and types capable of operating in the High North, and long-range fires capability: summary.

	Finland	Norge	US	Canada	UK	
Confirmed units	No data	1 brigade, 1 battalion	2 brigades, 1 battalion	1 battalion	1 battalion	2 battalions
Type	No data	1 mech. brig., 1 inf. bat.	1 airborne brig., 1 inf. brigade, 1 marine inf. brigade	1 infantry battalion	1 marine inf. battalion	2 marine infantry battalions
Estimated units or units with uncertain capability	6 brigades, 6 battalions	—	3 brigades	1 battalion	1–3 battalions	—
Type	2 mech. brig., 3–4 inf. brig., 6 inf. bat.	—	3 inf. brig.	1 unknown, probably inf. battalion	1 mar. Inf. battalion, 1–2 inf. bat.	—
Total, maximum possible number of units and type	2 mech. brig., 4 inf. brig., 6 inf. bat.	1 mech. brig., 1 inf. bat.	1 airborne brig., 4 inf. brigade, 1 marine inf. brigade	2 infantry battalions	2 marine infantry battalions	2 marine infantry battalions
LRF	Yes	No	Yes	No	Yes	Unknown

5.2 Discussion and further research

An important question closely linked to these results concerns the military balance in the area. A list of Western units that have the capability to operate in the High North provides a natural point of departure for further assessments of the potential balance of forces between NATO and Russia in the region. It is therefore appropriate to comment on that balance here. To assess, on the basis of this study's findings, what balance of forces would obtain between allied and Russian forces in the High North would require additional information. First, the ability of Russian units to operate in the area would also need to be estimated. Second, it is necessary to judge which units, and how many, on each side would in fact be deployed to this region rather than to other theatres. More detailed estimates on these remaining questions lie outside the scope of this study. It is possible, however, to use the study's results to outline certain starting points or parameters for any such assessments.

For example, given the region's remoteness and sparse population, it should be assumed that Russia would not view the High North as the primary theatre in any conflict with NATO, and that the Russian leadership would in that case set modest objectives for operations there. A Russian attack on the allied parts of the High North would therefore likely be sized to allow greater concentrations

of force on other, more important stretches of the Russia–NATO frontier. The number of Russian units committed would depend on the resistance expected; the volume of allied forces available could thus be a determining factor in the scale of the Russian effort.

The issue of time is therefore critical, because the number of allied forces able to operate in the High North may vary greatly depending, above all, on whether US reinforcements have been deployed. If Russia were to attack NATO without warning, only Finnish, Norwegian, and Swedish forces would be in or near the High North. In the near term, before reinforcements can arrive, these are the forces that matter for any assessment of the balance.

Even within this narrower set of units, uncertainty remains. As Table 7 summarises, Finland and Norway together field about seven brigades that can be regarded as capable of operating in the High North. If a Swedish brigade is added, the total amounts to a substantial force of roughly two divisions. A set of Russian ground units is commonly associated with Arctic operations; before the expanded war in Ukraine, these numbered about four brigades, two of them based in Murmansk Oblast.¹⁶⁵ If Russia has not trained, or is not training, additional units with the requisite capability, Russian forces would face a serious numerical disadvantage in a High North scenario even before reinforcements from other allied countries arrive. That conclusion, however, assumes that all Finnish units with the necessary capability deploy to the area, which is unrealistic given Finland's need to prioritise the defence of the south and the likely limited operational mobility of many of the Finnish formations concerned. If, instead, Finland contributes only two brigades to the defence of the High North, the allied force there would amount to about four brigades. In that case the local balance would be roughly even: four allied brigades against four Russian.

The presence of larger ground-combat formations able to operate in the High North raises another issue for judging the West–Russia balance there: How many units can realistically be deployed simultaneously without loss of effectiveness or without incurring greater vulnerability to one's own units? The area is operationally sparse, seeing as it is likely to be characterised by the problem of the low-density battlefield, but can become tactically crowded. It is unclear where the point of diminishing returns lies—the point at which adding more units would merely burden logistics and increase exposure rather than raise aggregate capability. If contact with the adversary cannot be widened, for example along one of the region's few major roads, vulnerable concentrations of troops and materiel may build up behind the lead elements as reinforcements arrive without the ability to disperse off-road. Experience from the Finnish

¹⁶⁵ Boulègue, Mathieu. *The Impact of the War Against Ukraine on Russia's Arctic Posture: Hard Power on Vulnerable Ice*. *Wilson Center: Polar Institute*.

Winter War suggests that lighter forces with local knowledge can exploit such situations to devastating effect. Whether this risk persists today, or is peculiar to the High North, is best examined through wargaming rather than an open-source literature review. Even so, assessments of the local balance should in practice prioritise the quality of available formations over their quantity.

The area's operational sparsity and its potential tactical density can also be discussed in light of the ongoing war in Ukraine and the low-density battlefield. Experience from that war suggests that modern armies possess far better capabilities for tactical intelligence collection and precision strike than before. As a result, the side attempting to make operationally significant advances has been hit quickly, producing high losses and a relatively static battlefield.¹⁶⁶ Whether these conditions apply to a High North scenario has not been examined in detail here. Any assessment of applicability must account for the very different force densities in the two theatres. The allied frontier with Russia in the High North (north of Tornio) is about 600 km long. If Russia were to deploy four brigades along that line, each kilometre of frontage would on average be covered by roughly 40 soldiers.¹⁶⁷ The equivalent figure for the Russian front in Ukraine in February 2024 was around 600, more than ten times denser.¹⁶⁸ One plausible reading of this illustrative, simplified calculation is that lessons from Ukraine do not translate directly to the High North, where far fewer soldiers and systems can be concentrated per unit of frontage and area. In certain limited locales, however, such as along the channelising roads, force density could become very high, making the local situation fully comparable with Ukraine. The ability to conduct bypass or outflanking movements off the road network would therefore matter greatly.

The relevance of lessons from Ukraine to fighting in the High North therefore warrants further study, especially where dynamics seen in that war could be amplified by High North conditions. One example is the increased vulnerability of logistics units. As noted above, the war in Ukraine points to an elevated ability to track and strike targets on the modern battlefield. To survive, combat units have been forced into greater dispersion and mobility. For manoeuvre formations this is a relatively manageable problem; their logistics, however, have become more exposed. Logistics units must act more predictably, concentrate at fixed transfer points, and are more constrained by local infrastructure, and will

¹⁶⁶ Kagan, Frederick et al. *Ukraine and the Problem of Restoring Maneuver in Contemporary War*. Washington D.C. Institute for the Study of War. 2024.

¹⁶⁷ A brigade is considered to comprise 5,600 personnel.

¹⁶⁸ With a frontline that the author estimates at roughly 750 km. The total Russian strength is assumed to be 470,000 personnel, see Watling, Jack, Reynolds, Nick. *Russian Military Objectives and Capacity in Ukraine Through 2024*. RUSI. 13 februari 2024.

therefore be detected and struck quickly.¹⁶⁹ These factors may be even more problematic in the High North, where movement off-road is severely limited and the demands on logistic support may be far higher than in more accessible theatres.

¹⁶⁹ Watling, Jack and Horne, Si. *Assuring the Tactical Sustainment of Land Forces on the Modern Battlefield*. London. Royal United Services Institute. 2024; Wilson, Thaddeus. "Adapting to the Expected LSCO Conflicts in the 21st Century." *Army Sustainment*. Vol. 56, no. 2, 2024: 4–7.

6 References

- 11th Airborne Division. Units. *11th Airborne Division*.
<https://11thairbornedivision.army.mil/Units/>. Accessed 16 September 2024.
- Alaska National Guard. 38th Troop Command. *Alaska Army National Guard*.
<https://ak.ng.mil/Components/Alaska-Army-National-Guard/38thTroop-Command/>. Accessed 18 October 2024.
- Alberta Biodiversity Monitoring Institute. Wetlands in the Prairie Region.
 ABMI. <https://wetland-report.abmi.ca/atlas-home/2.0-Alberta-Wetlands/2.3Wetlands-Prairie-Region.html>. Accessed 24 May 2024.
- Andersson, Henrik. *FOA-R--99-01064-201 Modellering av markstrid under vinterförhållanden*. Stockholm. FOA. 1998.
- Arcovitch, Mikel. National Guard Conducts Arctic Training with Canada.
National Guard. 4 March 2024.
<https://www.nationalguard.mil/News/Article-View/Article/3693666/national-guard-conducts-arctic-training-withcanada/>. Accessed 18 October 2024.
- Army MOD Press Office. Paratroopers ‘Break the Ice’ with JEF and NATO Allies. March 2023. *ParaData*.
<https://www.paradata.org.uk/article/paratroopers-break-ice-jef-and-natoallies-march-2023>. Accessed 21 October 2024.
- Army Technology. British Army’s Apache helicopters deploy to Arctic. *Army Technology*. 16 January 2019.
<https://www.armytechnology.com/news/british-army-apache-helicopters-arctic/?cf-view>. Accessed 12 February 2025.
- Aronsson, Albin. UK. In Ottosson, Björn and Pallin, Krister (eds.). *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm. FOI. 2024.
- Austin, Akeel. U.S. Marines of 2nd Battalion, 10th Marine Regiment train with HIMARS in Norway in preparation for Exercise Nordic Response 2024. *dvids*. 27 February 2024.
<https://www.dvidshub.net/image/8261639/usmarines-2nd-battalion-10th-marine-regiment-train-with-himars-norwaypreparation-exercise-nordic-response-24>. Accessed 22 October 2024.
- Baker, Austin., Multinational Soldiers conduct winter warfare training during Defense Exercise North 2023. *dvids*. 7 March 2023.
<https://www.dvidshub.net/video/875602/multinational-soldiers-conductwinter-warfare-training-during-defense-exercise-north-2023>. Accessed 3 October 2024.

- Barry, Gregory. How the 10th Mountain Division Is Going Back to Its Alpine and Mountain Roots. *Military Review*. No. 4, 2024: 105–112.
- Boulègue, Mathieu. The Impact of the War Against Ukraine on Russia's Arctic Posture: Hard Power on Vulnerable Ice. *Wilson Center: Polar Institute*.
- British Army. 29th Commando Regiment Royal Artillery. *British Army*. <https://www.army.mod.uk/learn-and-explore/about-the-army/corpsregiments-and-units/royal-artillery/29th-commando-regiment-royalartillery/>. Accessed 12 February 2025.
- British Army. Guided Multiple Launch Rocket System (GMLRS). *British Army*. <https://www.army.mod.uk/learn-and-explore/equipment/artillery-andair-defence/guided-multiple-launch-rocket-system-gmlrs/>. Accessed 22 October 2024.
- Bost, Joshua, Knox, Elizabeth and Perez, Jomar. 'Assured Mobility in the Arctic'. *Military Review*. No. 1, 2024: 141–148.
- Chockey, William. Korps Mariniers and U.S. Marines conduct amphibious landing. *dvids*. 21 March 2022. <https://www.dvidshub.net/image/7105919/korps-mariniers-and-usmarines-conduct-amphibious-landing>. Accessed 24 January 2025
- Cizkova, Hana et al. Actual state of European wetlands and their possible future in the context of global climate change. *Aquatic Sciences*. Vol 75, 2011: 3–26.
- Clark, J. The Arctic Dilemma: Force Generation Considerations for Land Forces. In Lynch, Michael and Coombs, Howard (eds). *International Competition in the High North: 2022 Conference Volume*. Carlisle. Strategic Studies Institute, US Army War College. 2024.
- Climate-Data. Fairbanks climate. *Climate-Data*. <https://en.climatedata.org/north-america/united-states-of-america/alaska/fairbanks1403/#climate-table>. Accessed 17 September 2024.
- Collins, John M. *Military Geography for Professionals and the Public*. Washington, D.C., National Defense University Press, 1998.
- Congressional Budget Office. *The U.S. Military's Force Structure: A Primer, 2021 Update*. Washington D.C., Congressional Budget Office. 2021.
- Crowther, T., et al. Mapping tree density at a global scale. *Nature*. Vol. 525, 2015: 201–205.
- Dalsjö, Robert. Det glesa slagfältet och försvaret av Sverige. *Kungliga Krigsvetenskapsakademiens Tidsskrift*. No. 3, 2019: 24–30.

- Defence Industry Europe. Royal Navy Commandos deploy to Arctic Circle for NATO defence drills. *Defence Industry Europe*. 11 January 2025. <https://defence-industry.eu/royal-navy-commandos-deploy-to-arcticcircle-for-nato-defence-drills/>. Accessed 12 February 2025.
- Defense Security Cooperation Agency. *Norway—M142 Hight Mobility Artillery Rocket Systems*. 9 August 2024. <https://www.dsca.mil/pressmedia/major-arms-sales/norway-m142-high-mobility-artillery-rocketsystems>. Accessed 6 November 2024.
- Dennis, Christopher. Why 11th Airborne Division? *US Army*. 16 May 2022. https://www.army.mil/article/256753/why_11th_airborne_division. Accessed 16 September 2024.
- Department of the Army. *ATP 3-09.24 The Field Artillery Brigade*. Washington, D.C., Headquarters, Department of the Army. 2024.
- Department of the Army. *FM 3-96 Brigade Combat Team*. Washington D.C., Headquarters, Department of the Army. 2021.
- Department of the Army. *Regaining Arctic Dominance—The U.S. Army in the Arctic*. Washington D.C., Headquarters, Department of the Army. 2021.
- Department of the Army. *ATP 3-90.97 Mountain Warfare and Cold Weather Operations*. Washington D.C., Headquarters, Department of the Army. 2016.
- Department of the Navy. *A Blue Arctic—A Strategic Blueprint for the Arctic*. Washington, D.C., Headquarters, Department of the Navy. 2021.
- Department of the Navy. *MCRP 1-10.1: Organization of the United States Marine Corps*. Washington D.C., Headquarters, Department of the Navy. 2020.
- Depledge, Duncan. Train Where You Expect to Fight: Why Military Exercises Have Increased in the High North. *Scandinavian Journal of Military Studies*. Vol. 3, no. 1, 2020: 288–301.
- de Wit, Rob. Utdelen en incasseren. *Marineblad*. 9 May 2023.
- Edvardsen, Astri. Kick-off in the North for the Norwegian Army's Biggest Exercise This Fall. *High North News*. 18 November 2022. <https://www.highnorthnews.com/en/kick-north-norwegian-armysbiggest-exercise-fall>. Accessed 8 November 2024.
- Edvardsen, Astri. Large Army and Navy Exercises in the Nordic Region This Late Fall. *High North News*. 1 December 2022. <https://www.highnorthnews.com/en/large-army-and-navy-exercisesnordic-region-late-fall>. Accessed 12 September 2023.

- European Environment Agency. Land cover and change accounts 2000–2018 [Dataset]. European Environment Agency. 22 August 2023. <https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-andchange-statistics>. Accessed 28 August 2024.
- Feickert, Andrew. *Infantry Brigade Combat Team (IBCT) Mobility, Reconnaissance, and Firepower Programs*. Washington D.C., Congressional Research Service. 2017.
- Finnish Meteorological Institute. Temperature and precipitation statistics from 1961 onwards [Dataset]. <https://en.ilmatieteenlaitos.fi/statistics-from1961-onwards>. Accessed 16 August 2024.
- Fitzgerald, Chad, Graw, Dan and Kuegler, Hannah. From Heaven to Hell: Fires Employment for the 11th Airborne Division ‘Arctic Angels.’ *Military Review*. Vol 1, 2024: 130–140.
- Folkesson, Ida. Norrlandsjägare och UK Rangers sida vid sida. *Försvarsmakten*. 7 October 2022. <https://www.forsvarsmakten.se/sv/aktuellt/2022/10/norrlandsjagare-ochuk-rangers-sida-vid-sida/>. Accessed 21 October 2024.
- ForcesNet. Royal Marines Undergo Reconnaissance Exercises In Arctic Circle. *ForcesNet*. 2 March 2021. <https://www.forcesnews.com/news/royalmarines-undergo-reconnaissance-exercises-arctic-circle>. Accessed 18 September 2024.
- Forsvaret. 339 Special Operations Aviation Squadron (SOAS). <https://www.forsvaret.no/om-forsvaret/organisasjon/forsvaretsspesialstyrker/339-soas>. Forsvaret. Accessed 8 January 2025.
- Forsvaret. Finnmark landforsvar. *Forsvaret*. <https://www.forsvaret.no/omforsvaret/organisasjon/haeren/finnmark-landforsvar>. Accessed 12 September 2024.
- Forsvaret. Innsatsstyrker. *Forsvaret-webbplats*. <https://www.forsvaret.no/heimevernet/innsatsstyrker>. Accessed 17 September 2024.
- Forsvaret. Om Heimevernet. *Forsvaret*. <https://www.forsvaret.no/heimevernet/om-heimevernet>. Accessed 12 September 2024.
- Forsvaret. Tenestestader. *Forsvaret*. <https://www.forsvaret.no/omforsvaret/tjenestesteder>. Accessed 17 October 2024.
- Forsvaret. Utstyr og materiell. *Forsvaret*. <https://www.forsvaret.no/omforsvaret/utstyr-og-materiell>. Accessed 8 January 2024.

- Forsvaret. Setermoen. *Forsvaret*. 24 June 2024.
<https://www.forsvaret.no/omforsvaret/tjenestesteder/setermoen>.
 Accessed 12 September 2024.
- Forsvaret. En demonstrasjon av styrke og samhold i nord. *Forsvaret*. 21 March 2024. <https://www.forsvaret.no/aktuelt-og-presse/aktuelt/endemonstrasjon-av-styrke-og-samhold-i-nord>. Accessed 8 November 2024.
- Forsvaret. Bardufoss. *Forsvaret*. 18 July 2023.
<https://www.forsvaret.no/omforsvaret/tjenestesteder/bardufoss>.
 Accessed 12 September 2024.
- Forsvaret. Mediebank. *Forsvaret*. 21 March 2022.
<https://mediebank.ntb.no/p/forsvaret/album/2448/17560315>. Accessed 6 November 2023.
- Forsvaret. Mediebank. *Forsvaret*. 21 March 2019.
<https://mediebank.ntb.no/p/forsvaret/album/16969/17643983>. Accessed 8 November 2023.
- Försvarsmakten. *Handbok Markstrid—Vintersoldat*. Stockholm. Försvarsmakten. 2024. <https://www.forsvarsmakten.se/sv/var-verksamhet/ovningar/nordicresponse-2024/>. Accessed 17 October 2024.
- Försvarsmakten. *FM2022-13205:10 Nästa armé—Koncept, krav och lösning. Iteration Q2*. Stockholm. Försvarsmakten. 2023.
- Försvarsmakten. *FM2022-19979:19 Försvarsmaktens analys avseende militär förmåga i övre Norrland—Fördjupat underlag*. Stockholm. Försvarsmakten. 2023.
- Försvarsmakten. *FIB 2022:6 Försvarsmaktens arbetsordning*. Stockholm. Försvarsmakten. 2022.
- Försvarsmakten. *FM2021-7366:18: Studie I19 MARK 2021S Markstridskoncept Övre Norrland*. Stockholm. Försvarsmakten. 2022.
- Försvarsmakten. *FM2019-3480:4 Bilaga 1 till Systemutvecklingsplan för Försvarsmaktens Vinterförmåga 2019–25*. Stockholm. Försvarsmakten. 2019.
- Försvarsmakten. *Handbok Armé—Brigad: AH Brig*. Stockholm. Försvarsmakten. 2016.
- Government of Canada. Over 600 Canadian Armed Forces members training with Allies and partners in Alaska on Exercise GLOBAL RESOLVE 24. *Government of Canada*. 13 February 2024.
<https://www.canada.ca/en/department-national-defence/news/2024/02/over-600-canadian-armed-forces-memberstraining-with-allies-and-partners-in-alaska-on-exercise-global-resolve24.html>. Accessed 18 September 2024.

- Government of Canada. Operation NANOOK 2023 successfully concluded in Canada's Arctic. *Government of Canada*. 13 September 2023. <https://www.canada.ca/en/department-nationaldefence/news/2023/09/operation-nanook-2023-successfully-concludedin-canadas-arctic.html>. Accessed 12 February 2025.
- Government of Canada. Operations and Exercises. *Government of Canada*. 16 August 2021. <https://www.canada.ca/en/army/services/exercises-andoperations.html>. Accessed 18 September 2024.
- Government of Canada. Vehicles. *Government of Canada*. 14 April 2021. <https://www.canada.ca/en/army/services/equipment/vehicles.html>. Accessed 18 September 2024.
- Gralén, Lars. Ett helikoptersystem avvecklas. *Helikopter FlottiljNytt*. Nr. 4:2004.
- Gustafsson, Jakob. Norway. In Ottosson, Björn and Pallin, Krister (ed). *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm. FOI. 2024.
- Gustafsson, Pär. *FOI Memo 7624 Russia's Ambitions in the Arctic Towards 2035*. Stockholm. FOI. 2021.
- Henningsson, Jan. *FOI Memo 8520 Natomedlemskapets konsekvenser för markdomänen—Ett diskussionsunderlag inför fortsatt förstågautveckling*. Stockholm. FOI. 2024.
- Henningsson, Jan. *FOI Memo 8203 Ändrade uppgifter för försvaret vid ett Natomedlemskap? Ett diskussionsunderlag inför fortsatt förstågautveckling*. Stockholm. FOI. 2023.
- Henningsson, Jan, Ardenfors, Oscar, Brolin, Filip and Gräns, Carl Michael. *Underlag för spel Nordkalotten vid ett Nato-medlemskap*. Stockholm. FOI. 2023.
- Henningsson, Jan and Welsh, John., *FOI Memo 8446 Natomedlemskapets konsekvenser för sjödomänen—Ett diskussionsunderlag inför fortsatt förstågautveckling*. Stockholm. FOI. 2024.
- Holst-Pederson Kvam, Ina. Bastionförsvaret og Russlands militärmakt—Et utdatert trusselbilde? *NUPI Policy Brief*. Vol. 2, 2021.
- Häggbloom, Robin. The Finnish wartime Army. *Corporal Frisk*. 26 May 2024. <https://corporalfrisk.com/2018/05/26/the-finnish-wartime-army/>. Accessed 12 September 2024.
- Häggbloom, Robin. 6. Division to the Defence of the common North. *Corporal Frisk*. 27 May 2022. <https://corporalfrisk.com/2022/05/27/6-division-tothe-defence-of-the-common-north/>. Accessed 12 September 2024.

- Häggbloom, Robin. A Northern Heavy-lift. *Corporal Frisk*. 11 December 2018. <https://corporalfrisk.com/2018/12/11/a-northern-heavy-lift/>. Accessed 16 December 2024.
- Hörnedal, Andreas. *FOI-R--5573--SE Rare Birds: A Look at the Low-density Battlefield and Armed Drones*. Stockholm. FOI. 2024.
- IISS. Chapter Two: North America. *The Military Balance*. Vol. 124, no. 1, 2024: 16–53.
- IISS. Chapter Three: Europe, *The Military Balance*. Vol. 124, no. 1, 2024: 54–157.
- IISS. Explanatory notes. *The Military Balance*. Vol. 124, no. 1, 2024: 532–539
- Ilmavoimat. Pohjoisen ja koko Suomen suojana [Protecting the North and Finland as a whole]. *Ilmavoimat*. <https://ilmavoimat.fi/lapinlennosto/tietoa-meista>. Accessed 17 October 2024.
- Ilmavoimat. Lapin lennosto operoi kahdella Hornetilla Kemissä [Lapland Air Command operates with two Hornets in Kemi]. *Ilmavoimat*. 27 May 2024. https://ilmavoimat.fi/-/lapin_lennosto_operoi_kemista_viikolla_22. Accessed 17 October 2024.
- Ilmavoimat. Lapin lennosto harjoittelee Ivalossa [Lapland Air Command exercises in Ivalo]. *Ilmavoimat*. 14 March 2022. <https://ilmavoimat.fi/lapin-lennosto-harjoittelee-ivalossa>. Accessed 17 October 2024.
- Jonsson, Michael. *Finland*. In Ottosson, Björn and Pallin, Krister (ed). *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm. FOI. 2024.
- Judson, Jen. BAE Systems wins US Army deal for Cold Weather All-Terrain Vehicle. *DefenseNews*. 23 August 2022. <https://www.defensenews.com/land/2022/08/23/bae-systems-wins-usarmy-deal-for-cold-weather-all-terrain-vehicle/>. Accessed 17 September 2024.
- Kagan, Frederick et al. Ukraine and the Problem of Restoring Maneuver in Contemporary War. Washington D.C. Institute for the Study of War. 2024.
- Kainuun Liitto. Kainuu in Figures. *Statistics*. 28 November 2023. <https://kainuunliitto.fi/en/kainuu-in-statistics/>. Accessed 6 November 2024.
- Kemin Satama. *Vuosikertomus 2023* [Annual report 2023]. <https://www.portofkemi.fi/wpcontent/uploads/2024/06/kesavuositomus2023.pdf>. Accessed 6 November 2024.

- Kepe, Marta. From Forward Presence to Forward Defense: NATO's Defense of the Baltics. *RAND*. 14 February 2024.
<https://www.rand.org/pubs/commentary/2024/02/from-forwardpresence-to-forward-defense-natos-defense.html>. Accessed 16 October 2024.
- Kettunen, Alexei. Suomesta GMLRS-ohjussuurvalta? [Finland to become a GMLRS missile superpower?]. *Soumen Sotilas*. 7 November 2022.
<https://suomensotilas.fi/2022/11/07/suomesta-gmlrs-ohjussuurvalta/>. Accessed 21 October 2024.
- Korps Mariniers. Facebook post. 13 February 2024.
<https://www.facebook.com/korpsmariniers1665>.
- Korps Mariniers. Facebook post. 25 January 2024;
<https://www.facebook.com/korpsmariniers1665>.
- Korps Mariniers. Facebook post. 6 March 2023.
<https://www.facebook.com/korpsmariniers1665>.
- Korps Mariniers. Facebook post. 10 March 2022.
<https://www.facebook.com/korpsmariniers1665>.
- Koskinen, Risto. Ankara ilmasto rikkoi lentokentän mosaiikiksi – Enontekiön lentoasemalla alkaa vihdoinkin miljoonaremontti [Harsh climate shattered the airport into a mosaic—Enontekiö Airport finally begins a millioneuro renovation]. *Yle*. <https://yle.fi/a/74-20100441>. Accessed 17 October 2024.
- Kystverket. Istjenesten i Norge. *Kystverket*. 16 April 2024.
<https://www.kystverket.no/navigasjonstjenester/istjenesten-i-norge/>. Accessed 16 October 2024.
- Kähkönen, Sanna. Kainuun prikaati kutsuu 1600 uutta alokasta, esikuntapäällikön mukaan pari viime vuotta ovat näyttäneet miksi puolustusvoimat on olemassa [Kainuu Brigade invites 1600 new recruits, according to the Chief of Staff, the last couple of years have shown why the Defence Forces exist]. *Yle*. 29 January 2024.
<https://yle.fi/a/74-20068330>. Accessed 18 September 2024.
- Lacdan, Joe. Soldiers prepare for combat operations in the Arctic. *US Army*. 1 March 2024.
https://www.army.mil/article/274157/soldiers_prepare_for_combat_operations_in_the_arctic. Accessed 16 September 2024.
- Lantmäteriverket. Arealer Kommunvis [Dataset]. *Statistik*. 1 January 2023.
<https://www.maanmittauslaitos.fi/sv/information-omlantmateriverket/organisation/statistik>. Accessed 28 August 2024.

Länsstyrelsen Norrbotten. *Om länet*.

<https://www.lansstyrelsen.se/norrbotten/omoss/om-lansstyrelsen-i-norrbottens-lan/landshovding-ochlansledning/om-lanet.html>. Accessed 28 August 2024.

Maavoimat. Cold Response 2022. *Maavoimat*.

<https://maavoimat.fi/coldresponse-2022>. Accessed 8 November 2024.

Maavoimat. Jägarbrigaden—Om oss. *Maavoimat*.

<https://maavoimat.fi/sv/jagarbrigaden/om-oss>. Accessed 16 April 2024.

Maavoimat. Kainuun prikaati Alokasinfo [Kainuu Brigade Rookie Info].

Maavoimat. <https://maavoimat.fi/kainuun-prikaatin-alokasinfo>.

Accessed 12 September 2024.

Maavoimat. Finnish Defence Forces to exercise defending NATO northern region together with allies. *Maavoimat*. 6 February 2024.

<https://maavoimat.fi/en/-/1948673/finnish-defence-forces-to-exercisedefending-nato-northern-region-together-with-allies>. Accessed 8 November 2024.

Maavoimat. Kainuun prikaatin alokkailla sotilasvala ja –vakuutus

Lapinlahdella ja Kajaanissa [Kainuu Brigade recruits take military oaths and affirmations in Lapinlahti and Kajaani]. *Maavoimat*. 29 January 2024. <https://maavoimat.fi/-/kainuun-prikaatin-alokkailla-sotilasvala-javakuutus-lapinlahdella-ja-kajaanissa>. Accessed 18 September 2024.

Maavoimat. Kainuun prikaatin alokkat valalla Kajaanin keskustassa [Kainuu Brigade recruits under oath in the centre of Kajaani]. *Maavoimat*. 8

March 2023. <https://maavoimat.fi/-/kainuun-prikaatin-alokkaat-valallakajaanin-keskustassa>. Accessed 18 September 2024.

Maavoimat. Maavoimille lisää K9-panssarihaupitseja [More K9 howitzers for the Finnish Army]. *Maavoimat*. 18 November 2022.

<https://maavoimat.fi/-/maavoimille-lisaa-k9-panssarihaupitseja#:~:text=Maavoimille%20hankitaan%20lis%C3%A4%C3%A4%20155%20mm:n%20raskaita%20K9panssarihaupitseja.%20Hankinta%20parantaa%20Maavoimien>. Accessed 12 September 2024.

Maavoimat. Exercise Northern Wind 2019 in Northern Sweden. *Maavoimat*.

2019. <https://maavoimat.fi/en/northernwind19-en>. Accessed 8 November 2024.

Malyasov, Dylan. US Army develops Arctic doctrine for extreme cold weather operations. *Defense blog*. 30 January 2024. <https://defence-blog.com/usarmy-develops-arctic-doctrine-for-extreme-cold-weather-operations/>. Accessed 16 September 2024.

- Manuel, Rojoef. Finnish Army to Receive New Batch of K9 Howitzers. *The Defense Post*. 22 November 2022.
https://www.thedefensepost.com/2022/11/22/finland-armyhowitzer/?expand_article=1. Accessed 12 september 2024.
- Marchand, Arno. Arcticse luchtmachtlessen (*Arctic Air Force Lessons*) *Vliegende hollander*. 30 March 2023.
- Margés, Joost. Actueler dan ooit (*More topical then ever*). *Alle Hens*. 10 March 2022.
- McClatchey, John. Global climate and weather. In *An Introduction to Physical Geography and the Environment*, Holden, Joseph (ed.), 195–228.
Harlow: Pearson Education Limited, 2017.
- Mikkola, Harri. *The Geostrategic Arctic: Hard Security in the High North*. Helsinki. Finnish Institute of International Affairs. 2019.
- Ministry of Defence. British–Dutch cooperation between marine units. *Defensie*. <https://english.defensie.nl/topics/international-cooperation/othercountries/british-dutch-cooperation-between-marine-units>. Accessed 3 February 2025.
- Ministry of Defence. Special forces en combat groups. *Defensie*.
<https://www.defensie.nl/onderwerpen/korps-mariniers/organisatie-korpsmariniers>. Accessed 3 February 2025.
- Ministry of Defence. A look at the Defence news 11–17 March. *Defensie*. 20 March 2024. <https://english.defensie.nl/latest/news/2024/03/20/a-look-atthe-defence-news-11---17-march>. Accessed 24 January 2025.
- Ministry of Defence. The UK’s Defence Contribution in the High North. *Ministry of Defence*. 2022.
- Ministry of Defence. UK Forces return home after successful NATO exercise. *GOV.UK*. 12 November 2018.
<https://www.gov.uk/government/news/ukforces-return-home-after-successful-nato-exercise>. Accessed 21 October 2024.
- National Oceanic and Atmospheric Administration. NOAA Online Weather Data [Dataset]. *National Weather Service*.
<https://www.weather.gov/wrh/Climate?wfo=buf>. Accessed 3 October 2024.
- NATO. There’s no business like snow business—US Marines build their skills in the Norwegian Arctic. *NATO*. 12 March 2024.
https://www.nato.int/cps/en/natohq/news_223083.htm?selectedLocale=en. Accessed 7 March 2024.
- NATO. *NATO Standard AJP-3.2: Allied Joint Doctrine for Land Operations*. 2022.

- Navy Lookout. Strike from the sea – developing the UK Commando Force. Navy Lookout. 24 June 2024. <https://www.navylookout.com/strike-from-thesea-developing-the-uk-commando-force/>. Accessed 22 January 2025.
- Navy Lookout. Understanding the Royal Navy’s littoral response group concept. *Navy Lookout*. 17 August 2021. <https://www.navylookout.com/understanding-the-royal-navy-littoralresponse-group-concept/>. Accessed 18 September 2024.
- Neretnieks, Karlis. Det glesa slagfältet—Ett bidrag till debatten. *Kungliga Krigsvetenskapsakademien*. 27 January 2020. <https://kkrva.se/det-glesaslagfaltet-ett-bidrag-till-debatten/>. Accessed 6 November 2024.
- Nieberg, Patty. Army activates Arctic Aviation Command for extreme cold flying. *Task & Purpose*. 20 August 2024. <https://taskandpurpose.com/news/army-activates-alaska-aviationcommand/>. Accessed 2 October 2024.
- Nieberg, Patty. 10th Mountain Division rolls more than 500 miles across Finland, Sweden and Norway. *Task & Purpose*. 13 May 2024. <https://taskandpurpose.com/news/10th-mountain-army-sweden-march/>. Accessed 3 October 2024.
- O’Hanlon, Michael. *The Science of War: Defense Budgeting, Military Technology, Logistics, and Combat Outcomes*. Princeton, Princeton University Press. 2009. Olefeldt, David et al. The Boreal–Arctic Wetland and Lake Dataset (BAWLD). *Earth System Science Data*. Vol 13, no. 11, 2021: 5127–5149
- Ottosson, Björn. USA. In Ottosson, Björn and Pallin, Krister (ed.). *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm. FOI. 2024.
- Peel, M.C, Finlayson, B.L. and McMahon, T.A. Updated world map of the Köppen–Geiger climate classification. *Hydrology and Earth System Sciences*. Vol 11, no. 5, 2007:1633–1644.
- Pelletier, Roch. Canadian Land Forces in the High North and Arctic—A Collective Effort. In Lynch, Michael and Coombs, Howard (ed.). *International Competition in the High North: 2022 Conference Volume*. Carlisle. Strategic Studies Institute, US Army War College. 2024.
- Perreira, Julian. UK Commando Helicopter Force completes Arctic warfare operations in Norway. *Forces News*. 20 April 2023. <https://www.forcesnews.com/operations/arcticantarctic/uk-commandohelicopter-force-complete-arctic-warfare-operations-norway>. Accessed 12 February 2025.

- Porin Prikaati—Pori Brigade. Facebook post. 19 March 2024.
<https://www.facebook.com/PorinPR>.
- Prebilic, Vladimir. Theoretical Aspects of Military Logistics. *Defense & Security Analysis*, Vol. 22, no. 2, 2006: 159–177.
- Puolustusvoimat. Utti Jaeger Regiment's main winter exercise to develop international joint operating capability. *Puolustusvoimat*. 8 February 2024. <https://puolustusvoimat.fi/en/-/1950813/utti-jaeger-regiment-s-mainwinter-exercise-to-develop-international-joint-operating-capability>. Accessed 16 December 2024.
- Qviller, Jörn. *Det amerikanske marinekorpset—Den nölande arktiske krigeren*. In Wegge, Nord (ed.). *Sikkerhetspolitikk og miliärmakt i Arktis*. Cappelen Damm Akademisk. 2023.
- Rauanheimo. Röyttä port in Tornio. *Rauanheimo*.
<https://www.rauanheimo.com/en/roytta-port-in-tornio/>. Accessed 16 October 2024.
- Regjeringen. Prop. 87 S til Stortinget. *Forsvarsløftet—For Norges trygghet. Langtidsplan for forsvarssektoren 2025–2036*.
- Regjeringen. *Fylkesinndelingen fra 2024*. 1 January 2024.
<https://www.regjeringen.no/no/tema/kommuner-ogregioner/kommunestruktur/fylkesinndelingen-fra-2024/id2922222/>. Accessed 28 August 2024.
- Rehman, Mishall. Numerous Exercises and Operations have CAF and American military personnel hone arctic skills. *Canadian Military Family Magazine*. 18 March 2022. <https://www.cmfmag.ca/numerous-exercisesand-operations-have-caf-and-american-military-personnel-hone-arcticskills/>. Accessed 18 September 2024.
- Reinsch, Michael. 10th Mountain Division's service members train with HIMARS. *U.S. Army*. 11 April 2019.
https://www.army.mil/article/220058/10th_mountain_divisions_service_members_train_with_himars. Accessed 22 October 2024.
- Roaten, Meredith. AUSA 2023: Cold Weather All-Terrain Vehicles delivered to US Army. *Jane's*. 12 October 2023.
<https://www.janes.com/osintinsights/defence-news/land/ausa-2023-cold-weather-all-terrain-vehiclesdelivered-to-us-army>. Accessed 17 September 2024.
- Rosstat. Statistical Publications. *Regioni Rossii. Sotsialno-ekonomichesike pokazateli* [Regions of Russia. Socio-economic indicators; dataset]. 21 March 2024. <https://rosstat.gov.ru/folder/210/document/13204>. Accessed 11 November 2024.

- Rosstat. Population size and distribution [Dataset]. *Volumes of the official publication of the results of the All-Russian Population Census of 2010*. rosstat.gov.ru/free_doc/new_site/perepis2010/croc/vol1pdf-m.html. Accessed 28 August 2024.
- Royal Airforce. Vliegbas Gilze-Rijen [Gilze-Rijen Air Base]. *Koninklijke Luchtmacht*. <https://www.defensie.nl/organisatie/luchtmacht/vliegbasesen-luchtmachtonderdelen/gilze-rijen>. Accessed 4 February 2025.
- Royal Navy. Commando Helicopter Force. *Royal Navy*. <https://www.royalnavy.mod.uk/organisation/units-and-squadrons/support-and-training/commando-helicopter-forceheadquarters>. Accessed 12 February 2025.
- Royal Navy. Equipment Commando: By Land. *Royal Navy*. <https://www.royalnavy.mod.uk/equipment/commando/by-land>. Accessed 18 September 2024.
- Royal Navy. Royal Marines at the tip of the NATO spear on major Arctic exercise. *Royal Marines*. 14 March 2024. <https://www.royalnavy.mod.uk/news-and-latestactivity/news/2024/march/14/240314-royal-marines-on-nordic-response>. Accessed 18 September 2024.
- Royal Navy. Royal Marines head “behind enemy lines” on fjord raids. *Royal Marines*. 22 February 2022. <https://www.royalnavy.mod.uk/news-andlatest-activity/news/2022/february/22/220222-royal-marines-headbehind-enemy-lines-on-fjord-training-raids>. Accessed 16 September 2024.
- Royal Navy. Commandos master the art of moving through Arctic battlefield. *Royal Navy*. 24 January 2020. <https://www.royalnavy.mod.uk/news/2020/january/24/240120-arcticmovement>. Accessed 18 September 2024.
- Schauer, Mark. Arctic Mobility Sustainment System tested at Army's Cold Regions Test Center. *U.S. Army*. 15 April 2024. https://www.army.mil/article/275337/arctic_mobility_sustainment_system_tested_at_armys_cold_regions_test_center. Accessed 2 October 2024.
- Serova, Natalia. Peculiarities of Financing Road Activities in the Arctic Region: the Experience of the Murmansk Oblast. *Arctic and North*. Vol. 45, 2021:36–47.
- Shouse, Michael, et al. Airborne Joint Forcible Entry Operations in an Extreme Cold Weather Environment. *Infantry Magazine*. 2023. Vol. 112, no. 1, 2023: 10–18.

- Simon, Kelly. "Arctic" zone classification at Fort Drum means Soldiers will receive new cold-weather equipment. *U.S. Army*. 26 January 2017. https://www.army.mil/article/181293/arctic_zone_classification_at_fort_drum_means_soldiers_will_receive_new_cold_weather_equipment. Accessed 2 October 2024.
- Skoglund, Per, Listou, Tore and Ekström, Thomas. Russian Logistics in the Ukrainian War: Can Operational Failures be Attributed to logistics? *Scandinavian Journal of Military Studies*. Vol. 5, no. 1, 2022: 99–110.
- South, Todd. 8,000+ soldiers tested in large-scale combat in the Arctic. *Army Times*. 27 February 2024. <https://www.armytimes.com/news/yourarmy/2024/02/26/8000-soldiers-tested-in-large-scale-combat-in-the-arctic/>. Accessed 16 September 2024.
- Statistics Finland. Population data by region. *Population and Society*. 26 April 2024. https://stat.fi/tup/suoluk/suoluk_vaesto_en.html#Population%20data%20by%20region. Accessed 16 August 2024.
- Statistiska Centralbyrån. Folkmängden efter region, civilstånd, ålder and kön. År 1968-2023 [Dataset]. *Statistikdatabasen*. https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BE__BE0101__BE0101A/BefolkningNy/table/tableViewLayout1/. Accessed 28 August 2024.
- Statistisk sentralbyrå. Maritime transport [Dataset]. *Statistikkbanken*. <https://www.ssb.no/en/statbank/table/08923/tableViewLayout1/>. Accessed 16 October 2024.
- Statistisk sentralbyrå. Population [Dataset]. *Statistikkbanken*. <https://www.ssb.no/en/statbank/table/01222/tableViewLayout1/>. Accessed 28 August 2024.
- Sword, Michael. Arctic Warfare Heats Up: Unique Division Specializes in Cold Weather Operations *AUSA*. 24 January 2023. <https://www.ausa.org/articles/arctic-warfare-heats-unique-divisionspecializes-cold-weather-operations>. Accessed 16 September 2024.
- Tharion, William et al. Energy requirements of military personnel. *Appetite*. Vol 44, no. 1, 2005: 47-65.
- The Royal Anglian Regiment. Facebook post. 10 May 2022. <https://www.facebook.com/TheRoyalAnglianRegiment>
- Trafikanalys. Gör ditt eget statistikurval—Sjötrafik. *Trafikanalys*. <https://www.trafa.se/sjofart/sjotrafik/?cw=1&q=t0802|ar|godsvikt|svenskhamn~standardtable>. Accessed 16 October 2024.
- Tuunainen, Pasi. New approaches to the study of Arctic warfare. *Nordia Geographical Publications*. Vol. 43, no. 1, 2014: 87–99.

- Twigt, André. NH90 werkt op voor amfibische taak [NH90 reworked for amphibious task]. *Vliegende hollander*. Vol 78, no 1–2. 22 February 2022.
- United States Census Bureau. County Population Totals and Components of Change: 2020–2023 [Dataset]. *U.S. Census Bureau*.
<https://www.census.gov/data/tables/time-series/demo/popest/2020/counties-total.html>. Accessed 3 October 2024.
- U.S. Marine Corps. 2nd Marine Division. *Marines*.
<https://www.2ndmardiv.marines.mil/>. Accessed 7 May 2024.
- U.S. Marine Corps. U.S. Marines Deploy for Months-Long Training During Marine Rotational Force–Europe. *Marines*.
<https://www.marforeur.marines.mil/In-the-News/Stories/Article/Article/3295078/us-marines-deploy-for-monthslong-training-during-marine-rotational-force-europe/>. Accessed 6 August 2024.
- Van den Bulk, Saminna. Afschrikken in de arctic [Deterrence in the Arctic]. *Alle Hens*. 15 March 2023.
- Van Duin, Joris. Helikoptergeweld boven de poolcirkel (*Helicopter force above the Arctic Circle*) *Vliegende hollander*. Vol. 80, no 3. 25 March 2024.
- Van Duin, Joris. Duidelijk signaal boven de Poolcirkel [Clear signal above the Arctic Circle]. *Alle Hens*. Vol 77, no 2. 15 March 2024.
- Vandiver, John. US Marine contingent to join huge NATO Nordic drill, show “we’ll be here when needed.” *Stars and Stripes*. 1 March 2024.
https://www.stripes.com/branches/marine_corps/2024-03-01/nordicresponse-marines-arctic-13168466.html. Accessed 17 September 2024.
- Vanhanen, Henri. *Northern Europe in NATO: From the Fringes to the Forefront of Euro-Atlantic Security*. I Linnainmäki, Joel and Pesu, Matti (ed.). *NATO’s New Northern Direction—The Evolving Role of the Alliance in Europe’s North*. Helsinki. Finnish Institute of International Affairs. 2024.
- Wall, Colin and Wegge, Njord. *The Russian Arctic Threat: Consequences of the Ukraine War*. Washington, D.C., Center for Strategic & International Studies. 2023.
- Warner, Gary. 2 Army soldiers killed and a dozen injured when truck skids off road in Alaska. *Stars and Stripes*. 3 October 2023.
<https://www.stripes.com/branches/army/2023-10-03/2-soldiers-killedvehicle-crash-alaska-11581028.html>. Accessed 6 November 2024.

- Watling, Jack and Horne, Si. Assuring the Tactical Sustainment of Land Forces on the Modern Battlefield. London. Royal United Services Institute. 2024.
- Watling, Jack and Reynolds, Nick. Russian Military Objectives and Capacity in Ukraine Through 2024. *RUSI*. 13 February 2024.
<https://www.rusi.org/explore-ourresearch/publications/commentary/russian-military-objectives-andcapacity-ukraine-through-2024>. Accessed 14 January 2025.
- Wegge, Njord. The Strategic Role of Land Power on NATO's Northern Flank. *Arctic Review on Law and Politics*. Vol. 5, 2022: 94–113.
- Welch, Jason. The Joint Fight: Arctic paratroopers and HIMARS build combat power during Northern Edge 21. *U.S. Army*. 12 May 2021.
https://www.army.mil/article/246308/the_joint_fight_arctic_paratroopers_and_himars_build_combat_power_during_northern_edge_21. Accessed 22 October 2024.
- Wiley De Moura, Nadine. US, Chilean armies set stage for inaugural exercise Southern Fenix 2024. *U.S. Army*. 11 April 2024.
https://www.army.mil/articleamp/275280/us_chilean_armies_set_stage_for_inaugural_exercise_southern_fenix_2024. Accessed 22 October 2024.
- Wilson, Thaddeus. 'Adapting to the Expected LSCO Conflicts in the 21st Century'. *Army Sustainment*. Vol. 56, no. 2, 2024: 4–7.
- Wolting, Jaap. Versterking vuursteun krijgt vorm [Strengthening fire support takes shape]. *Koninklijke Landmacht*. 4 June 2024.
- Zonn, Igor, Kostianoy, Andrey and Semenov, Aleksandr (ed.). Murmansk Oblast. In *The Western Arctic Seas Encyclopedia*. Springer, Cham.
https://doi.org/10.1007/978-3-319-25582-8_130066.

7 Annex 1: Estimate of the Finnish wartime order of battle

7.1 Assumptions and calculations

To estimate the number of units that the peacetime brigades generate on mobilisation, the following assumptions are made:

1. The total force mass contributed by any one formation in the peacetime establishment bears the same proportion to the whole wartime force as that formation's share of the entire peacetime establishment.
 Example: If Peacetime Brigade X constitutes 10% of the peacetime establishment, the mobilised units deriving from Brigade X are assumed to constitute 10% of the wartime force.
2. The ratio between personnel in fully manned combat units and total personnel in the wartime force (the "division slice") is the same across all formations in the peacetime establishment.
3. The ratio between personnel in combat units and personnel in both combat and support units is the same across all peacetime brigades.
4. A brigade comprises 5600 personnel.
5. A battalion comprises 700 personnel.¹⁷⁰
6. A regiment comprises 1400–1600 personnel.¹⁷¹

Open sources indicate that, excluding special forces and helicopter units, the Army's wartime order of battle would comprise two mechanised brigades, two armoured regiments, and nine light infantry brigades, i.e. approximately 64,600 personnel. The support units consist of seven engineer regiments, one artillery brigade, three signals battalions, one air-defence regiment, and three logistics regiments, amounting to about 24,200 personnel.¹⁷² The Army's wartime strength totals 185,000 personnel.¹⁷³ The division slice—the ratio of personnel in fully manned combat formations to total wartime personnel—would therefore be:

¹⁷⁰ Häggblom, Robin, "The Finnish wartime Army," *Corporal Frisk*, 26 May 2018.

¹⁷¹ IISS, "Chapter Three: Europe," *The Military Balance*, vol. 124, no. 1, 2024: 54–157; IISS, "Explanatory notes," *The Military Balance*, vol. 124, no. 1, 2024: 532–539.

¹⁷² IISS, "Chapter Three: Europe"; Jonsson, Michael, *Finland*, in Ottosson, Björn and Pallin, Krister (eds.), *FOI-R--5527--SE Western Military Capability in Northern Europe 2023—Part I: National Capabilities*, Stockholm, FOI, 2024.

¹⁷³ IISS, "Chapter Three: Europe."

$$\frac{24,200 + 64,600}{185,000} = 48\%$$

It is also known that, at any given time, the Army's normal manning consists of 13,000 conscripts and approximately 4400 regulars, which yields a peacetime total of 17,400 personnel. The Jaeger Brigade has 400 regulars and 2200 conscripts.¹⁷⁴ The brigade would therefore constitute the following share of the basic organisation as a whole:

$$\frac{400 + 2,200}{4,400 + 13,000} = 15\%$$

If similar proportions (including the same division slice) apply to the Army's wartime organisation, approximately 13,000 personnel in the wartime force should have experience from service in the Jaeger Brigade:

$$185,00 \times 0.15 \times 0.48 = 13,200 \text{ pers}$$

Given a typical brigade size of 5600 personnel, roughly two Finnish brigades and a few battalions would, on the strength of their origin in the Jaeger Brigade alone, have good capability to operate in the High North. The ratio of personnel in combat units to all personnel (excluding the division slice) is:

$$\frac{64,600}{24,200 + 64,400} = 73\%$$

Disregarding what are presumed to be support units within this force package, the personnel attributable to the Jaeger Brigade in the wartime order of battle should therefore amount to:

$$13,200 \times 0.73 = 9,600 \text{ pers}$$

This figure implies that just under two non-support brigades in the wartime order of battle could have their origins in the Jaeger Brigade. There are no updated official figures for the size of the Kainuu Brigade, but news reports and older sources suggest around 500 permanent staff and 3300–4000 conscripts in peacetime.¹⁷⁵ Applying the same assumptions used for the Jaeger Brigade, the Kainuu Brigade would be expected to account for a sizeable share of the peacetime force structure:

¹⁷⁴ Maavoimat, "Jägarbrigaden—Om oss" [Jaeger Brigade—About us], *Maavoimat*,

¹⁷⁵ Kähkönen, Sanna, "Kainuun prikaati kutsuu 1600 uutta alokasta, esikuntapäällikön mukaan pari viime vuotta ovat näyttäneet miksi puolustusvoimat on olemassa" [Kainuu Brigade invites 1600 new recruits, according to the Chief of Staff, the last couple of years have shown why the Defence Forces exist], *Yle*, 29 January 2024; Maavoimat, "Kainuun prikaatin alokkailla sotilasvala ja -vakuutus Lapinlahdella ja Kajaanissa" [Kainuu Brigade recruits take military oaths and affirmations in Lapinlahti and Kajaani], *Maavoimat*, 29 January 2024; Maavoimat, "Kainuun prikaatin alokat valalla Kajaanin keskustassa" [Kainuu Brigade recruits under oath in the centre of Kajaani], *Maavoimat*, 8 March 2023,

$$\frac{400 + 3,300}{4,400 + 13,00} = 22\%$$

This implies a total strength in the wartime order of battle (excluding the division slice) of:

$$185,000 \times 0.22 \times 0.48 = 19,100 \text{ pers}$$

Which, in turn, means that the personnel strength for the Kainuu Brigade, excluding support units, would be:

$$19,100 \times 0.73 = 13,800 \text{ pers}$$

Excluding support units, this likely leaves two brigades and just over three battalions.

8 References

- Häggbloom, Robin. The Finnish Wartime Army. *Corporal Frisk*. 26 May 2024. <https://corporalfrisk.com/2018/05/26/the-finnish-wartime-army/>. Accessed 12 September 2024.
- IISS. Chapter Three: Europe, *The Military Balance*, vol. 124, no. 1, 2024: 541–57.
- IISS. Explanatory notes, *The Military Balance*, vol. 124, no. 1, 2024: 532–539.
- Kähkönen, Sanna. Kainuun prikaati kutsuu 1600 uutta alokasta, esikuntapäällikön mukaan pari viime vuotta ovat näyttäneet miksi puolustusvoimat on olemassa [Kainuu Brigade invites 1600 new recruits, according to the Chief of Staff, the last couple of years have shown why the Defence Forces exist]. *Yle*. 29 January 2024. <https://yle.fi/a/74-20068330>. Accessed 18 September 2024.
- Maavoimat. Jägarbrigaden—Om oss [Jägerbrigad—About us]. *Maavoimat*. <https://maavoimat.fi/sv/jagarbrigaden/om-oss>; accessed 16 April 2024.
- Maavoimat. Kainuun prikaatin alokkailla sotilasvala ja –vakuutus Lapinlahdella ja Kajaanissa [Kainuu Brigade recruits take military oaths and affirmations in Lapinlahti and Kajaani]. *Maavoimat*. 29 January 2024. <https://maavoimat.fi/-/kainuun-prikaatin-alokkailla-sotilasvala-javakuutus-lapinlahdella-ja-kajaanissa>. Accessed 18 September 2024.
- Maavoimat. Kainuun prikaatin alokkat valalla Kajaanin keskustassa [Kainuu Brigade recruits under oath in the centre of Kajaani]. *Maavoimat*. 8 March 2023. <https://maavoimat.fi/-/kainuun-prikaatin-alokkaat-valallakajaanin-keskustassa>. Accessed 18 September 2024.

